



FCC LISTED,
 REGISTRATION NUMBER:
 720267

Informe de ensayo nº:
 Test report No:

ISED LISTED
 REGISTRATION NUMBER
 4621A-2

NIE: 52731RRF.005

Test report

USA FCC Part 15.231, 15.209

CANADA RSS-210, RSS-Gen

Radio Frequency Devices. Periodic operation in the band 40.66-40.70 MHz and above 70 MHz
 Radiated emission limits; general requirements
 Licence-Exempt Radio Apparatus: Category I Equipment
 General Requirements for compliance of Radio Apparatus

Identificación del objeto ensayado.....: Identification of item tested	Transceiver TPMS
Marca Trademark	LDL Technology
Modelo y/o referencia tipo 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
Características Features	RS232, CAN, Bluetooth, RF 434MHz, LF 125 kHz
Solicitante Applicant	LDL TECHNOLOGY Parc Technologique du canal 3 rue Giotto 31520 Ramonville Saint-Agne France
Método de ensayo solicitado, norma.....: Test method requested, standard	USA FCC Part 15.231 10-1-17 Edition: Periodic operation in the band 40.66-40.70 MHz and above 70 MHz. USA FCC Part 15.209 10-1-17 Edition: Radiated emission limits; general requirements. CANADA RSS-210 Issue 9 (August 2016): Licence-Exempt Radio Apparatus: Category I Equipment. CANADA RSS-Gen Issue 4 (November 2014): General Requirements for compliance of Radio Apparatus. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Resultado.....: Summary	IN COMPLIANCE
Aprobado por (nombre / cargo y firma) Approved by (name / position & signature)	A. Llamas RF Lab. Manager
Fecha de realización Date of issue	2018-07-09

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Competences and guarantees

DEKRA Testing and Certification is a testing laboratory accredited by the National Accreditation Body (ENAC - Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 720267.

DEKRA Testing and Certification is a laboratory with a measurement site in compliance with the requirements of RSS 212, Issue 1 (Provisional) and has been added to the list of filed sites of the Canadian Certification and Engineering Bureau. Reference File Number: ISED 4621A-2.

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

DEKRA Testing and Certification 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 Testing and Certification at the time of performance of the test.

DEKRA Testing and Certification 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 Test Report apply only to the particular item under test established in this document.

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General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
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4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification and the Accreditation Bodies.

Uncertainty

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

Usage of samples

Samples undergoing test have been selected by: **the client**

Sample S/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
52731E/013	Tranceiver TPMS	12059	---	2018-05-08

Auxiliary elements used with the sample S/01

Control N°	Description	Model	Serial N°	Date of reception
52731E/014	Starting system	---	---	2018-05-08
52731E/015	Key-card	--	---	2018-05-08

1. Sample S/01 has undergone following test(s).
All radiated tests indicated in appendix A.

Sample S/02 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
52731E/002	Tranceiver TPMS	12059	---	2017-12-18

Auxiliary elements used with the sample S/02:

Control N°	Description	Model	Serial N°	Date of reception
52731E/014	Starting system	---	---	2018-05-08
52731E/015	Key-card	--	---	2018-05-08

1. Sample S/02 has undergone following test(s).
All conducted tests indicated in appendix A.

Test sample description

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.

Identification of the client

LDL TECHNOLOGY

Parc Technologique du canal

3 rue Giotto 31520 Ramonville Saint-Agne, France

Testing period

The performed test started on 2018-05-24 and finished on 2018-05-29.

The tests have been performed at DEKRA Testing and Certification.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 k Ω
Reference resistance to earth	< 1 Ω

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 k Ω
Reference resistance to earth	< 1 Ω
Normal site attenuation (NSA)	< ± 4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 35 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

Remarks and comments

1: The tests have been performed by the technical personnel: Miguel Angel Torres and Gonzalo Rueda.

2: Used instrumentation:

Conducted Measurements

		Last Cal. date	Cal. due date
1.	Spectrum analyser Rohde & Schwarz FSV40	2017/07	2019/07
2.	DC power supply R&S NGPE 40/40	2018/02	2021/02

Radiated Measurements

		Last Cal. date	Cal. due date
1.	Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2.	BiconicalLog antenna ETS LINDGREN 3142E	2017/04	2020/04
3.	Multi Device Controller EMCO 2090	N.A.	N.A.
4.	Double-ridge Guide Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2016/11	2019/11
5.	EMI Test Receiver R&S ESU26	2018/02	2020/02
6.	Spectrum analyser Rohde & Schwarz FSW50	2018/02	2020/02
7.	RF pre-amplifier 30 MHz-6 GHz Bonn Elektronik BLNA 0360-01N	2017/07	2018/07
8.	RF pre-amplifier 1-18 GHz Bonn Elektronik BLMA 0118-1M	2018/03	2019/03
9.	DC power supply R&S NGPE 40/40	2018/02	2021/02

Testing verdicts

Not applicable	N/A
Pass	P
Fail	F
Not measured	N/M

FCC PART 15 PARAGRAPH / RSS-210		VERDICT			
		NA	P	F	NM
Section 15.231 Subclause (e) / RSS-210 A.1.4.	Transmitter deactivation		P		
Section 15.231 Subclause (c) / RSS-210 A.1.3.	Bandwidth		P		
Section 15.231 Subclause (e) / 15.209 / RSS-210 A.1.4. / RSS-Gen	Field strength and Emission limitations radiated (Transmitter)		P		

Appendix A – Test result

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TEST CONDITIONS

Power supply (V):

$$V_{\text{nominal}} = 12/24 \text{ Vdc}$$

Type of power supply = DC voltage from battery.

