DEKRA Testing and Certification, S.A.U.
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ENAC ENSAYOS Nº 51/LE147

Test report No:
NIE: 64009RRF.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.
License-Exempt radio Apparatus (All Frequency Bands): Category I Equipment
General Requirements and Information for the Certification of Radio Apparatus.

(*) Identification of item tested	Pressure and Temperature measurement sensor
(*) Trademark	Intuitu
(*) Model and /or type reference	Intuitu Sensor 9Bar V001
Other identification of the product	HW version: SNS_08 B8 SW version: 1.0.0 FCC ID: QCE-S09001 IC: 25968-S09001
(*) Features	BLE, 433MHz RF transmitter, 125kHz LF receiver
Applicant	NOKIAN TYRES PLC Pirkkalaistie 7, 37101 Nokia, FINLAND
Test method requested, standard	USA FCC Part 15.231 (10-1-19 Edition): Periodic operation in the band 40.66-40.70 MHz and above 70 MHz USA FCC Part 15.209 (10-1-19 Edition): Radiated emission limits; general requirements. CANADA RSS-210 Issue 10 (December 2019). CANADA RSS-Gen Issue 5 (March 2019). ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Jose Carlos Luque RF Lab. Supervisor 74841983Y JOSE CARLOS LUQUE (C:A29507456) Firmado digitalmente por 74841983Y JOSE CARLOS LUQUE (C:A29507456) Fecha: 2020.08.25 12:29:44 +02'00'
Date of issue	2020-08-25
Report template No	FDT08_22 (*) "Data provided by the client"

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Competences and guarantees

DEKRA Testing and Certification S.A.U. 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 FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

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

DEKRA Testing and Certification S.A.U. 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 S.A.U. at the time of performance of the test.

DEKRA Testing and Certification S.A.U. 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.

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.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification S.A.U.
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 S.A.U. and the Accreditation Bodies.

Uncertainty

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

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").

2. The sample of the Intuitu Sensor 9Bar V001 is a tire pressure and temperature measurement sensor with BLE interface to mobile application.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of result.

Usage of samples

Samples undergoing test have been selected by: The client.

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

Control Nº	Description	Model	Serial Nº	Date of reception
64009B/008	Pressure and Temperature measurement sensor	Intuitu Sensor 9Bar V001	--	2020/03/24

Sample S/01 has undergone the following test(s): All RADIATED tests indicated in Appendix A.

- Sample S/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
64009B/004	Pressure and Temperature measurement sensor	Intuitu Sensor 9Bar V001	--	2020/03/20

Sample S/02 has undergone the following test(s): All CONDUCTED tests indicated in Appendix A except Transmitter deactivation.

- Sample S/03 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
64009B/013	Pressure and Temperature measurement sensor	Intuitu Sensor 9Bar V001	--	2020/06/04

Sample S/03 has undergone the following test(s): Transmitter deactivation CONDUCTED tests indicated in Appendix A.

Test sample description

Ports……. :	Port name and description		Cable				
			Specified max length [m]	Attached during test	Shielded	Coupled to patient(3)	
	-			☐	☐	☐	
Supplementary information to the ports……..:	-						
Rated power supply .....:	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: 3V (CR2032)					
Rated Power .....:	-						
Clock frequencies .....:	32kHz, 32MHz, 64MHz, 26MHz, 8MHz						
Other parameters.....:	-						
Software version .....:	1.0.0						
Hardware version.....:	SNS_08 B8						
Dimensions in cm (W x H x D)....:	49mm x 49mm x 17mm						
Mounting position.....:	☐	Table top equipment					
	☐	Wall/Ceiling mounted equipment					
	☐	Floor standing equipment					
	☐	Hand-held equipment					
	☒	Other: Tyre mount					
Modules/parts .....:	Module/parts of test item			Type		Manufacturer	
	Intuitu test sample#7(EE:F4:40:CA:EF:6B)					Nokian Tyres	
	Intuitu test sample#8(F3:BB:DD:1C:29:B0)					Nokian Tyres	
	Intuitu test sample#1(E0:A3:D6:1B:05:59)					Nokian Tyres	
	-						
Accessories (not part of the test item) .....:	Description			Type		Manufacturer	
	UART to USB dongle					DLP Design Inc.	
	Mini USB cable						
	Power cable						
	Android Phone with nRF Connect			Huawei Y6		Huawei	
	-						
Documents as provided by the applicant.....:	Description			File name		Issue date	
	-						

(3) Only for Medical Equipment

Identification of the client

NOKIAN TYRES PLC

Pirkkalaistie 7, 37101 Nokia, FINLAND

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2020-04-23
Date (finish)	2020-06-09

Document history

Report number	Date	Description
64009RRF.005	2020-08-25	First release

Environmental conditions

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

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

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

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 35 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Nicolás Salguero, Cristina Calle and Jose Manuel Jimenez.

