

Assessment report No:
NIE: 52731RAN.002

Assessment report
RF EXPOSURE REPORT ACCORDING TO
FCC 47 CFR Part 2.1091
ISED RSS-102 Issue 5:2015 ISED, RSS-102-SPR-002 Issue 1:2016

Identification of item tested.....:	Transceiver TPMS
Trademark	LDL Technology
Model and /or type reference	12059
Other identification of the product	FCC ID: T4512059 IC: 6450A-12059
Final HW version	312-059-1090-B
Final SW version	416002021013
Features	RS232, CAN, Bluetooth, RF 434 MHz, LF 125 kHz
Manufacturer	LDL TECHNOLOGY Parc Technologique du canal 3 rue Giotto 31520 Ramonville Saint-Agne, France
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) RSS-102-SPR-002 Issue 1 (2016-09) – Supplementary Procedure for Assessing Compliance with RSS-102 Nerve Stimulation Exposure Limits (3kHz a 10MHz)
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager
Date of issue	2018-09-14
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Index

Competences and guarantees.....	3
General conditions.....	3
Uncertainty	3
Usage of samples.....	3
Test sample description	3
Identification of the client	3
Testing period.....	4
Environmental conditions.....	4
Used instrumentation.....	4
General description of the device under evaluation	5
Assessment summary	6
Appendix A – FCC RF Exposure.....	7
FCC RF Exposure evaluation for mobile devices.....	8
FCC MPE Evaluation Results.....	9
Appendix B – ISED RF Exposure.....	13
ISED RF Exposure evaluation for mobile devices	14
ISED MPE Evaluation Results	15
ISED Nerve Stimulation evaluation results	19
Appendix C – Photographs.....	20

Competences and guarantees

In order to assure the traceability to other national and international laboratories, DEKRA has a calibration and maintenance program for its measurement equipment.

DEKRA guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA at the time of performance of the test.

DEKRA is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Assessment Report apply only to the particular item under test established in this document.

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General conditions

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Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA internal document PODT000.

Usage of samples

Samples under test have been selected by: the Client.

Sample **S/01** is composed of the following elements:

Control N°	Description	Model	Serial number	Reception date
52731/14	Starting system	---	---	08/05/2018
52731/15	Car key	---	---	08/05/2018

Test sample description

The test sample consists of a transceiver TPMS sensor for vehicles.

Identification of the client

LDL TECHNOLOGY

Parc Technologique du canal

3 rue Giotto 31520 Ramonville Saint-Agne, France

Testing period

WPT evaluation test were performed on 2018-07-25 and finished on 2018-07-27.

The tests have been performed at DEKRA Testing and Certification, S.A.U.

Environmental conditions

The following limits were not exceeded during the tests:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 30 % Max. = 60 %

Used instrumentation

		Last Cal. date	Cal. due date
1.	Narda ELT-400 Exposure Level Tester	2017/10	2019/10
2.	Lumiloop GMBH LSProbe 1.2	2017/09	2019/09

General description of the device under evaluation

The HUB TPMS is designed for truck and trailer vehicles. It receives information from TPMS sensor placed in the tires of vehicles. The product included an emitter/transmitter Bluetooth for displayed the data on a smartphone. The Bluetooth allows too the diagnostic of the product.

According to the manufacturer, during its normal use, the separation distance between the device and the body of nearby users will be greater than 20 cm. In order to perform the assesment a conservative separation distance of 20 cm has been used.

The equipment specifications declared by the manufacturer are:

Frequency (MHz)	Technology	Max. RF output power (dBm)	Max. Antenna gain (dBi)	Maximum E.I.R.P. (dBm)
433.9085-433.9315	RF 433 MHz	16.0	-10.0	6.0
2400-2483.5	Bluetooth	5.8	+2.2	8.0

Table 1: Equipment specifications

The equipment also includes one external LF antenna for a LF transmission technology at 125 kHz which is plugged into the lockset of the vehicle. According to the manufacturer, the intended use distance during the normal use of the device will be more than 5-10 centimeters between the transmitter's radiating structure and the hands and legs of the user, and more than 20 centimeters between the body of the user or nearby persons.

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	433	RF Tx	ISM	Pass
2	2450	Bluetooth	ISM	Pass
3	0.125	LF Tx	LF	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 – RF TX – 433 MHz Band

Maximum output power (dBm):	16.00
Maximum antenna Gain (dBi):	-10.00
Minimum use distance (cm):	20.00
Worst Case Frequency (MHz):	433.9085
Maximum EIRP (dBm):	6.00
Maximum EIRP (mW):	3.98
General population - Power density limit (mW/cm ²):	0.289

Power density at minimum use distance:

Power density (mW/cm ²):	0.0008
General population - Power density limit (mW/cm ²):	0.289
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):	1.05
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 – Bluetooth – 2450 MHz Band

Maximum output power (dBm):	5.8
Maximum antenna Gain (dBi):	2.2
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	2400.0
Maximum EIRP (dBm):	8.00
Maximum EIRP (mW):	6.31
General population - Power density limit (mW/cm ²):	1.0