Type of antenna = Integral antenna

TEST FREQUENCIES:

The equipment transmits at the nominal frequency of 433.92 MHz.

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is directly connected to the spectrum analyzer.



RADIATED MEASUREMENTS

The equipment under test was scanned for spurious emissions in the frequency range 30 to 5000 MHz.

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-5 GHz (1 GHz-18 GHz Double ridge horn antenna).

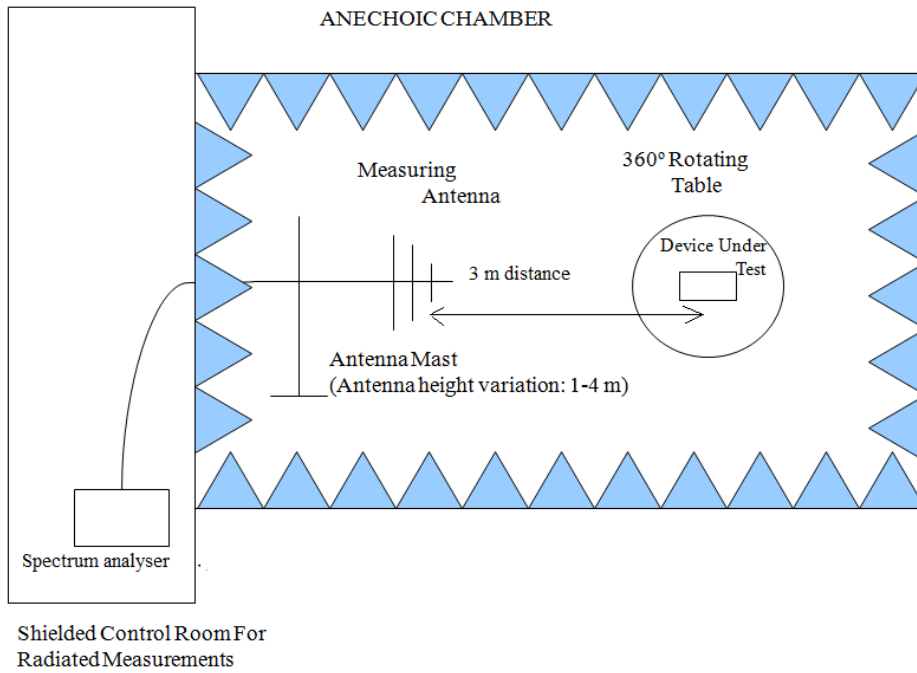
For radiated emissions in the range 1 GHz - 5 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance. The sample is prepared so that transmits continuously when the batteries are connected

The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

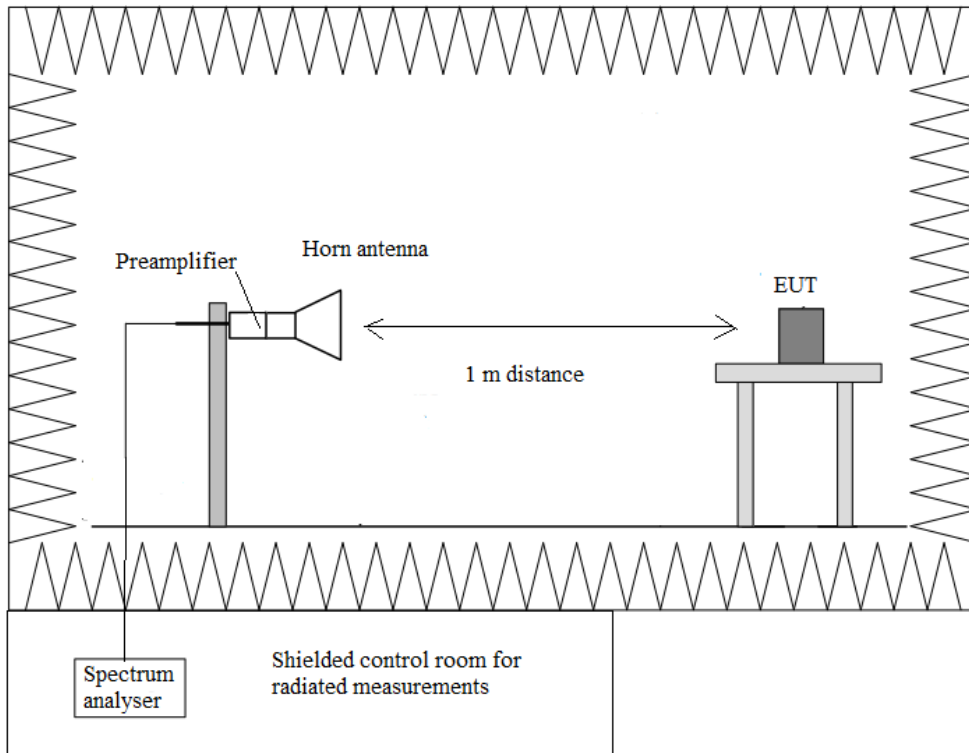
Measurements were made in both horizontal and vertical planes of polarization.