Used instrumentation:

Conducted Measurements:

		Last Calibration	Due Calibration
1.	Shielded room ETS LINDGREN S101	N/A	N/A
2.	Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV 40	2020/03	2022/03
3.	DC POWER SUPPLY 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N/A	N/A
4.	Digital multimeter FLUKE 175	2019/09	2020/09

Radiated Measurements:

		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N.A.	N.A.
2.	Shielded Room ETS LINDGREN S101	N.A.	N.A.
3.	EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2019/10	2021/10
4.	Biconical/Log Antenna 30 MHz - 6 GHz ETS LINDGREN 3142E	2020/04	2023/04
5.	Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2019/09	2021/09
6.	PRE-AMPLIFIER G>40dB 1-18 GHz BONN ELEKTRONIK BLMA 0118-1M	2020/05	2021/05
7.	Broadband Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2019/11	2022/11
8.	Power supply DC 20 V / 165 A AGILENT TECHNOLOGIES N8734A	N.A.	N.A.
9.	Digital multimeter FLUKE 175	2019/10	2020/10

Testing verdicts

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

Summary

1. 434 MHz Transmitter

FCC PART 15 PARAGRAPH/ RSS-210			
Requirement – Test case		**Verdict**	**Remark**
Section 15.231 Subclause (a) (1) / RSS-210 A.1.1	Transmitter deactivation	P	
Section 15.231 Subclause (c) / RSS-210 A.1.3	Bandwidth	P	
Section 15.231 Subclause (e) / RSS-209 / RSS 210 A.1.4 / RSS-Gen	Field strength and Emission limitations radiated (Transmitter)	P	
Supplementary information and remarks: None.			

Appendix A: Test results. 434 MHz Transmitter

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TEST CONDITIONS

POWER SUPPLY (V):

V nonimal:	3.0 Vdc
Type of Power Supply:	Internal Battery
Type of Antenna:	Integral (Inverted F-antenna (PCB))
Maximum Declared Antenna Gain:	-22.6 dBi

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 connected to the spectrum analyser using a low loss RF cable. The reading of the spectrum analyser is corrected taking into account the cable loss.

RADIATED MEASUREMENTS

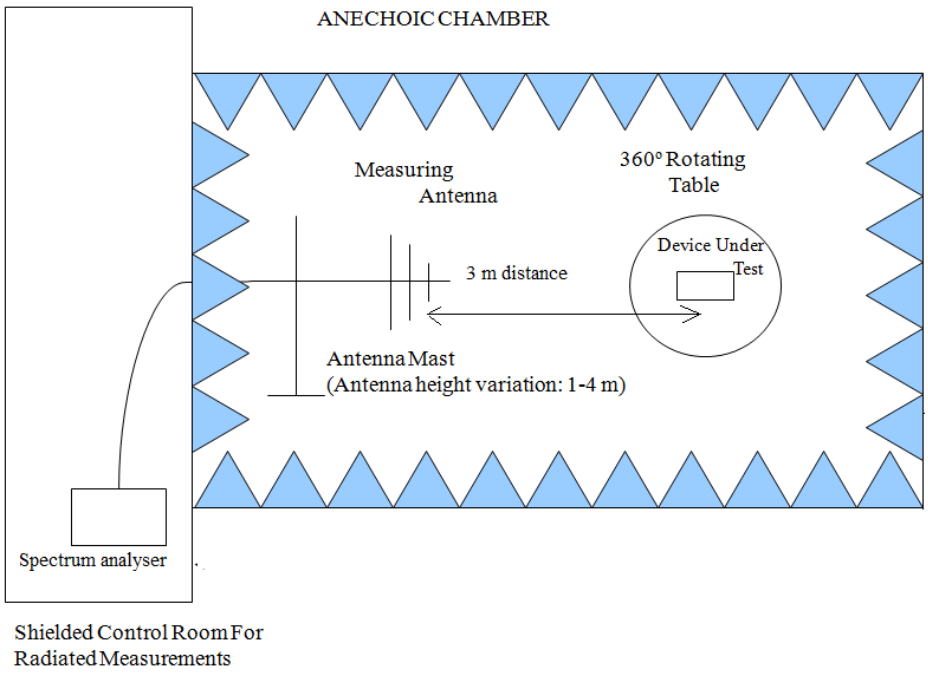
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz) is situated at a distance of 3 m and at a distance of 1m for the frequency range 1 GHz-5 GHz (1 GHz-18 GHz Double ridge horn antenna).

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.

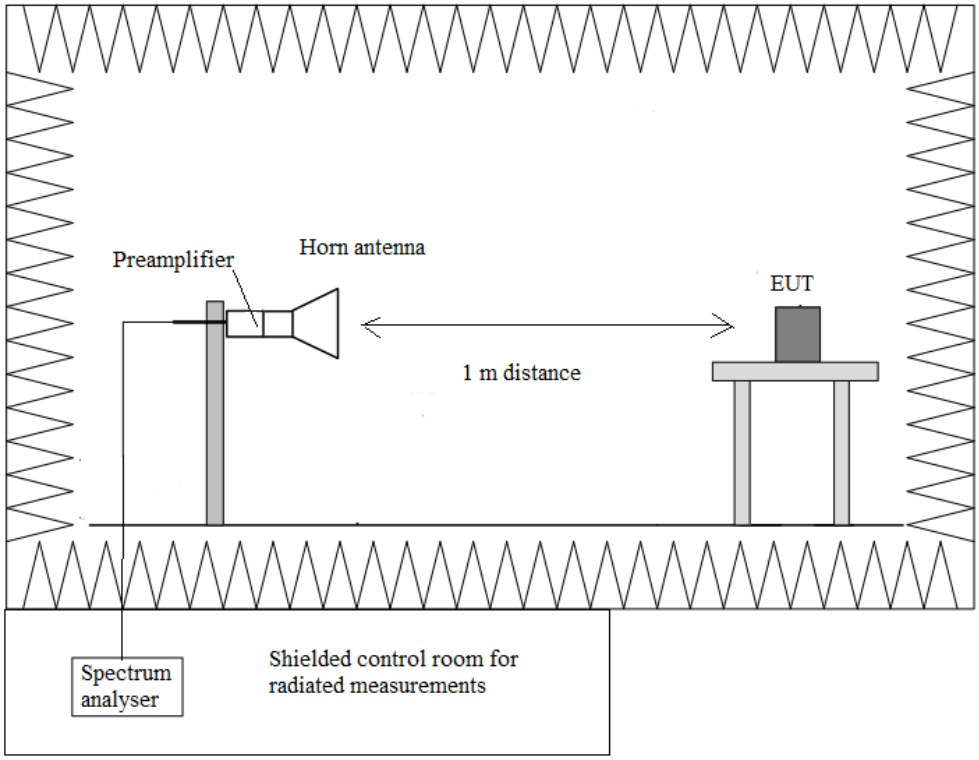
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup f > 1 GHz:



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

SPECIFICATION:

FCC 15.231:

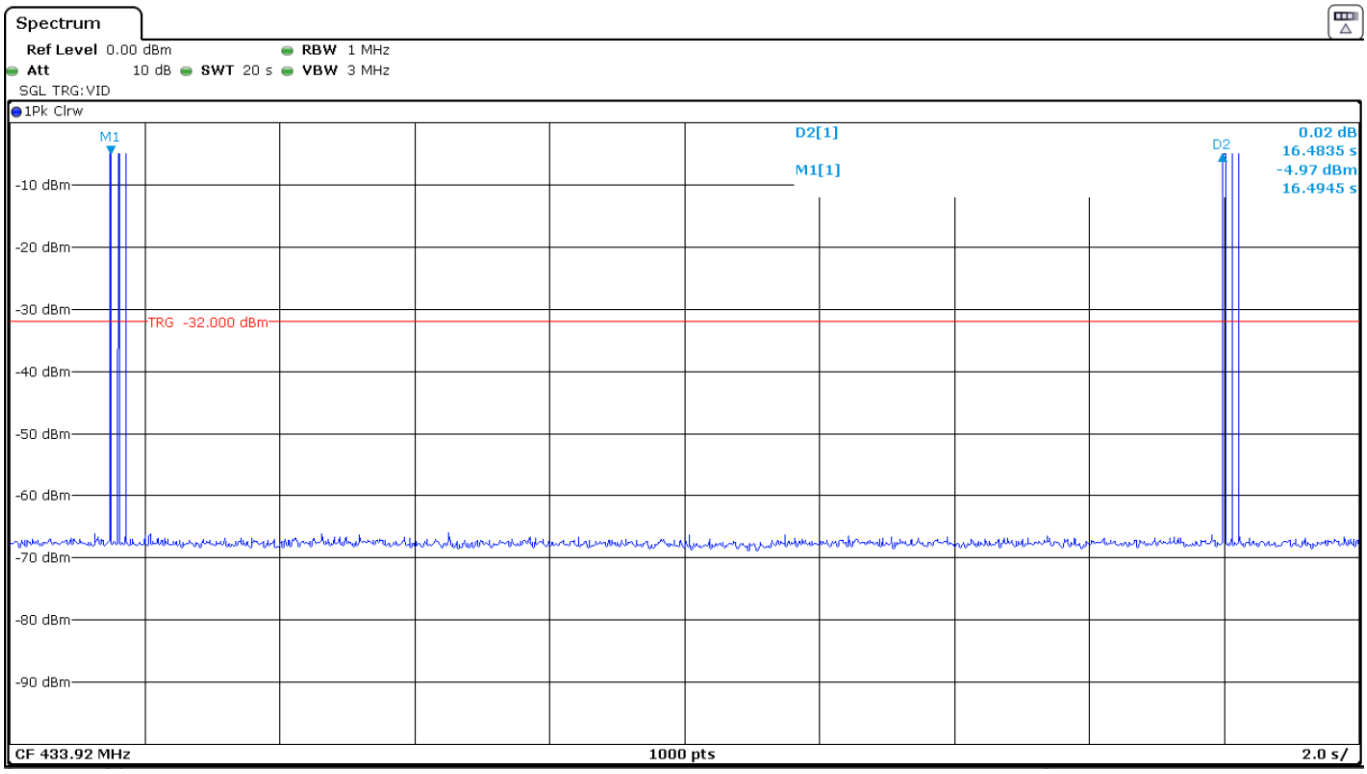
Devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission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

RSS-210:

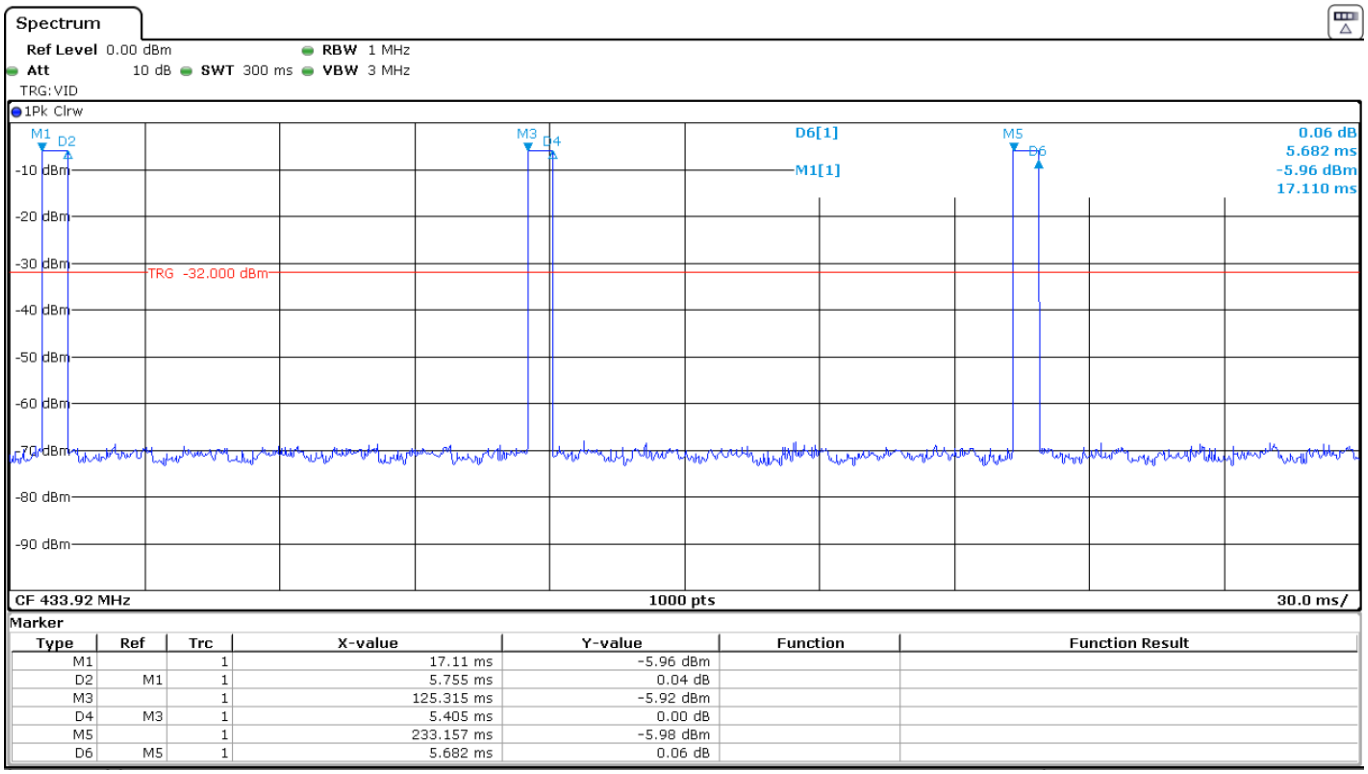
Devices operated under the provisions of this section shall be capable of automatically limiting their operation so that the duration of each transmission is not greater than 1 second and the silent period between transmissions is at least 30 times the duration of the transmission, but not less than 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

RESULTS:

1. Burst period= 16.48 s



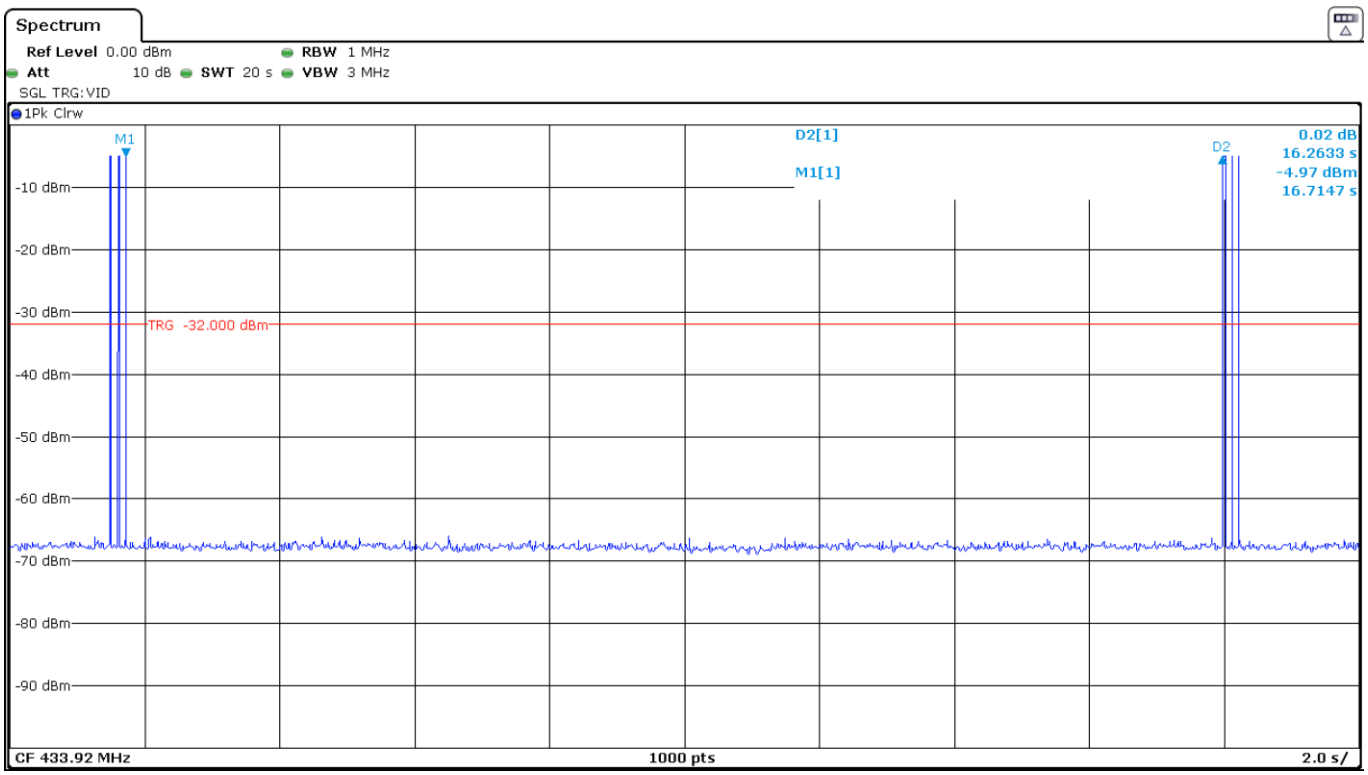
2. Pulse duration= 5.75 ms



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	17.11 ms	-5.96 dBm		
D2	M1	1	5.755 ms	0.04 dB		
M3		1	125.315 ms	-5.92 dBm		
D4	M3	1	5.405 ms	0.00 dB		
M5		1	233.157 ms	-5.98 dBm		
D6	M5	1	5.682 ms	0.06 dB		

3. Silent period between transmissions= 16.26 s



The equipment transmits 3 pulses of 5.75 ms (total transmission time = 3 x 5.75 ms = 17.25 ms) every 16.48 second (see plots above).

30 times the duration of the transmission is 517.5 miliseconds.

The silent period between transmissions is 16.26 seconds

Measurements uncertainty (%)	<±0.01

Verdict: PASS

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

SPECIFICATION:

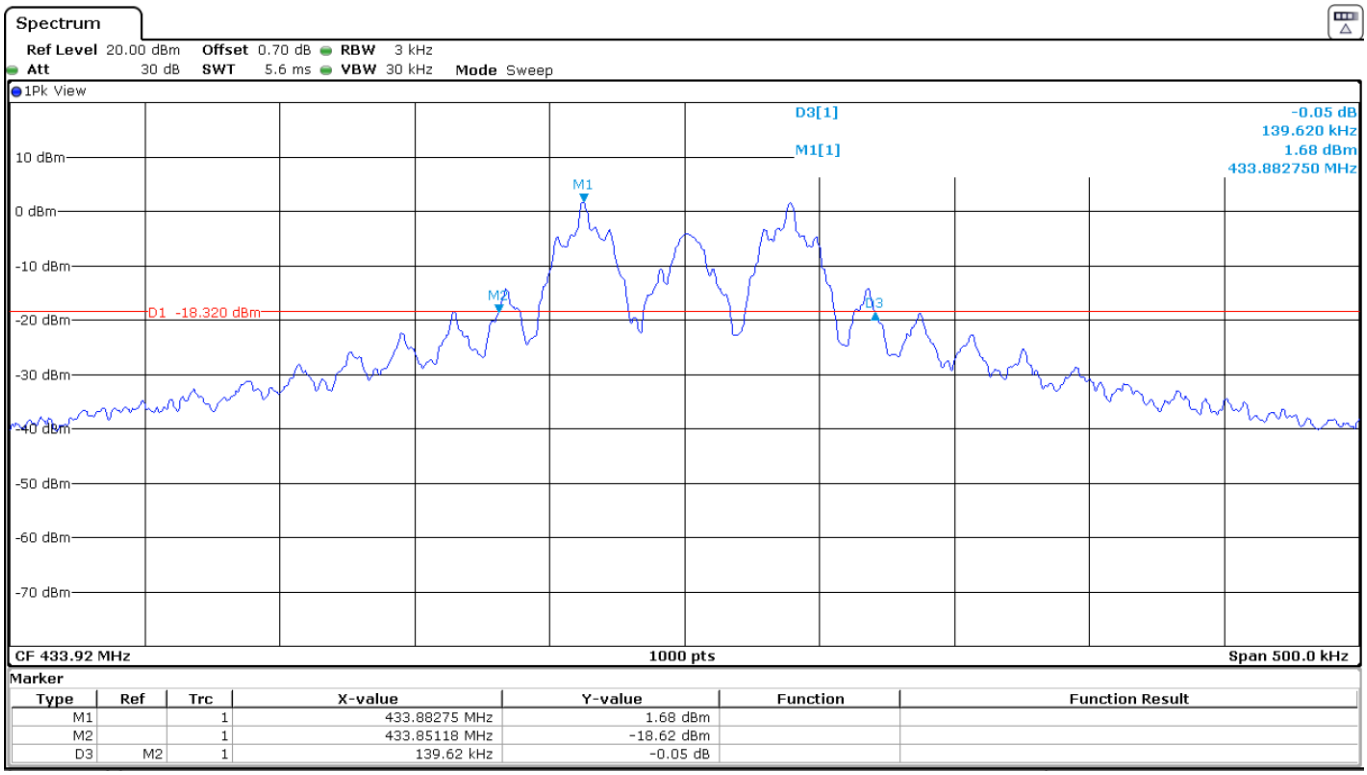
FCC 15.231: The bandwidth of the emission shall be no wider than 0.25 % of the centre frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

RESULTS:

Nominal centre frequency = 433.92 MHz

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

Measured 20 dB Bandwidth (kHz)	139.62
Measurement uncertainty (kHz)	<±0.66



Verdict: PASS

Occupied Bandwidth

SPECIFICATION:

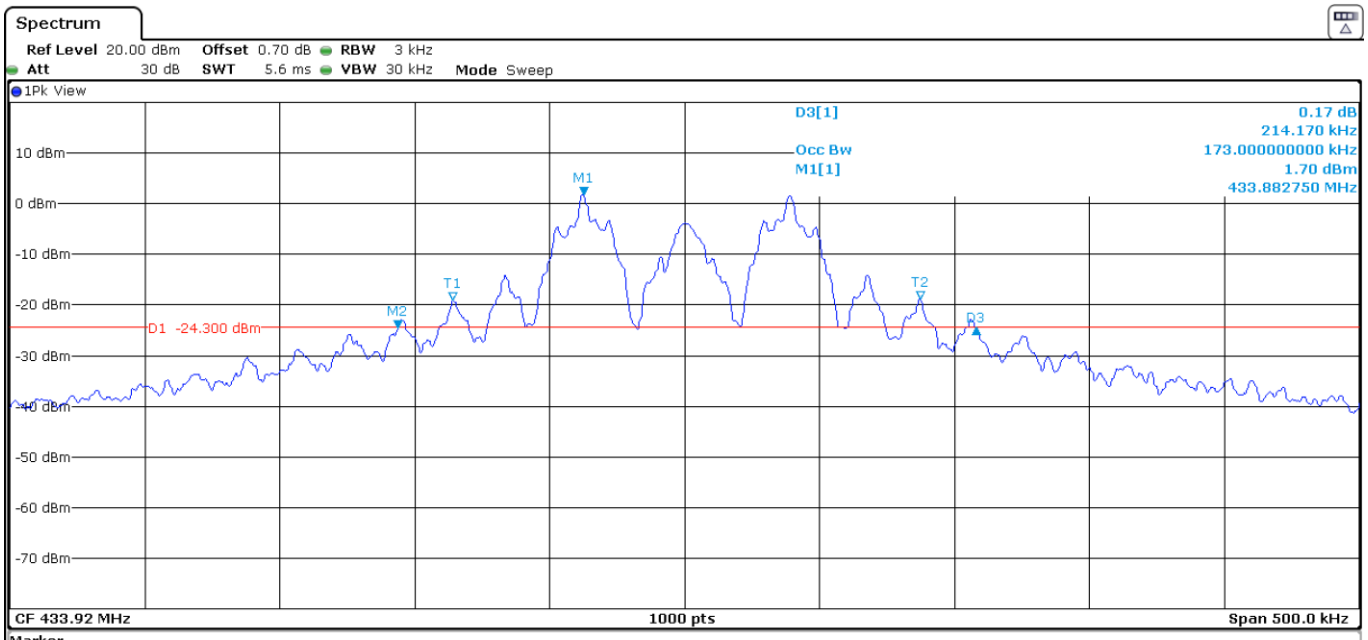
RSS-210. A.1.3: The 99% bandwidth shall be no wider than 0.25 % of the centre frequency for devices operating above 70 MHz and below 900 MHz.

RESULTS:

Nominal centre frequency = 433.92 MHz

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

99% Bandwidth (kHz)	173
-26 dBc bandwidth (kHz)	214.17
Measurement uncertainty (kHz)	<±0.66



FCC 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:

Frequency Range (MHz)	Field strength of fundamental (µV/m)	Field strength of spurious emissions (µV/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:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º 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.

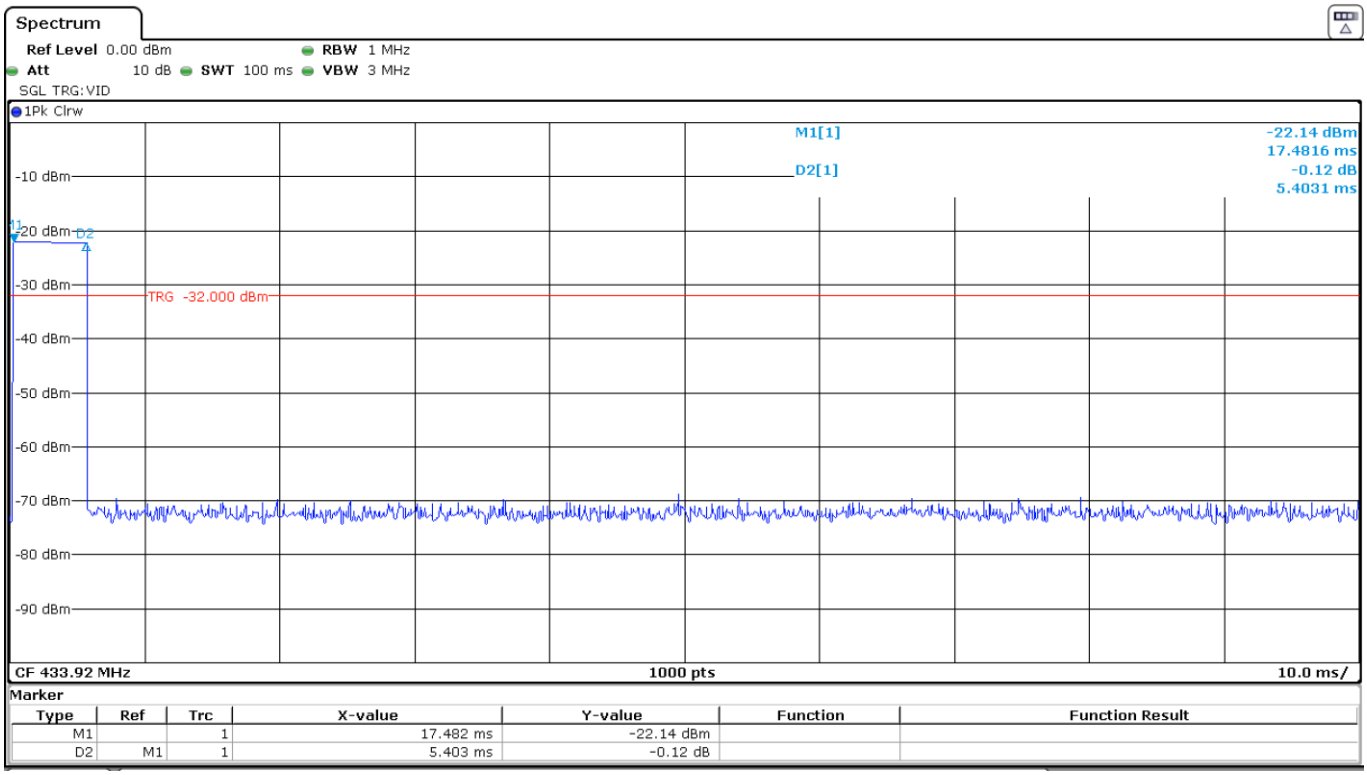
All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-1000 MHz and at distance of 1m for the frequency range 1 GHz-5 GHz.