Power density at minimum use distance:

Power density (mW/cm ²):	0.00126
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):	0.71
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 433 MHz, Bluetooth and 125 kHz transmitters, therefore the worst case multiple frequencies calculation will be as follow:

$$\frac{0.0001}{0.289} + \frac{0.00126}{1} = 0.0016 < 1 \text{ Limit}$$

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/ <i>f</i>	-	6**
1.1-10	87/ <i>f</i> ^{0.5}	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ <i>f</i> ^{0.25}	0.1540/ <i>f</i> ^{0.25}	8.944/ <i>f</i> ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 <i>f</i> ^{0.3417}	0.008335 <i>f</i> ^{0.3417}	0.02619 <i>f</i> ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616000/ <i>f</i> ^{1.2}
Note: <i>f</i> 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 – RF TX – 433 MHz Band

Maximum output power (dBm):	16.00
Maximum antenna gain (dBi):	-10.00
Minimum use distance (m):	0.2
Worst Case Frequency (MHz):	433.9085
Maximum EIRP (dBm):	6.00
Maximum EIRP (W):	0.00398
General public - Power density limit (W/m ²):	1.66

Power density at minimum use distance:

Power density (W/m ²):	0.008
General public - Power density limit (W/m ²):	1.66
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):	0.14
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 – Bluetooth – 2450 MHz Band

Maximum output power (dBm):	5.8
Maximum antenna gain (dBi):	2.2
Minimum use distance (m):	0.2
Worst Case Frequency (MHz):	2400.0
Maximum EIRP (dBm):	8.0
Maximum EIRP (W):	0.0063
General public - Power density limit (W/m ²):	5.34

Power density at minimum use distance:

Power density (W/m ²):	0.013
General public - Power density limit (W/m ²):	5.34
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):	0.01
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 433 MHz, Bluetooth and 125 kHz transmitters, therefore the worst case multiple frequencies calculation will be as follow:

$$\frac{0.008}{1.66} + \frac{0.013}{10} = 0.0061 < 1 \text{ Limit}$$

ISED Nerve Stimulation evaluation results

According to RSS-102 Issue 5, Nerve Stimulation exposure limits shall be evaluated for transmission into the frequency range from 0.003 to 10 MHz. Supplementary Procedure SPR-002, Issue 1, for Radio Standards Specification RSS-102 sets out the general test methods to be followed when carrying out an assessment to the nerve stimulation exposure requirements of RSS-102 Issue 5.

Measurements have been performed following Supplementary Procedure SPR-002, “Annex E – E.1.2. Actively Used Table-Top Devices”, using the equipment listed in the “Used Instrumentation” paragraph of this document, and following the measurement method shown in paragraph 6.6.1.1 of the same standard. Although the device is not exactly an actively used table-top device, measurements following the guidance shown into SPR-002 Annex E have been performed to fulfill the requested three steps to ensure compliance with the limits of RSS-102. The fields that expose the hands and the legs of the user have been measured into Front and Positions 1 to 4 at 5 cm distance, and the fields that expose the core of the user have been measured at a conservative 10 cm distance.

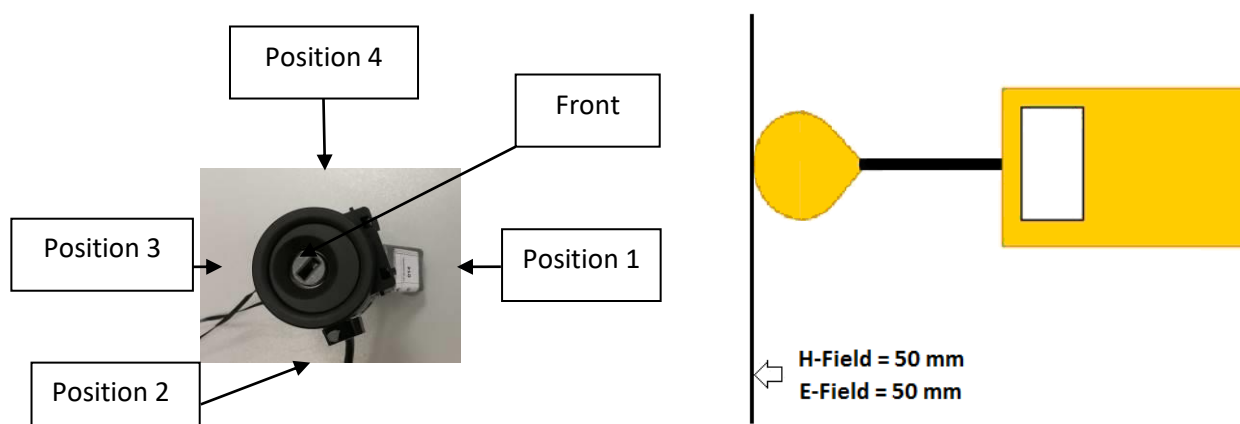


Figure 1: Nerve Stimulation measurement setup

Measured values for each configuration are listed in the following tables:

Frequency (kHz)	Dist. (mm)	H-Field measurements [A/m]					Max [A/m]	Limit [A/m]	% Limit	Verdict
		Front	Position 1	Position 2	Position 3	Position 4				
125	50	14.89	10.74	11.66	12.43	12.54	14.89	90.0	16.54	Pass
125	100	10.30	8.21	8.35	8.74	8.92	10.30	90.0	11.44	Pass

Table 2: H-field measurement values and ISED limit for Nerve Stimulation

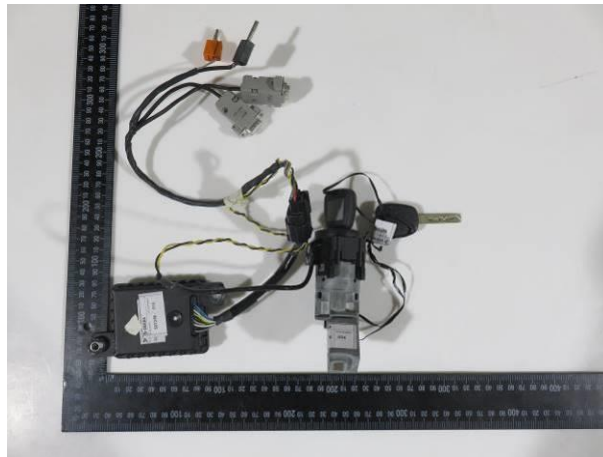
Frequency (kHz)	Dist. (mm)	E-Field measurements [V/m]					Max [V/m]	Limit [V/m]	% Limit	Verdict
		Front	Position 1	Position 2	Position 3	Position 4				
125	50	50.20	39.10	43.20	36.40	35.80	50.20	83.0	60.48	Pass
125	100	37.90	25.42	25.31	28.60	28.30	37.90	83.0	45.66	Pass

Table 3: E-field measurements values and ISED limit for Nerve Stimulation

All H-Field and E-Field values are in compliance to values shown into “Table 4: RF Field Strength Limits for Devices Used by the General Public” for the frequency range used by the device.

Appendix C – Photographs

Equipment view

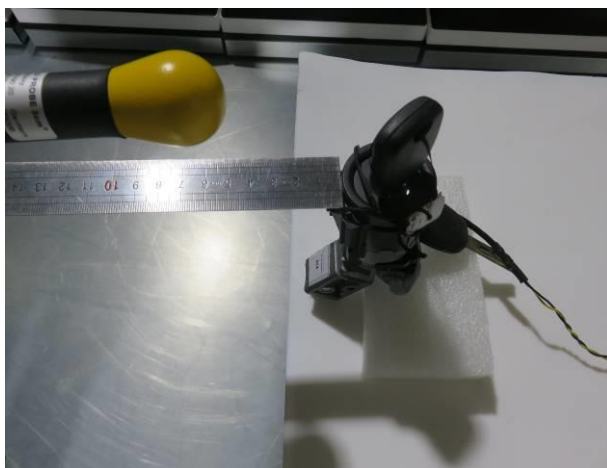


Nerve stimulation H-Field and E-Field measurement setup views at 50 mm (Worst case distance)

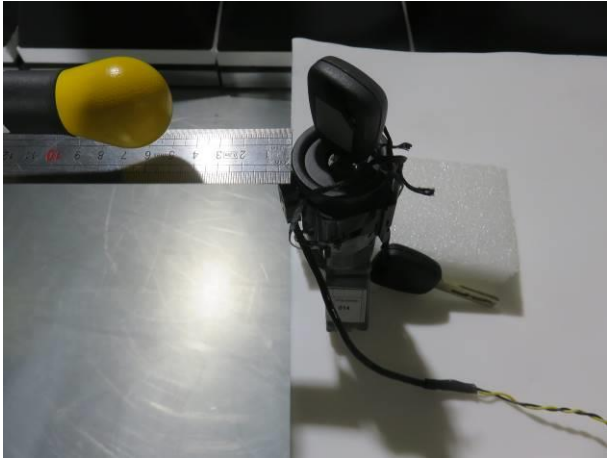
Front



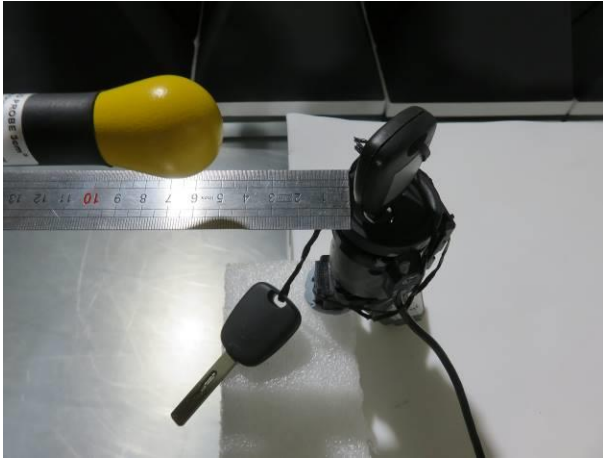
Position 1



Position 2



Position 3



Position 4