The test was performed with the equipment transmitting first with only the 433.92 MHz radio and repeated with the 2.4 GHz BT LE and 125 kHz radios transmitting simultaneously to check the impact of the co-location of the other radio interfaces. The results and plots below show the worst results obtained.

Radiated measurements setup $f < 1$ GHz



Radiated measurements setup $f > 1$ GHz



Section 15.231 Subclause (e) / RSS-210 A.1.4. Transmitter deactivation.

SPECIFICATION

FCC 15.231:

Devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

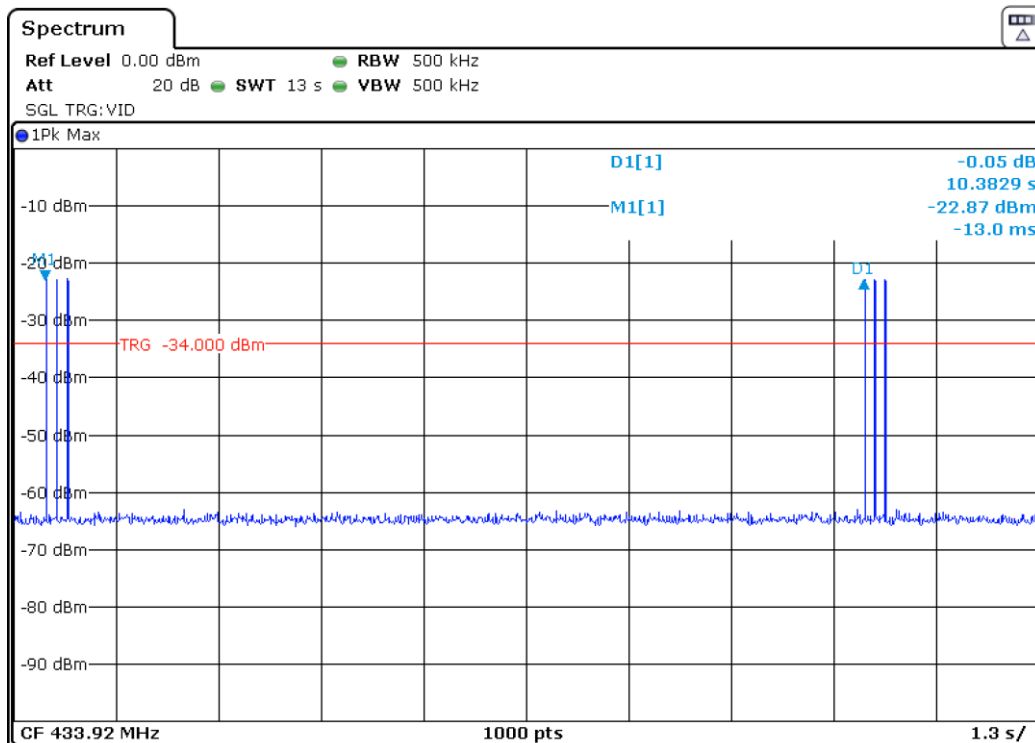
RSS-210:

Devices operated under the provisions of this section shall be capable of automatically limiting their operation so that the duration of each transmission is not greater than 1 second and the silent period between transmissions is at least 30 times the duration of the transmission, but not less than 10 seconds under any circumstances. However, devices that are designed for limited use for the purpose of initial programming, reprogramming or installing, and not for regular operations, may operate for up to 5 seconds, provided such devices are used only occasionally in connection with each unit being programmed or installed.