The transmission is pulsed so the average value 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

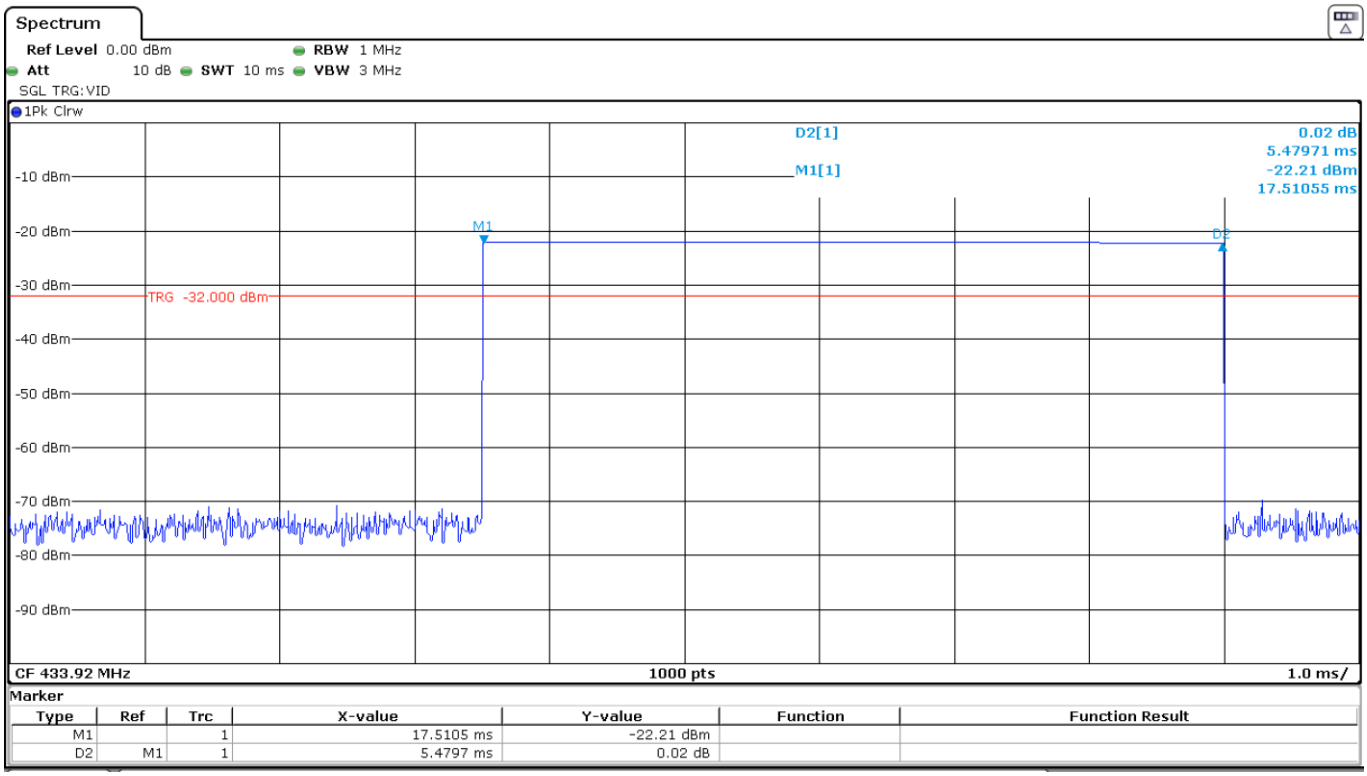
The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

Computation of duty cycle correction factor

Number of pulses within 100 ms: 1



Pulse duration: 5.75 ms



Duty-cycle correction factor calculation.