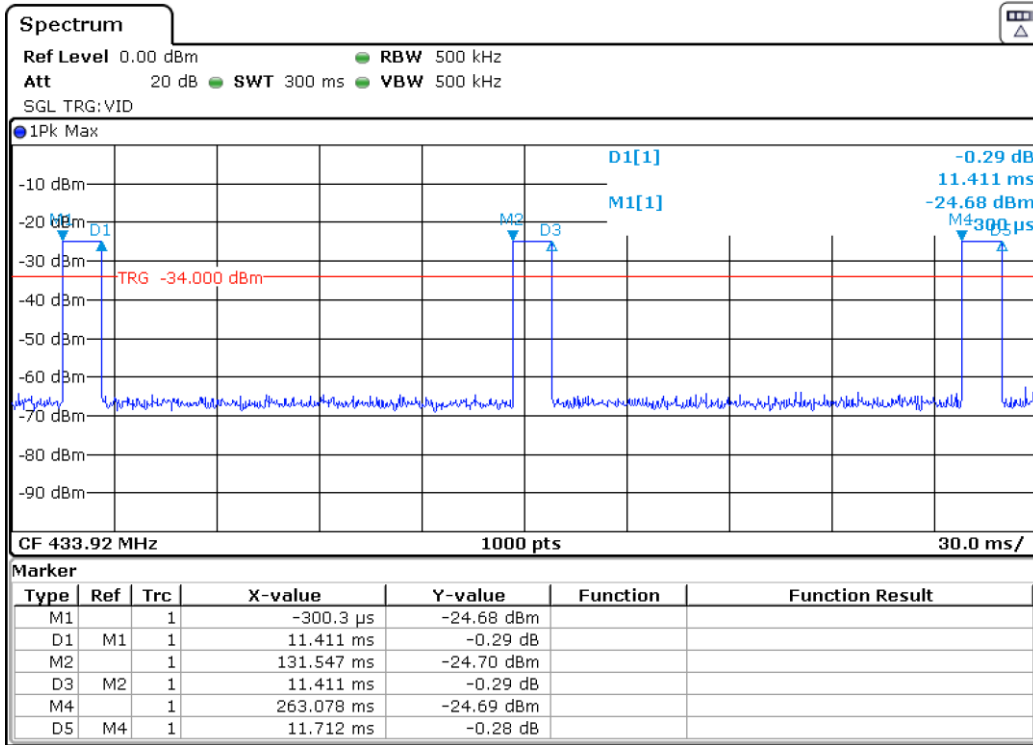
RESULTS

In normal operation the equipment transmits periodically RF bursts composed of 3 pulses (see next plots).

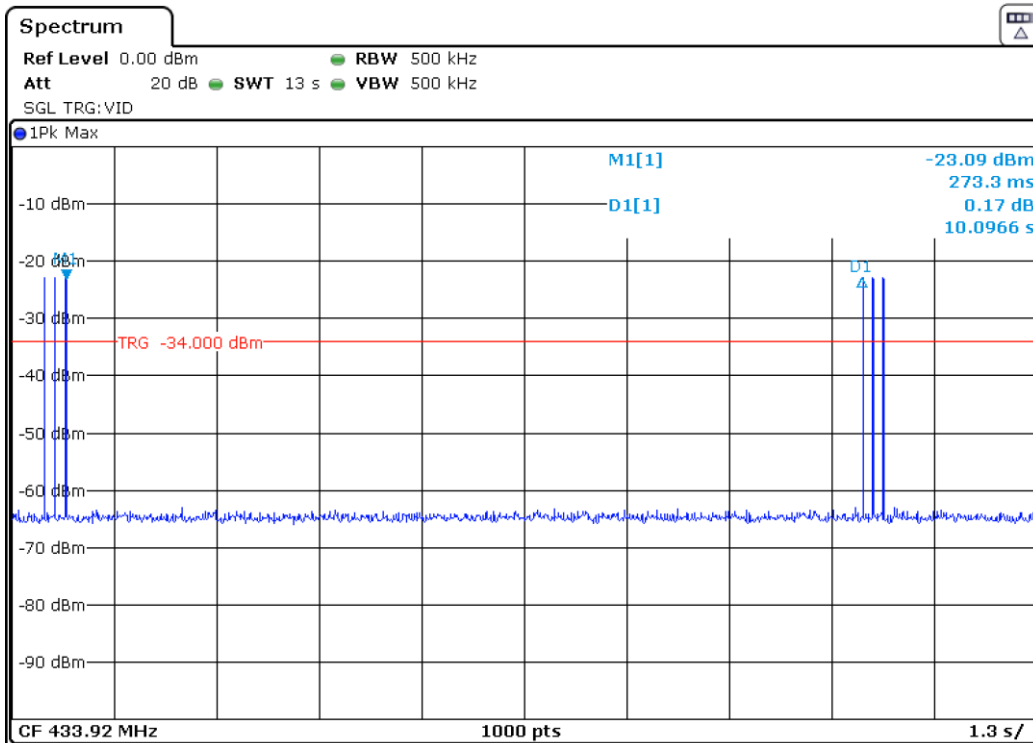
1. Burst period = 10.383 s.



2. Pulses duration = 11.411 + 11.411 + 11.712 ms.



3. Silent period between transmissions = 10.097 s.



The equipment transmits 3 pulses (total transmission time = $11.411 + 11.411 + 11.712 = 34.534$ ms) every 10.383 seconds (see plots above).

30 times the duration of the transmission is 1036.02 milliseconds (1.03602 seconds).

The silent period between transmissions is 10.097 seconds.

Measurement uncertainty (%)	< ± 0.01
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Verdict: Pass

Section 15.231 Subclause (c) / RSS-210 A.1.3. Bandwidth

SPECIFICATION

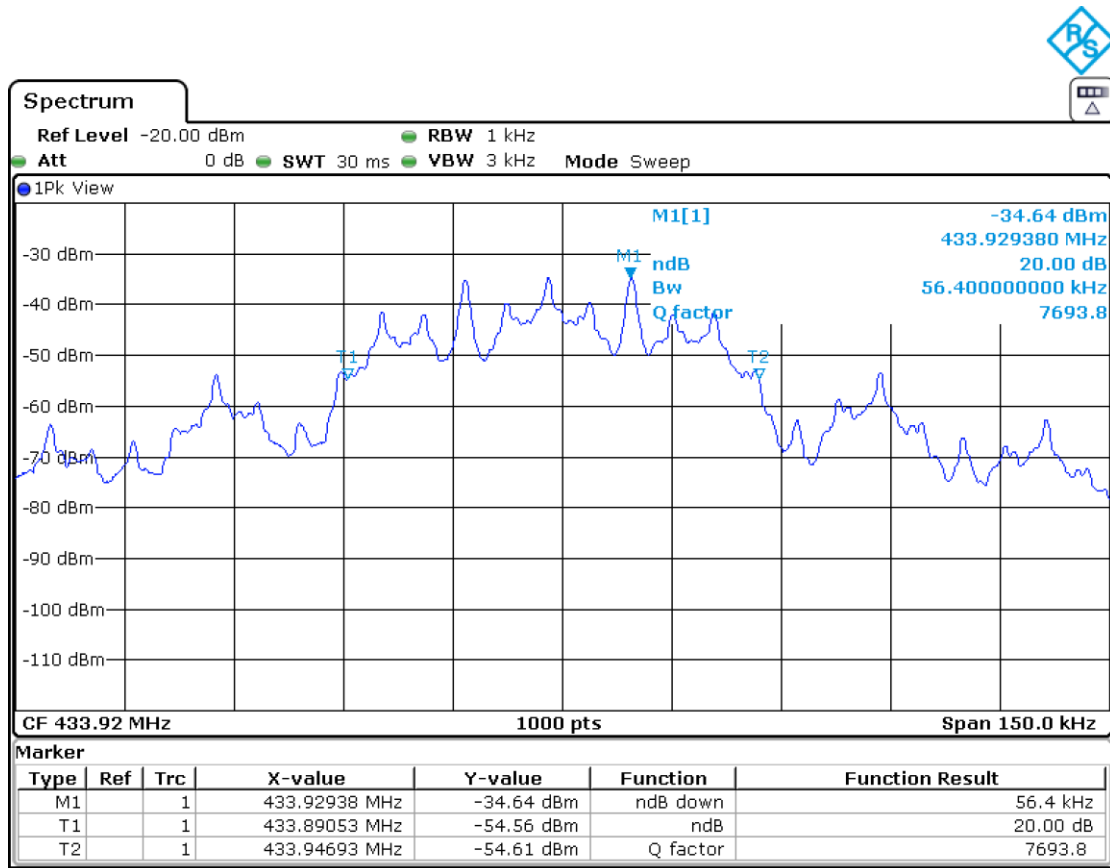
FCC 15.231: The bandwidth of the emission shall be no wider than 0.25 % of the centre frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

RESULTS (see next plots)

Nominal centre frequency = 433.92 MHz

Limit of spectrum bandwidth = 0.25 % of 433.92 MHz = 1084.80 kHz

Measured 20 dB Bandwidth (kHz)	56.40
Measurement uncertainty (kHz)	<±0.28



Verdict: PASS

Occupied Bandwidth

SPECIFICATION

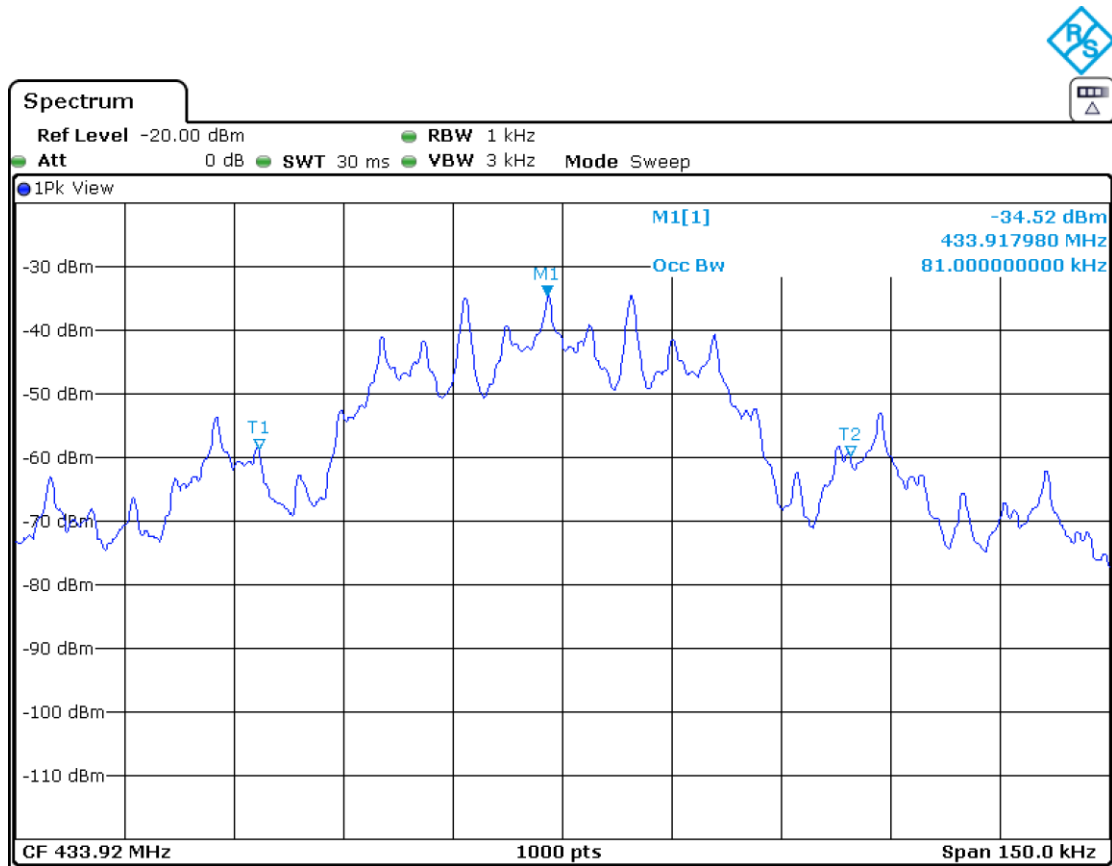
RSS-210. A.1.3.: the 99% bandwidth shall be no wider than 0.25% of the centre frequency for devices operating between 70 MHz and 900 MHz.

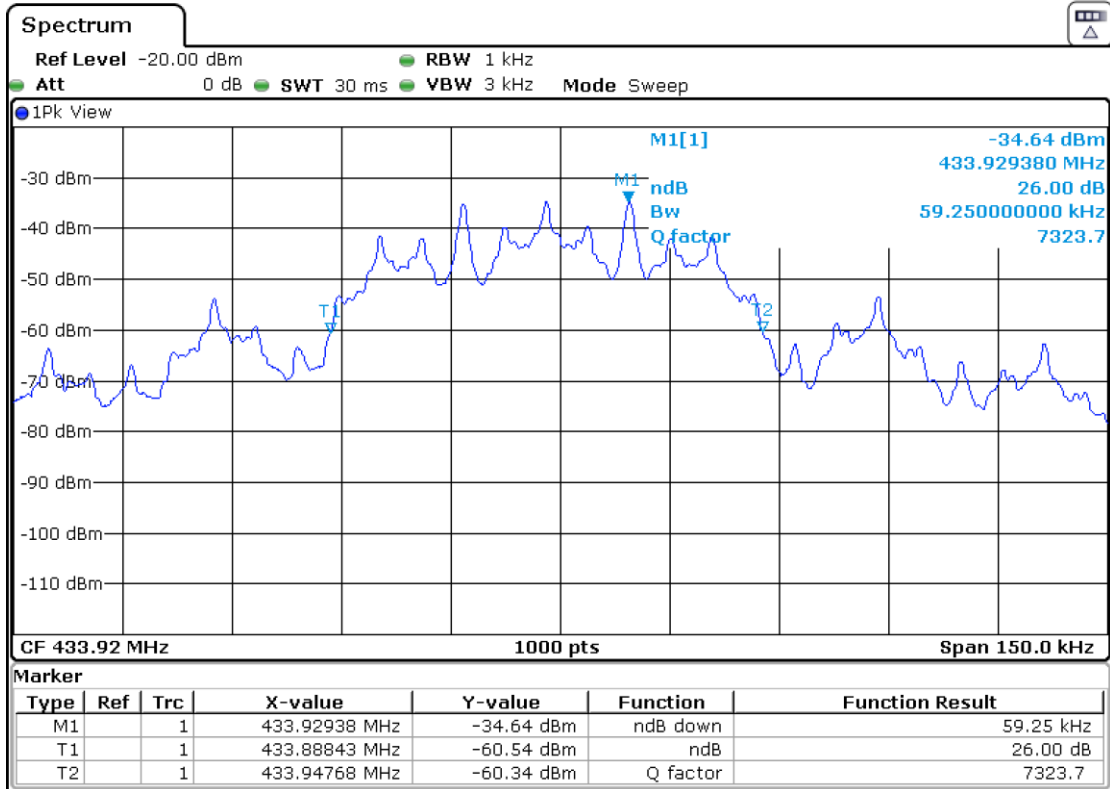
RESULTS (see next plots).

Nominal centre frequency = 433.92 MHz

Limit of spectrum bandwidth = 0.25 % of 433.92 MHz = 1084.80 kHz

99% bandwidth (kHz)	81.00
-26 dBc bandwidth (kHz)	59.25
Measurement uncertainty (kHz)	<±0.28





Section 15.231 Subclause (e) / 15.209 / RSS-210 A.1.4. / RSS-Gen. Field strength and Emission limitations radiated (Transmitter)

SPECIFICATION

Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	Field strength of fundamental ($\mu\text{V/m}$)	Field strength of spurious emissions ($\mu\text{V/m}$)
40.66 – 40.70	1,000	100
70 – 130	500	50
130 - 174	500 to 1,500 **	50 to 150 **
174 - 260	1,500	150
260 - 470	1,500 to 5,000 **	150 to 500 **
Above 470	5,000	500

** : Linear Interpolations. The maximum permitted unwanted emission level is 20dB below the maximum permitted fundamental level.

Spurious emissions shall be attenuated to the limits shown in the above table or to the general limits shown in Section 15.209/RSS-Gen, whichever limit permits a higher field strength.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RESULTS:

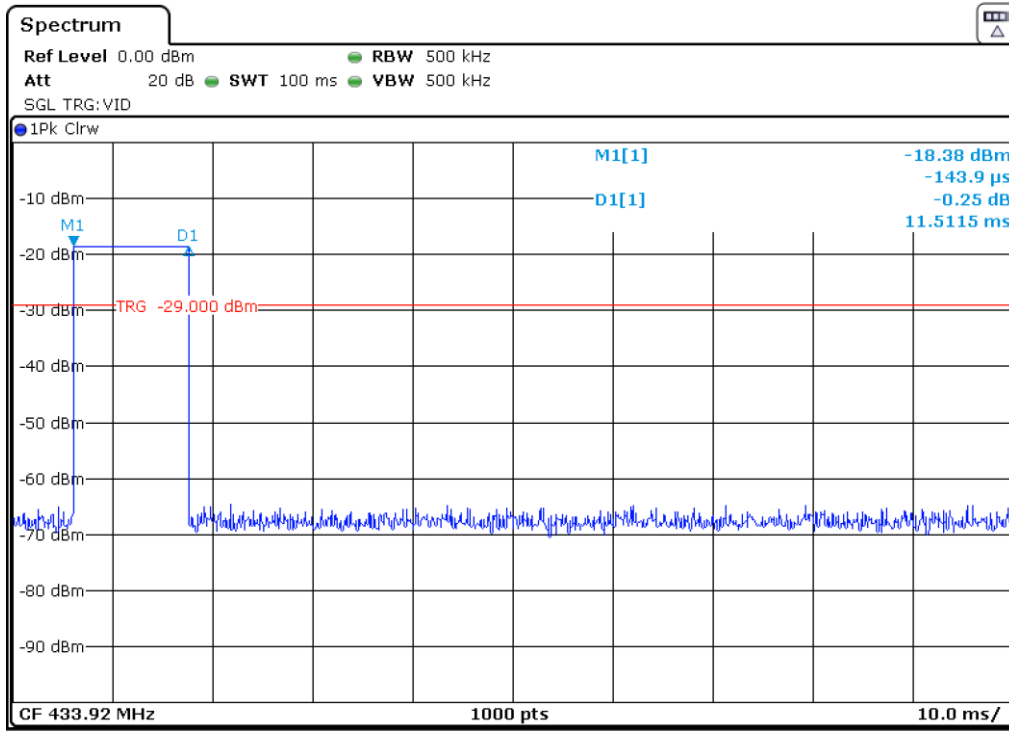
For radiated spurious emissions, the test was performed with the equipment transmitting first with only the 433.92 MHz radio and repeated with the 2.4 GHz BT LE and 125 kHz radios transmitting simultaneously to check the impact of the co-location of the other radio interfaces. The results and plots below show the worst results obtained.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyser. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

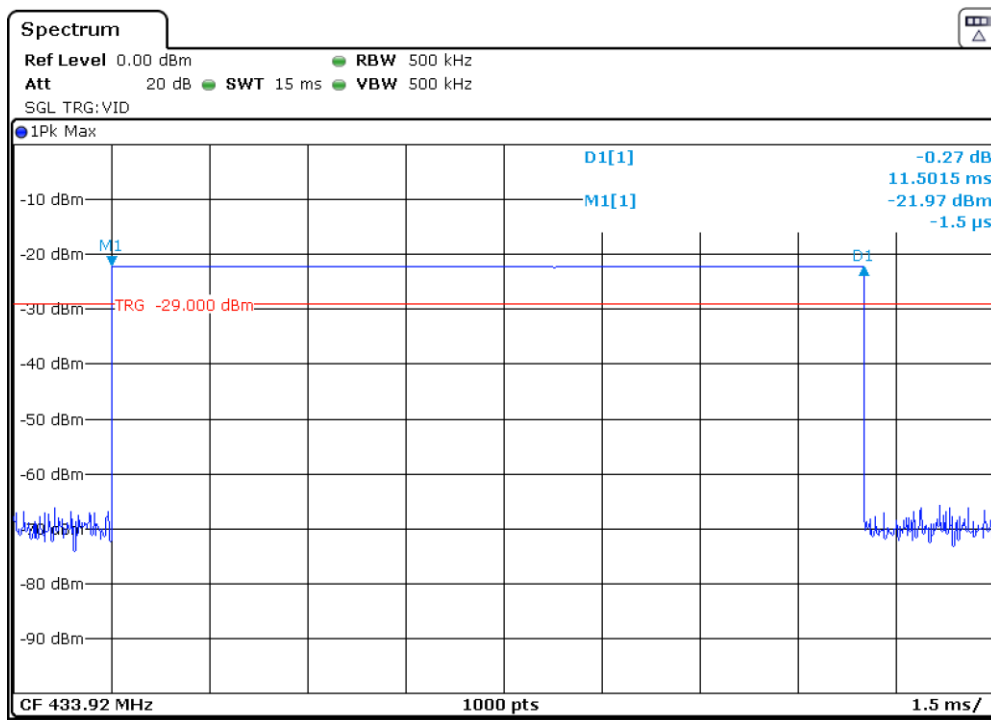
The transmission is pulsed so the average values of transmitter fundamental and spurious emissions are calculated from the measured peak values using the duty cycle correction factor δ as indicated in standard ANSI C63.10-2013.

Computation of duty-cycle correction factor

Number of pulses within 100 ms: 1



Pulse duration: 11.50 ms.



Duty-cycle correction factor calculation.

Sub-pulse	Duration (ms)	Number of pulses	Sub-pulse "On Time" (ms)
1	11.50	1	11.50
		TOTAL ON TIME	11.50

Duty cycle correction factor $\delta = 11.50 / 100 = 0.115$

$\delta = 20 \log (0.115) = -18.79 \text{ dB}$

Frequency range 30 MHz-1000 MHz (see next plots)

I. Fundamental

Frequency (MHz)	Polarization	Detector	Emission Level	Limits
				15.231 (e) / 15.209
433.92 (Fundamental)	H	Peak	37,757.22 $\mu\text{V/m}$ (91.54 dB $\mu\text{V/m}$)	43,992.5 $\mu\text{V/m}$ / --- (92.87 dB $\mu\text{V/m}$) / ---

Calculation for average level

Spurious frequency (MHz)	Emission Level (dB $\mu\text{V/m}$) Peak	Duty-cycle correction factor δ (dB)	Corrected Emission Level (dB $\mu\text{V/m}$) Average	Limits
				15.231 (e) / 15.209
433.92 (Fundamental)	91.54	-18.79	72.75	4,399.25 $\mu\text{V/m}$ / --- (72.87 dB $\mu\text{V/m}$) / ---

II. Spurious emissions.

Frequency range 30 MHz-1 GHz (see next plots)

Highest spurious emissions levels

Frequency (MHz)	Polarization	Detector	Emission Level (dB μ V/m)	Limits 15.209 (dB μ V/m)
43.48300	V	Quasi-peak	38.92	40.0
95.86300	V	Quasi-peak	23.20	43.5
120.11300	V	Quasi-peak	28.60	43.5
208.14050	V	Quasi-peak	29.11	43.5
218.14300	V	Quasi-peak	25.60	46.0

Measurement uncertainty (dB): ± 3.88 dB.

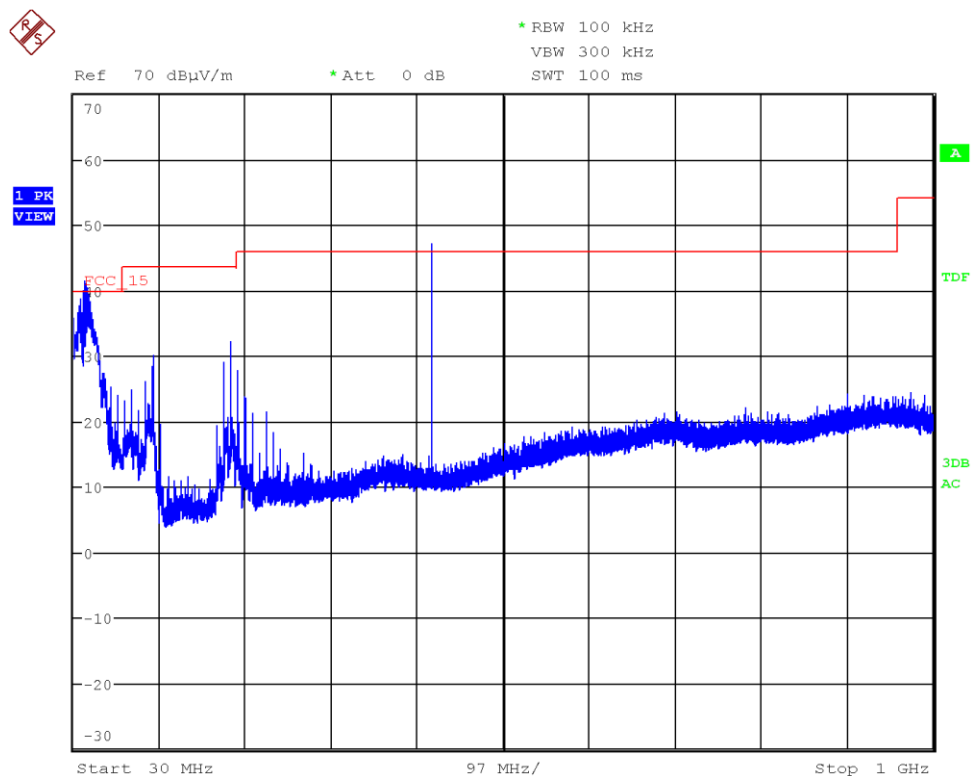
Frequency range 1 GHz-5 GHz (see next plots)

No spurious emissions were found at less than 20 dB respect to the limit.

Measurement uncertainty (dB): ± 4.87 dB.

Verdict: PASS.

FREQUENCY RANGE 30 MHz-1000 MHz



Note: The plot above shows the results of the scan using peak detector. For spurious emissions measurement the carrier frequency (fundamental) was attenuated using a notch filter. The peak above the limit of 46 dB μ V/m is the carrier for 433.92 MHz radio.

FREQUENCY RANGE 1 GHz to 5 GHz