Sub-pulse	Duration (ms)	Number of pulses	Sub-pulse "On Time" (ms)
1	5.47971	1	5.47971
		TOTAL ON TIME	5.47971

Duty cycle correction factor δ = 5.47971 / 100 = 0.0547971
δ = 20 log (0.0547971) = - 25.2248 dB

Frequency range 30 MHz - 1 GHz:

I. Fundamental

Frequency (MHz)	Polarization	Detector	Emission Level	Limits 15.231 (e) / 15.209
433.92 (Fundamental)	V	Peak	38,547.84µV/m (91.72 dBµV/m)	43,992.5 µV/m / --- (92.87 dBµV/m) / ---

Calculation for average level

Spurious frequency (MHz)	Emission Level (dBµV/m) Peak	Duty-cycle correction factor δ (dB)	Corrected Emission Level (dBµV/m) Average	Limits 15.231 (e) / 15.209
433.92 (Fundamental)	91.72	-25.2248	66.4952	4,399.25 µV/m / --- (72.87 dBµV/m) / ---

II. Spurious emissions. Highest spurious emissions levels

Frequency (MHz)	Polarization	Detector	Emission Level	Average/quasi-peak Limits 15.231 (e) / 15.209
887.84665	V	Quasi-Peak	44.86	52.87 / 45

Measurement uncertainty (dB): <±4.65

Frequency range 1 - 5 GHz:

Highest spurious emissions levels.

Frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Average Limits (dBµV/m) 15.231 (e) / 15.209
1.301761	H	Peak	44.98	52.87 / 54
1.735682	H	Peak	60.11	52.87 / 54
2.169578	H	Peak	40.99	52.87 / 54
2.603519	H	Peak	38.9	52.87 / 54

Calculation for average level

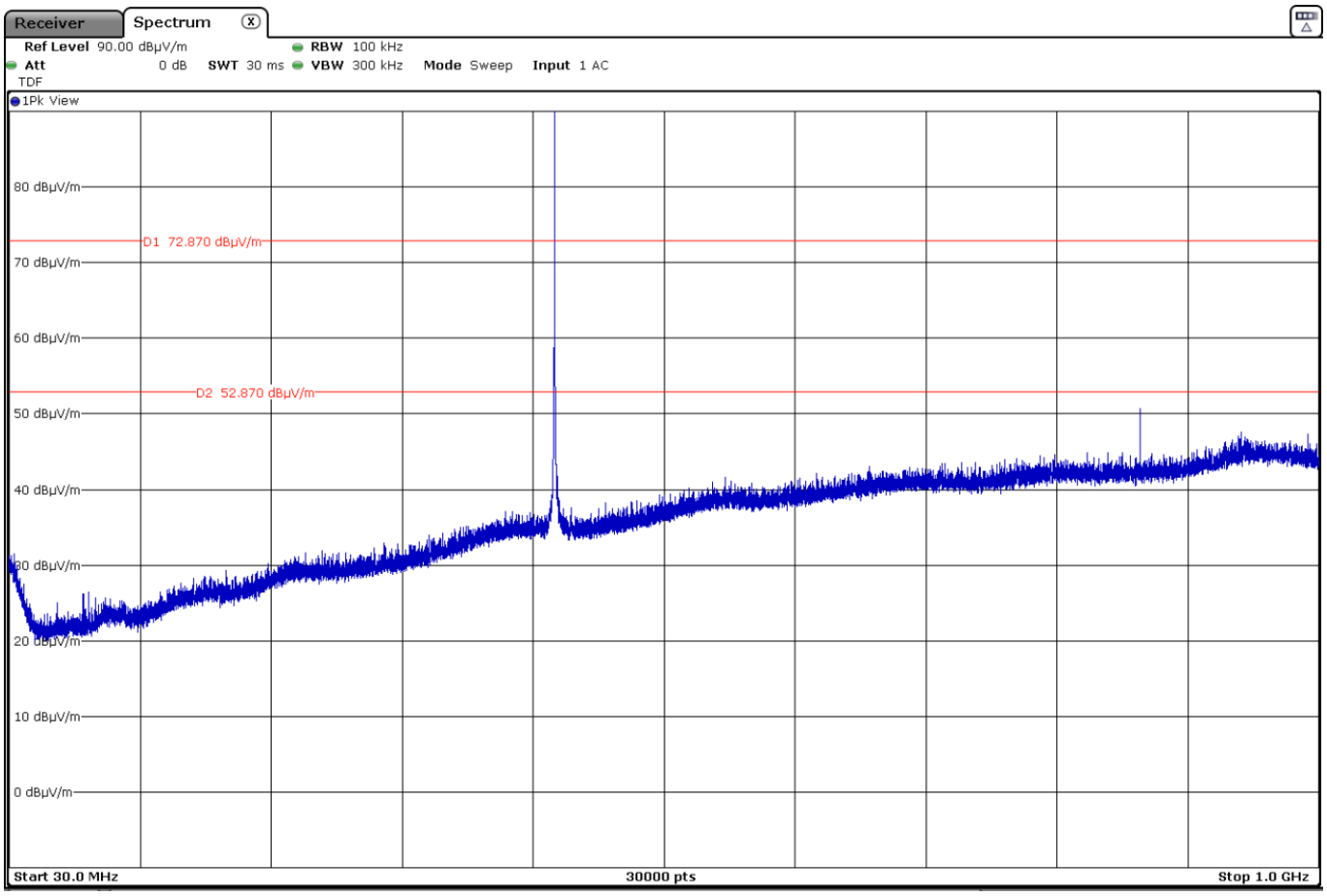
Spurious frequency (GHz)	Emission Level (dBµV/m) Peak	Duty-cycle correction factor δ (dB)	Corrected Emission Level (dBµV/m) Average	Average Limits (dBµV/m) 15.231 (e) / 15.209
1.73568	60.11	-25.2248	34.8852	52.87 / 54

All other peaks values are below the average limits

Measurement uncertainty (dB): <±4.98

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:



Note: The peak above the limit is the carrier frequency.

FREQUENCY RANGE 1 - 5 GHz: