R F – T E S T R E P O R T

- FCC 15.231, RSS210 -

Type / Model Name	:	Wusu Sensit 87E
Product Description	:	Transmitter for a TPMS
Applicant	:	WEGMANN Automotive GmbH
Address	:	Rudolf-Diesel-Str. 6
		97209 VEITSHOECHHEIM, GERMANY
Manufacturer	:	LDL Technology
Address	:	3 Rue Giotto
		31520 RAMONVILLE-SAINT-AGNE, FRANCE

Test Result according to the standards listed in clause 1 test standards:	**POSITIVE**

Test Report No. : 80098855-00 Rev_0	19. October 2021 Date of issue

Deutsche Akkreditierungsstelle
D-PL-12030-01-03
D-PL-12030-01-04

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FCC ID: 2AUZ3030198 IC: 25799-030198

Contents

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September 23, 2021)

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (October 2020)

Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.231	Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.
RSS-210 Issue 10, December 2019	Low Power Licence – Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment
RSS-Gen Issue 5, March 2019 with A1 March 2019 and A2 February 2021	General Requirements and Information for the Certification of Radiocommunication Equipment
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
CISPR 16-4-2: 2013	Uncertainty in EMC measurement

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2 EQUIPMENT UNDER TEST

2.1 Information provided by the Client

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

2.2 Sampling

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according his/her instructions.

2.3 Photo documentation of the EUT – Detailed photos see ATTACHMENT A

2.4 Equipment type

Transmitter of a tire preasure monitoring system.

2.5 Short description of the equipment under test (EUT)

Wusu Sensit 87E is part of TPMS system. It is designed to be installed in vehicle wheel. It is supplied by a +3V Lithium battery and include several sensors: pressure, temperature, acceleration. It transmits periodically pressure and temperature data to receiver (not described in this document) by radio frequency. It uses an integrated RF transmitter. This sensor can transmit both in RF 315MHz and 434MHz.

Number of tested samples: 3

	CW	Typical transmission	Alarm mode
Firmware version 433.92 MHz	421055710350	421057010350	421056710350
Firmware version 315.00 MHz	412035710150	412037010150	412036710150
Serial number	d6A7C48E / d6A7C654 (Model 030198) d6A7CAbb (Model 03199)		

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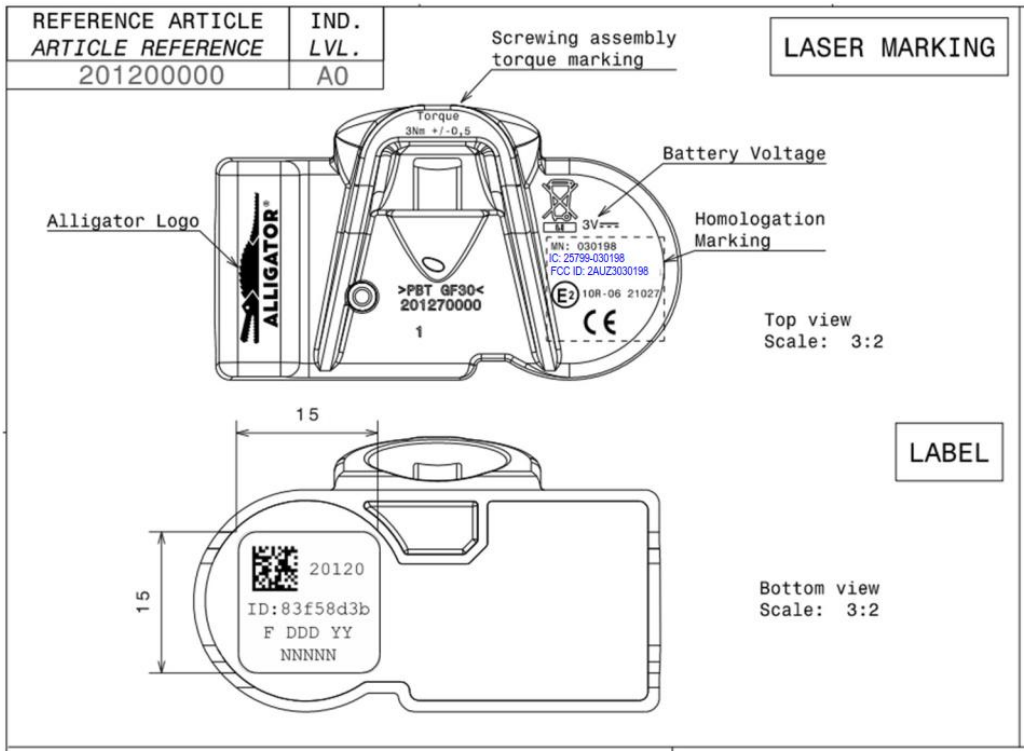
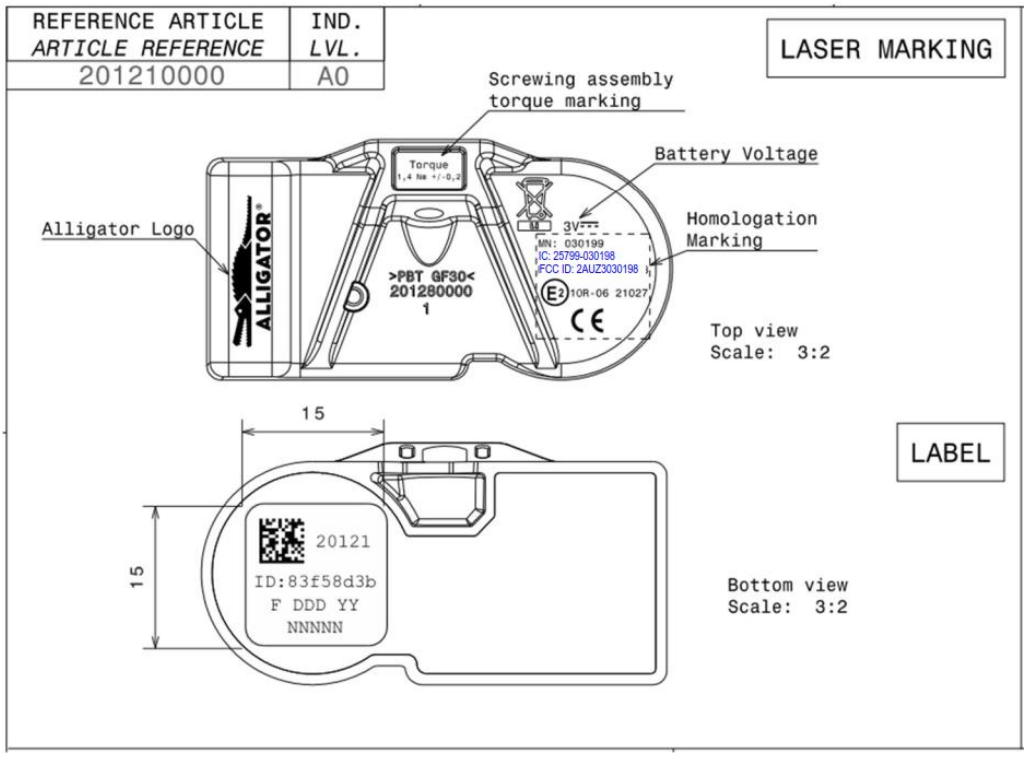
2.6 Variants of the EUT

There are two models of this sensor: model 030198 and model 030199. Only the plastic housing is different. The PCB and BOM are the same for both models. The Radio Part where not changed, both IC have same radio performance. Below you can see a drawing of the both housing.

Model 030198



Model 030199



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2.7 Operation frequency and modulation

TX mode at 315.00 MHz or 433.92 MHz
Modulation type = FSK / deviation = 80 kHz (± 40 kHz) / coding = Manchester / bit rate = 11400 bit/s

RX mode at 125 kHz.
Modulation = ASK / coding = Manchester inverted / bit rate = 3900 bit/s

2.8 Antennas

- Name of manufacturer: OMON
- Antenna name: LOOP ANTENNA CMS
- Antenna reference: 090390000-B0
- max. gain: 315.00 MHz = -33.7dBi
  433.92 MHz = -26.7dBi
- Radiation pattern: NA

2.9 Transmit operating modes

The equipment under test was operated during the measurement under the following conditions:

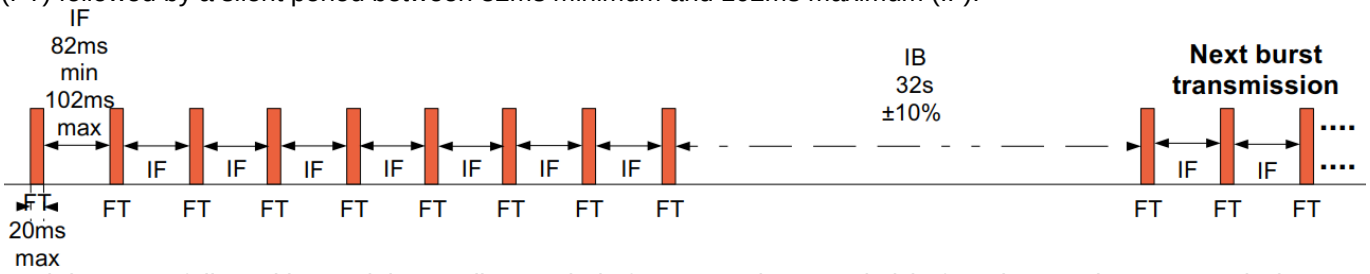
- Unmodulated TX mode at 315.00 MHz or 433.92 MHz and RX at 125 kHz

- Modulated TX mode at 315.00 MHz or 433.92 MHz (typical transmission or alarm mode) and RX at 125 kHz

- Standby

Typical transmission:

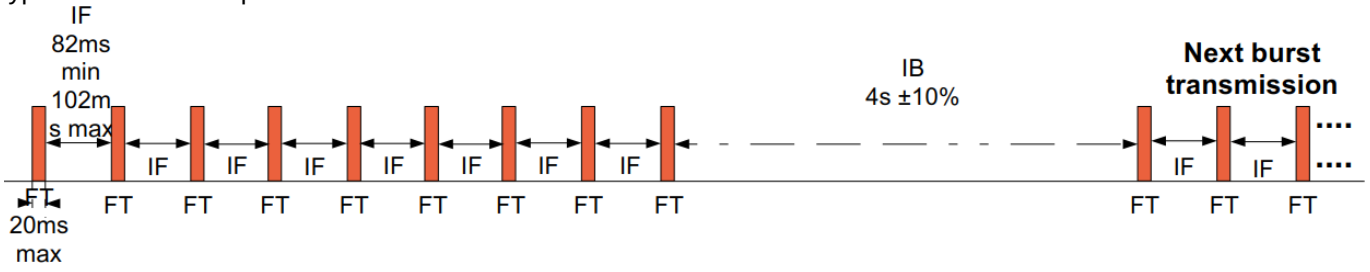
RF burst emissions are periodic, they are composed of 9 frames with a maximum transmission on time of 20ms (FT) followed by a silent period between 82ms minimum and 102ms maximum (IF).



Each burst are followed by a minimum silent period of 32 seconds ±10% (IB) before the next burst transmission.

Alarm mode:

When an alarm pressure pneumatic appears (puncture) the following pattern is transmitted:
8 burst emissions are transmitted, they are composed of 9 frames with a maximum transmission on time of 20ms (FT) followed by a silent period between 82ms minimum and 102ms maximum (IF).
Time between each burst (IB) is about 4s ±10%.
Once the eight burst sent the sensor mode switch automatically and the emission becomes consistent with the typical transmission pattern.



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2.10 Power supply system utilised

Power supply voltage, V_{nom} : 3.0 V DC (CR2050)

2.11 Peripheral devices and interface cables

No peripheral devices and interface cables is used.

2.11.1 Test Jig

No test jig is used.

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3 TEST RESULT SUMMARY

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS Gen, 8.8	AC power line conducted emissions	not applicable [1)]
15.231(b)	RSS210, A.1.2	Field strength of the fundamental wave	passed
15.209	RSS-Gen, 6.4	Spurious emissions (magnetic field) 9 kHz – 30 MHz	passed
15.209	RSS-Gen, 6.5	Spurious emissions radiated (electric field)	passed
15.35(c)	RSS-Gen, 6.10	Correction for pulse operation (duty cycle)	passed
15.231(a)(4) 15.231(e)	RSS210, A.1.1 RSS210, A.1.4	Signal deactivation	passed
15.231(c)	RSS210, A.1.3	Emission bandwidth and OBW99	passed

Note: [1)] The measurement is not applicable, because the EuT has no AC mains connections and is powered by a 3.0 V battery.

3.1 Final assessment

The equipment under test fulfills the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 15 September 2021

Testing concluded on : 22 September 2021

Checked by:

Klaus Gegenfurtner
I confirm the correctness and integrity of this document
2021.10.19 08:25:26 +02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Josef Knab
I'm the autor of this document.
2021.10.19 07:49:11 +02'00'

Josef Knab
Radio Team

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4 TEST ENVIRONMENT

4.1 Address of the test laboratory

CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY

4.2 Environmental conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature:	15 - 35 ° C
Humidity:	30 - 60 %
Atmospheric pressure:	86 - 106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor k = 2. The true value is located in the corresponding interval with a probability of 95 % The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 2011 + A1 / 2014 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Measurement Type	Range	Confidence Level	Calculated Uncertainty
AC power line conducted emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
EBW and OBW	2400 MHz to 30000 MHz	95%	± 2.5 x 10^{-7}
Output power ERP, radiated	1000 MHz to 7000 MHz	95%	± 2.71 dB
Field strength of the fundamental	1000 MHz to 7000 MHz	95%	± 2.71 dB
Power spectral density	2400 MHz to 3000 MHz	95%	± 0.62 dB
Spurious Emissions, conducted	9 kHz to 10000 MHz	95%	± 2.15 dB
Spurious Emissions, conducted	10000 MHz to 40000 MHz	95%	± 3.47 dB
Spurious Emissions, radiated	9 kHz to 30 MHz	95%	± 3.53 dB
Spurious Emissions, radiated	30 MHz to 1000 MHz	95%	± 4.44 dB
Spurious Emissions, radiated	1000 MHz to 30000 MHz	95%	± 2.34 dB
Spurious Emissions, radiated	30000 MHz to 40000 MHz	95%	± 5.13 dB

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4.4 Conformity Decision Rule

The conformity decision rule is based on the ILAC G8 published at the time of reporting.

4.5 Measurement Protocol for FCC and ISED

4.5.1 GENERAL INFORMATION

4.5.1.1 Test methodology

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011
ISED: DE0009

The test methods used comply with ANSI C63.10, „Testing Unlicensed Wireless Devices ".

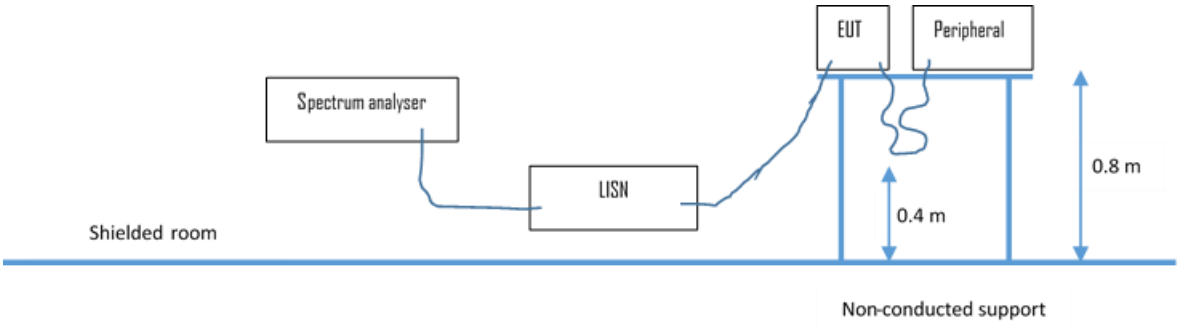
4.5.1.2 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.5.2 Details of test procedures

4.5.2.1 Conducted emission

Test setup according ANSI C63.10



The final level, expressed in dBµV, is arrived at by taking the reading directly from the Spectrum analyser. This level is compared to the limit.

To convert between dBµV and µV, the following conversions apply:

dBµV = 20(log µV)
µV = Inverse log(dBµV/20)

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50 Ω / 50 µH (CISPR 16) characteristics. The receiver is protected by means of an impedance matched pulse limiter connected directly to the RF input. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emission is re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

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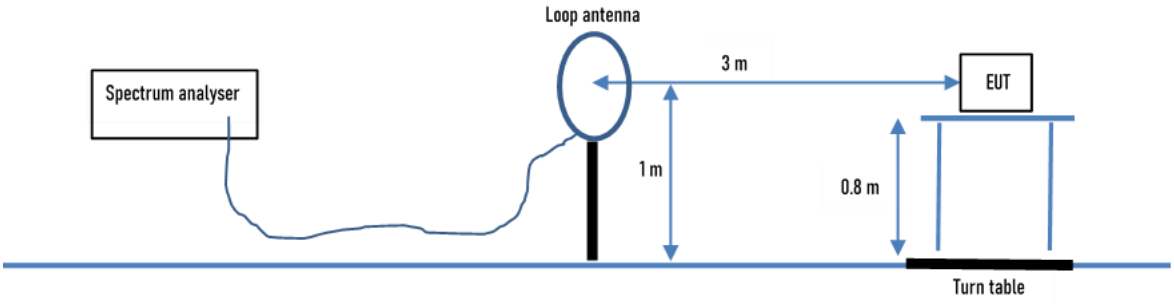
4.5.2.2 Radiated emission

4.5.2.2.1 OATS1 test site (9 kHz - 30 MHz):

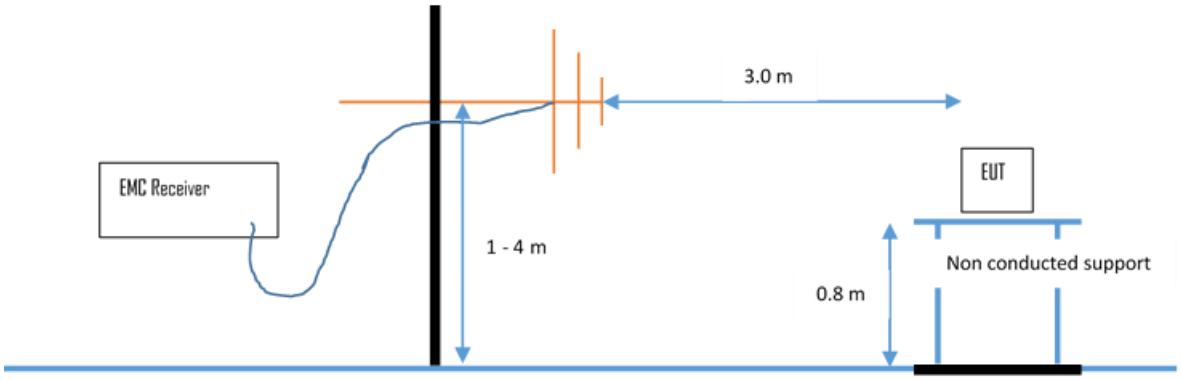
Test setup according ANSI C63.10



Emissions from the EUT are measured in the frequency range of 9 MHz to 30 MHz using a tuned receiver and a calibrated loop antenna. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. When the EUT contains a loop antenna that can only be placed in a vertical axis, normal measurements shall be made aligning the measurement antenna along the site axis, and then orthogonal to the axis. For each measurement antenna alignment, the EUT shall be rotated through 0° to 360° on a turntable. When the EUT contains a loop antenna that can be placed in a horizontal or vertical axis, normal measurements shall be made aligning the measurement antenna along the site axis, orthogonal to the axis, and then with the measurement antenna horizontal. For each measurement antenna alignment, the EUT shall be rotated through 0° to 360° on a turntable.

4.5.2.2.2 OATS1 test site (30 MHz - 1 GHz):

Test setup according ANSI C63.10.



Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees. The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

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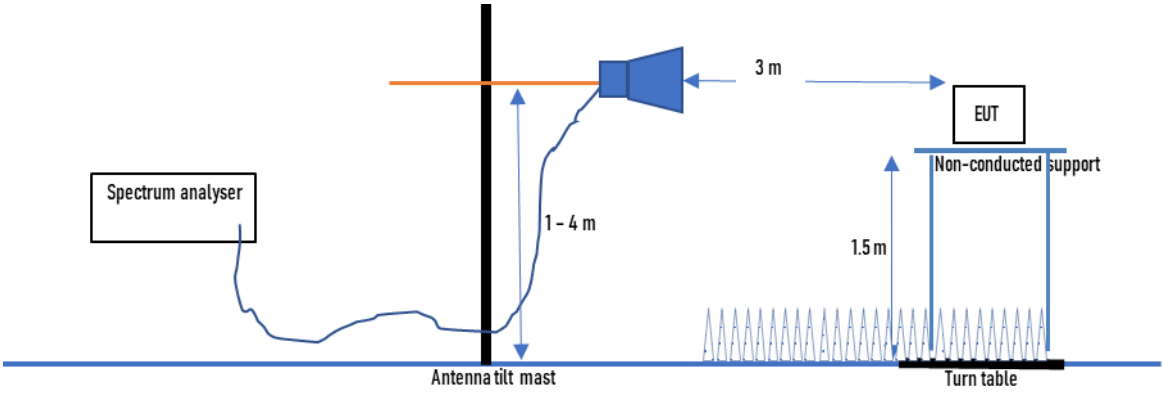
The resolution bandwidth setting:
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	-	Limit (dBµV/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

4.5.2.2.3 Anechoic chamber 1 (1000 MHz – 18000 MHz)

Test setup according ANSI C63.10.



Radiated emissions from the EUT are measured in the frequency range 1 GHz up to 18 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a non-conducting table, 1.5 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements.

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5 TEST RESULTS

5.1 Field strength of the fundamental wave

For test instruments and accessories used see section 6 Part **CPR 2**.

5.1.1 Description of the test location

Test location: OATS1
Test distance: 3 m

5.1.2 Photo documentation of the test set-up – see ATTACHMENT B

5.1.3 Applicable standard

According to FCC Part 15C, Section 15.231(e) and RSS-210, Section A.1.4:

5.1.4 Description of Measurement

Accordance to ANSI C63.10, Item 6.5.
EMI test receiver settings:
30 MHz – 1000 MHz: RBW: 120 kHz

5.1.5 Test result

Variant: 030198 – 315.00 MHz

Frequency (MHz)	Level Pk (dBµV)	Level QP (dBµV)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
315.00	46.2	--	20.7	-14.1	66.9	52.8	67.7	-14.9

Variant: 030199 – 315.00 MHz

Frequency (MHz)	Level Pk (dBµV)	Level QP (dBµV)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
315.00	46.6	--	20.7	-14.1	67.3	53.2	67.7	-14.5

Variant: 030198 – 433.92 MHz

Frequency (MHz)	Level Pk (dBµV)	Level QP (dBµV)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
433.92	51.5	--	24	-14.1	75.5	61.4	72.9	-11.5

Variant: 030199 – 433.92 MHz

Frequency (MHz)	Level Pk (dBµV)	Level QP (dBµV)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
433.92	50.9	--	24	-14.1	74.9	60.8	72.9	-12.1

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Limit according to FCC Section 15.231(e) and RSS 210, Table A2:

Frequency (MHz)	Field strength of fundamental @ 3m		Effective limit for 315 MHz	
	(µV/m)	dB(µV/m)	(µV/m)	dB(µV/m)
40.66 – 40.70	1000	60		
70 - 130	500	54		
130 - 174	500 to 1500*	54 to 63.5*		
174 - 260	1500	63.5		
260 - 470	**1500 to 5000***	**63.5 to 74***	**2416.67**	**67.66**
Above 470	5000	81.9		

*Linear interpolation

Frequency (MHz)	Field strength of fundamental @ 3m		Effective limit for 433.92 MHz	
	(µV/m)	dB(µV/m)	(µV/m)	dB(µV/m)
40.66 – 40.70	1000	60		
70 - 130	500	54		
130 - 174	500 to 1500*	54 to 63.5*		
174 - 260	1500	63.5		
260 - 470	**1500 to 5000***	**63.5 to 74***	**4398.67**	**72.87**
Above 470	5000	81.9		

*Linear interpolation

The requirements are **FULFILLED.**

Remarks: The test was performed in “CW” at a test distance of 3 metres.

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5.2 Spurious emissions (magnetic field) 9 kHz – 30 MHz

For test instruments and accessories used see section 6 Part **SER 1**.

5.2.1 Description of the test location

Test location: OATS 1
Test distance: 3 m

5.2.2 Photo documentation of the test set-up – see ATTACHMENT B

5.2.3 Applicable standard

According to FCC Part 15C, Section 15.209(a) and RSS-Gen 8.9:

5.2.4 Description of Measurement

In accordance to ANSI C63.10, Item 6.4.

The resolution bandwidth during the measurement is as follows:
9 kHz – 150 kHz: RBW: 200 Hz
150 kHz – 30 MHz: RBW: 9 kHz

5.2.5 Test result

f (kHz)	QP reading (dBµV)	AV reading (dBµV)	Ant. factor (dB)	Distance corr. (dB)	QP level (dBµV/m)	AV level (dBµV/m)	Limit (dBµV/m)	Delta (dB)
125	--	1.5	20.0	-80.0	--	-58.5	25.7	-84.2
250	--	11.8	20.0	-80.0	--	-48.2	19.6	-67.8
500	15.5	--	20.0	-40.0	-4.5	--	33.6	-38.1
1000	8.0	--	20.0	-40.0	-12.0	--	27.6	-39.6
15000	9.0	--	20.0	-40.0	-11.0	--	29.5	-40.5
25000	2.9	--	20.0	-40.0	-17.1	--	29.5	-46.6

⇨ No unwanted emissions from the EuT could be measured in the relevant frequency ranges.
⇨ Only ambient noises could be detected.

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Limit according to FCC Part 15 Subpart 15.209(a):

Frequency	Field strength of spurious emissions		Measurement distance
(MHz)	(µV/m)	dB(µV/m)	(metres)
0.009 - 0.490	2400/F(kHz)	--	300
0.490 - 1.705	24000/F (kHz)	--	30
1.705 - 30.0	30	29.5	30

Limit according to RSS-Gen clause 8.9, Table 6:

Frequency	Field strength of spurious emissions		Measurement distance
(MHz)	(µA/m)	dB(µA/m)	(metres)
0.009 - 0.490	6.37/F(kHz)	--	300
0.490 - 1.705	63.7/F (kHz)	--	30
1.705 - 30.0	0.08	-22	30

The requirements are **FULFILLED.**

Remarks: The test was performed in “CW” at a test distance of 3 metres.

No spurious emissions in the different variants and transmission frequencies (315.00 MHz and 433.92 MHz) could be detected.

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5.3 Spurious emissions radiated (electric field)

For test instruments and accessories used see section 6 Part **SER 2, SER 3**.

5.3.1 Description of the test location

Test location: OATS1
Test location: Anechoic chamber 1

Test distance: 3 m

5.3.2 Photo documentation of the test set-up – see ATTACHMENT B

5.3.3 Applicable standard

According to FCC Part 15C, Section 15.231(b), Section 15.209(a) and Section 15.205(a):
According to RSS-Gen, Section 8.9, RSS-Gen, Section 8.10 and RSS-210, A.1.4:

5.3.4 Description of Measurement

In accordance to ANSI C63.10, Item 6.5 and 6.6.

Instrument settings:
30 MHz – 1000 MHz: RBW: 120 kHz
1000 MHz – 4500 MHz RBW: 1 MHz
Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level dB(µV/m)	-	Limit dB(µV/m)	=	Delta (dB)
170.5	5	+	20	=	25	-	30	=	-5

5.3.5 Test result f < 1 GHz

Variant: 030198 – 315.00 MHz

Frequency (MHz)	Level Pk (dBµV)	Level QP (dBµV)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
630.00	7.4	--	28.6	-14.1	36	21.9	47.7	-25.8

Variant: 030199 – 315.00 MHz

Frequency (MHz)	Level Pk (dBµV)	Level QP (dBµV)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
630.00	7.4	--	28.6	-14.1	36	21.9	47.7	-25.8

FCC ID: 2AUZ3030198 IC: 25799-030198

Variant: 030198 – 433.92 MHz

Frequency (MHz)	Level Pk (dBµV)	Level QP (dBµV)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
867.84	8.0	--	32.4	-14.1	40.4	26.3	52.9	-26.6

Variant: 030199 – 433.92 MHz

Frequency (MHz)	Level Pk (dBµV)	Level QP (dBµV)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
867.84	6.9	--	32.4	-14.1	39.3	25.2	52.9	-27.7

5.3.6 Test result f > 1 GHz

Variant: 030198 – 315.00 MHz

Frequency (MHz)	Level Pk (dBµV)	Level AV (dBµV)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
1575.00	55.2	--	-11.4	-14.1	43.8	29.7	54.0	-24.3
1890.00	48.6	--	-8.3	-14.1	40.3	26.2	54.0	-27.8
2205.00	51.0	--	-7.8	-14.1	43.2	29.1	54.0	-24.9
2520.00	47.9	--	-6.4	-14.1	41.5	27.4	54.0	-26.6

Variant: 030199 – 315.00 MHz

Frequency (MHz)	Level Pk (dBµV)	Level AV (dBµV)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
1575.00	54.6	--	-11.4	-14.1	43.2	29.1	54.0	-24.9
1890.00	49.3	--	-8.3	-14.1	41.0	26.9	54.0	-27.1
2205.00	50.1	--	-7.8	-14.1	42.3	28.2	54.0	-25.8
2520.00	48.3	--	-6.4	-14.1	41.9	27.8	54.0	-26.2

Variant: 030198 – 433.92 MHz

Frequency (MHz)	Level Pk (dBµV)	Level AV (dBµV)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
1735.68	48.7	--	-10.1	-14.1	38.6	24.5	54.0	-29.5
2169.60	55.5	--	-8.0	-14.1	47.5	33.4	54.0	-20.6
3037.44	48.0	--	-6.3	-14.1	41.7	27.6	54.0	-26.4
3471.36	49.1	--	-6.5	-14.1	42.6	28.5	54.0	-25.5
3905.28	50.7	--	-5.5	-14.1	45.2	31.1	54.0	-22.9
4339.20	49.6	--	-5.1	-14.1	44.5	30.4	54.0	-23.6

FCC ID: 2AUZ3030198 IC: 25799-030198

Variant: 030199 – 433.92 MHz

Frequency (MHz)	Level Pk (dBµV)	Level AV (dBµV)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
1735.68	48.2	--	-10.1	-14.1	38.1	24.0	54.0	-30.0
2169.60	54.7	--	-8.0	-14.1	46.7	32.6	54.0	-21.4
2603.52	48.2	--	-6.8	-14.1	41.4	27.3	54.0	-26.7
3037.44	48.1	--	-6.3	-14.1	41.8	27.7	54.0	-26.3
3471.36	48.4	--	-6.5	-14.1	41.9	27.8	54.0	-26.2
3905.28	50.9	--	-5.5	-14.1	45.4	31.3	54.0	-22.7
4339.20	48.7	--	-5.1	-14.1	43.6	29.5	54.0	-24.5

Limit according to FCC Section 15.231(e) and RSS 210, Table A2:

Frequency (MHz)	Field strength of spurious emissions @ 3m		Effective limit for 315 MHz	
	(µV/m)	dB(µV/m)	(µV/m)	dB(µV/m)
40.66 – 40.70	100	40		
70 - 130	50	34		
130 - 174	50 to 150*	34 to 43.5*		
174 - 260	150	43.5		
260 - 470	**150 to 500***	**51.4 to 54**	**241.67**	**47.66**
Above 470	500	54		

*Linear interpolation

Frequency (MHz)	Field strength of spurious emissions @ 3m		Effective limit for 433.92 MHz	
	(µV/m)	dB(µV/m)	(µV/m)	dB(µV/m)
40.66 – 40.70	100	40		
70 - 130	50	34		
130 - 174	50 to 150*	34 to 43.5*		
174 - 260	150	43.5		
260 - 470	**150 to 500***	**51.4 to 54**	**439.87**	**52.87**
Above 470	500	54		

*Linear interpolation

FCC ID: 2AUZ3030198 IC: 25799-030198

Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in the table above or to the general limits shown in the table below according to § 15.209, whichever limit permits a higher field strength.

Limit according to FCC Section 15.209 and RSS-Gen, Table 5:

Frequency (MHz)	15.209 Limits (µV/m)	15.209 Limits dB(µV/m)
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

Additionally, there is a limit according to §15.35(b) on the radio frequency emissions, as measured with a peak detector, corresponding to 20 dB above the maximum permitted average limits.

Restricted bands of operation according to FCC Part 15C, Section 15.205(a):

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209.

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6
13.36 – 13.41			

FCC ID: 2AUZ3030198 IC: 25799-030198

Restricted bands of operation according to RES-Gen, Table 7:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in RSS-Gen, Table 3.

MHz	MHz	MHz	GHz
0.090 – 0.110	13.36 – 13.41	399.9 – 410	5.35 – 5.46
0.495 – 0.505	16.42 – 16.423	608 – 614	7.25 – 7.75
2.1735 – 2.1905	16.69475 – 16.69525	960 – 1240	8.025 – 8.5
4.125 – 4.128	16.80425 – 16.80475	1435 – 1626.5	9.0 – 9.2
4.17725 – 4.17775	25.5 – 25.67	1645.5 – 1646.5	9.3 – 9.5
4.20725 – 4.20775	37.5 – 38.25	1660 – 1710	10.6 – 12.7
6.215 – 6.218	73 – 74.6	1718.8 – 1722.2	13.25 – 13.4
6.26775 – 6.26825	74.8 – 75.2	2200 – 2300	14.47 – 14.5
6.31175 – 6.31225	108 – 138	2310 – 2390	15.35 – 16.2
8.291 – 8.294	149.9 – 150.05	2483.5 – 2500	17.7 – 21.4
8.362 – 8.366	156.52475 – 156.52525	2655 – 2900	22.01 – 23.12
8.37625 – 8.38675	156.7 – 156.9	3260 – 3267	23.6 – 24.0
8.41425 – 8.41475	162.0125 – 167.17	3332 – 3339	31.2 – 31.8
12.29 – 12.293	167.72 – 173.2	3345.8 – 3358	36.43 – 36.5
12.51975 – 12.52025	240 – 285	3500 – 4400	Above 38.6
12.57675 – 12.57725	322 – 335.4	4500 – 5150	

The requirements are **FULFILLED.**

Remarks: The measurement is performed up to the 10th harmonic.

The test was performed in “CW” at a test distance of 3 metres.

FCC ID: 2AUZ3030198 IC: 25799-030198

5.4 Correction for pulse operation (duty cycle)

For test instruments and accessories used see section 6 Part **DC**.

5.4.1 Description of the test location

Test location: Shielded Room S4

5.4.2 Photo documentation of the test set-up – see ATTACHMENT B

5.4.3 Applicable standard

According to FCC Part 15C, Section 15.35(c) and RES-Gen, Section 8.2:

5.4.4 Description of Measurement

In accordance to ANSI C63.10, Item 7.5.

K_E:	pulse operation correction factor	(dB)
t_{iw}	pulse duration for one complete pulse track	(ms)
t_{iB}	pulse duration for one pulse	(µs)
T_w	a period of the pulse track	(ms)
p	number of pulses in one train	

5.4.5 Test result

The Duty cycle factor (dB) is calculated applying the following formula:

$$K_E = 20 \log ((t_{iB})/100)$$

Duty cycle	t_{iw} (ms)	T_w (ms)	t_{iB} (ms)	p	K_E (dB)
315 MHz (typical)	--	--	19.797	1	-14.1
315 MHz (alarm mode)	--	--	19.797	1	-14.1
433.92 MHz (typical)	--	--	19.797	1	-14.1
433.92 MHz (alarm mode)	--	--	19.797	1	-14.1

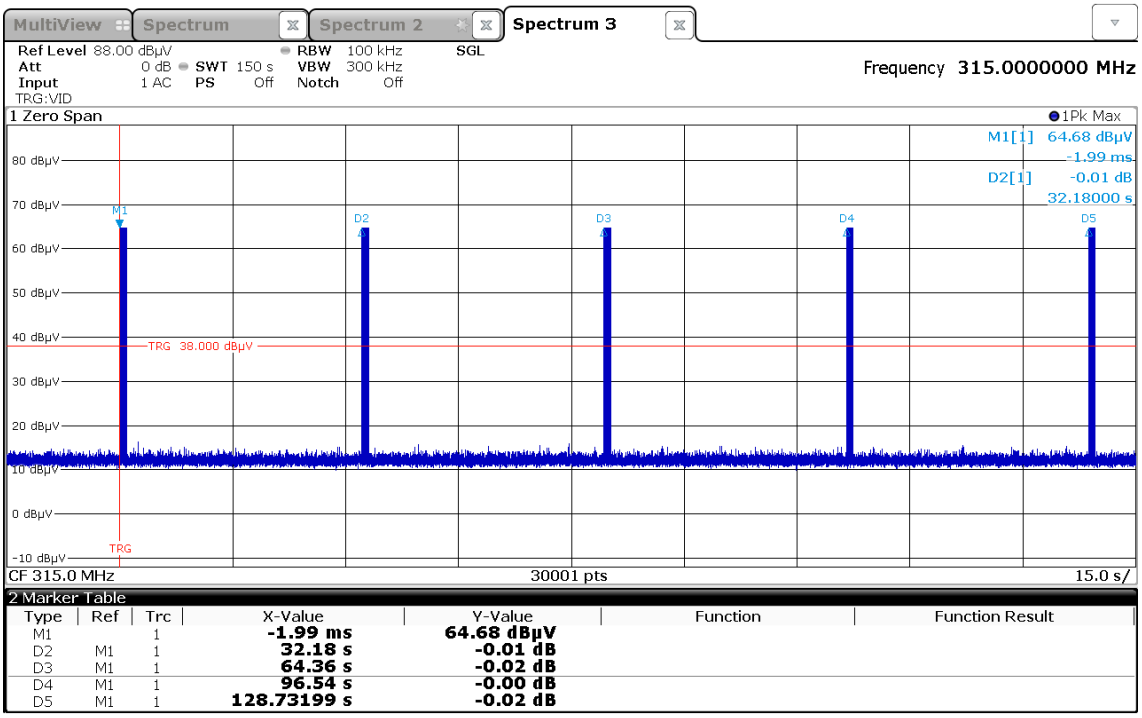
Remarks: The pulse train (T_w) exceeds 100 ms, therefore the duty cycle has been calculated by averaging the sum of the pulse widths over the 100 ms width with the highest average value.

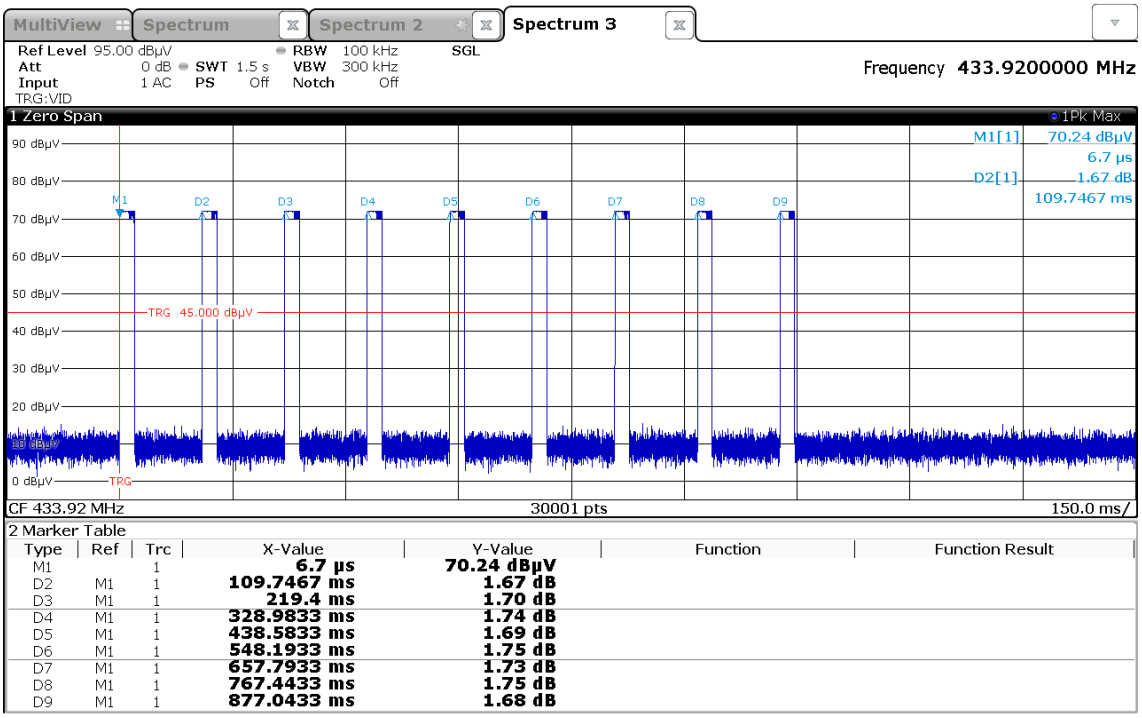
For detailed results, please see the test protocol below.

FCC ID: 2AUZ3030198 IC: 25799-030198

5.4.6 Test protocol – 315 MHz (typical)

Correction for pulse operation (duty cycle)





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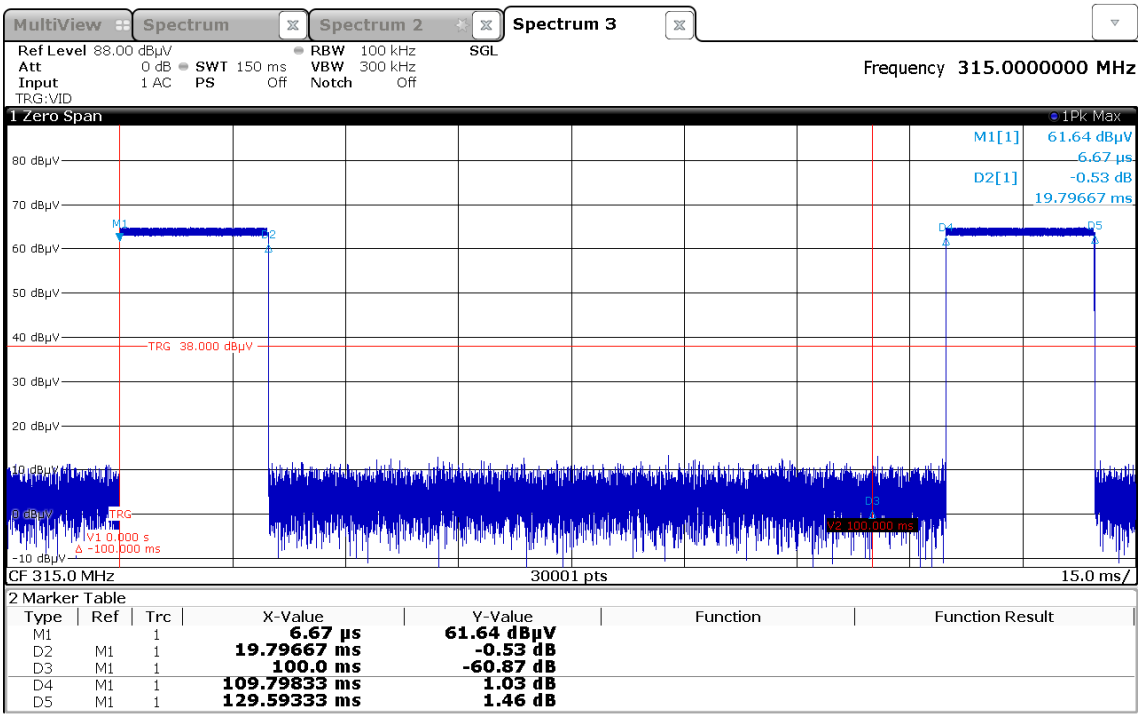
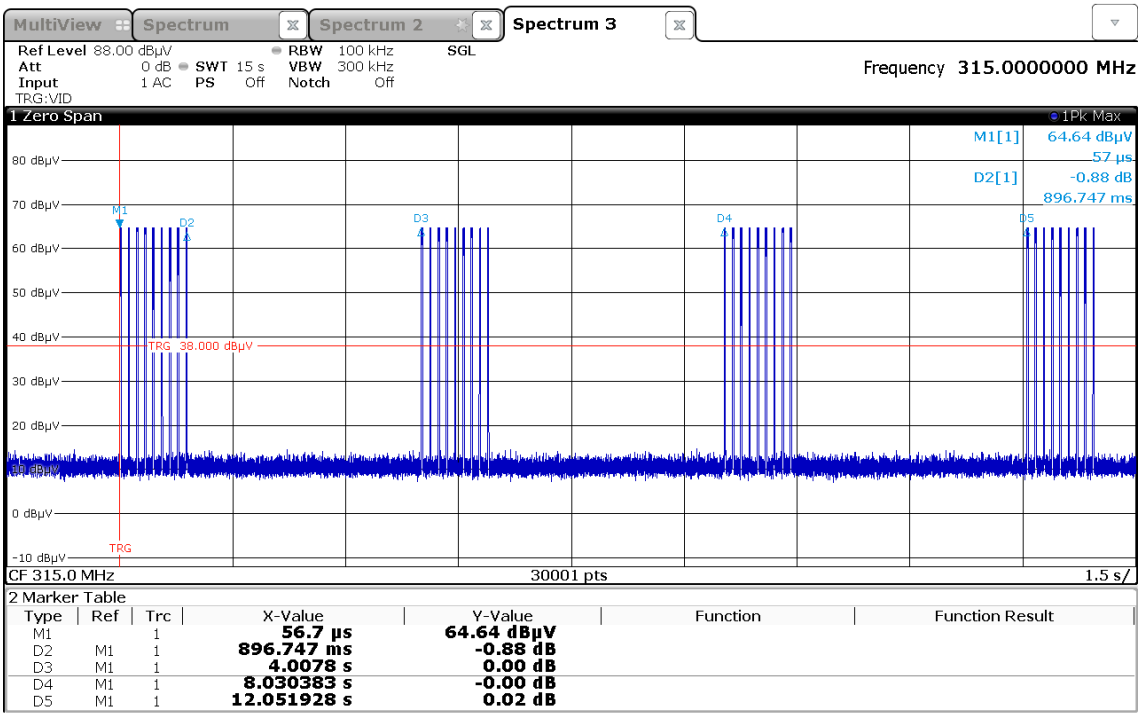
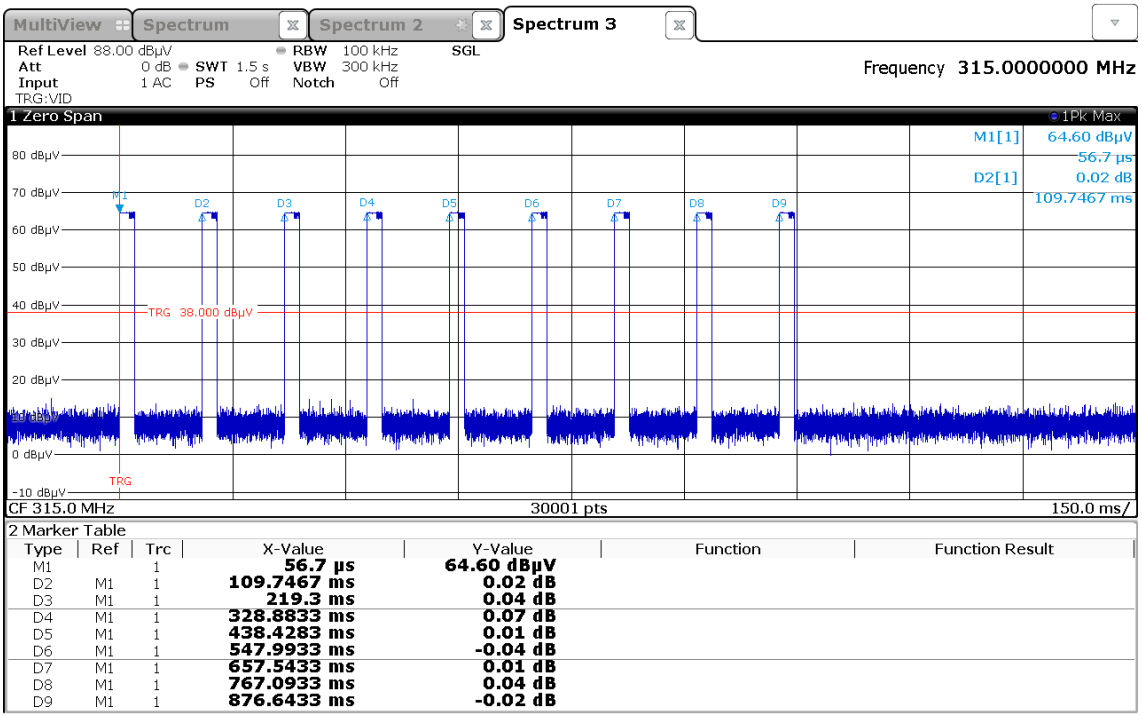


FCC ID: 2AUZ3030198 IC: 25799-030198

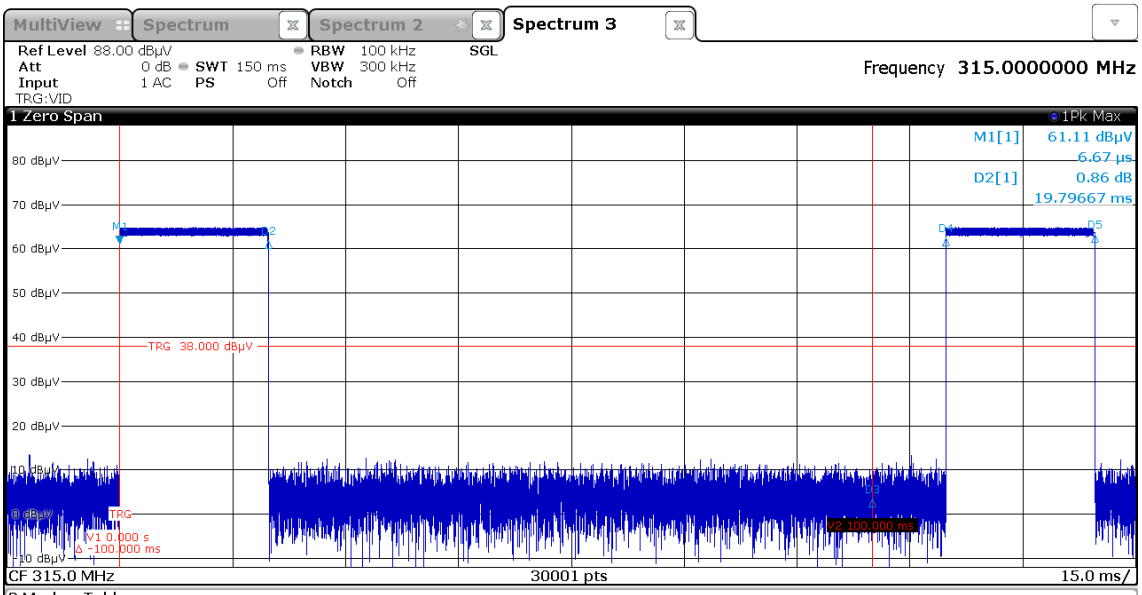
5.4.7 Test protocol – 315 MHz (alarm mode)

Correction for pulse operation (duty cycle)





FCC ID: 2AUZ3030198 IC: 25799-030198



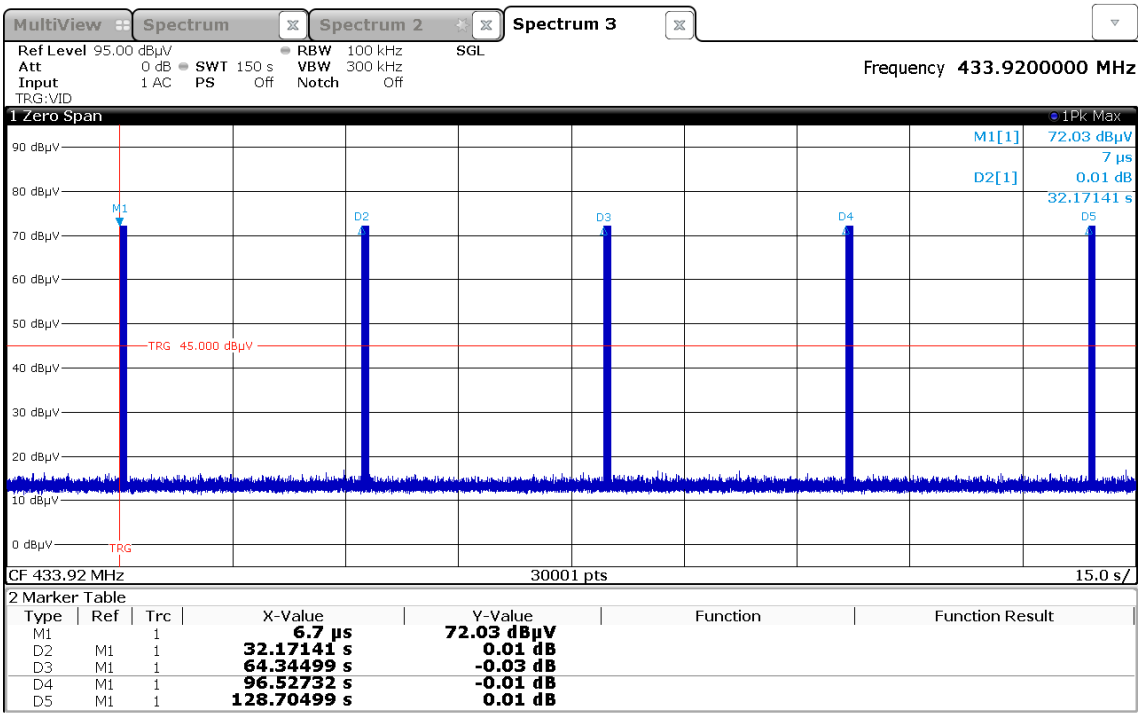
2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**6.67 µs**	**61.11 dBµV**		
D2	M1	1	**19.79667 ms**	**0.86 dB**		
D3	M1	1	**100.0 ms**	**-57.73 dB**		
D4	M1	1	**109.78333 ms**	**1.48 dB**		
D5	M1	1	**129.57833 ms**	**2.17 dB**		

FCC ID: 2AUZ3030198 IC: 25799-030198

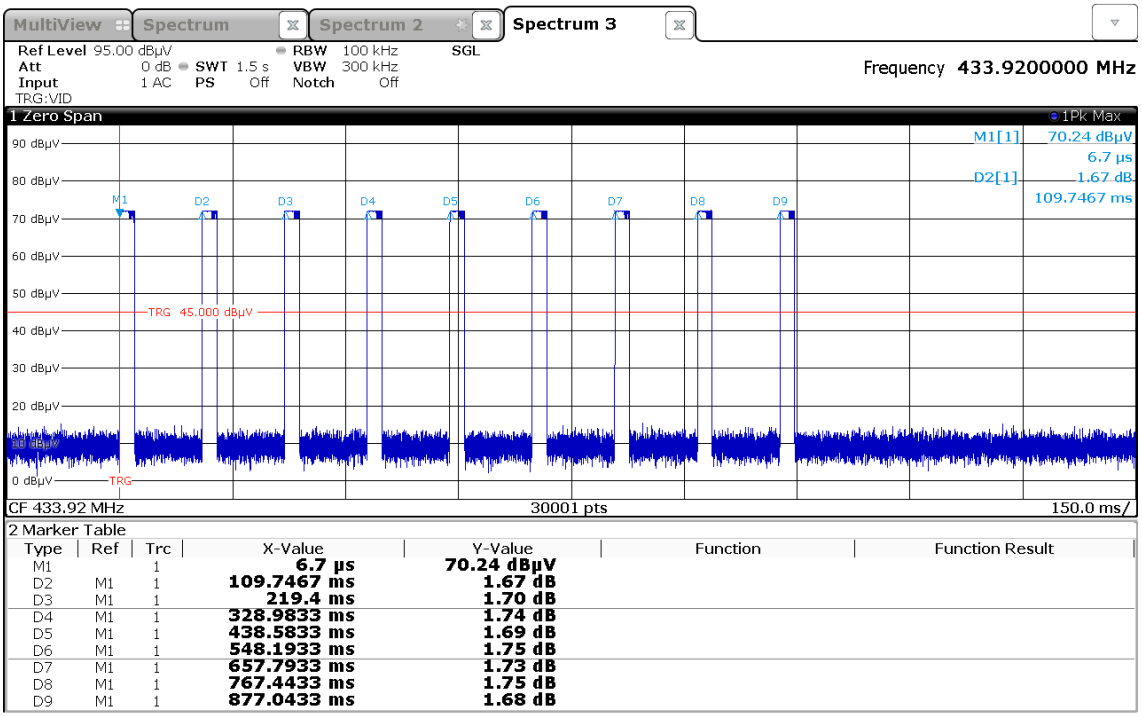
5.4.8 Test protocol – 433.92 MHz (typical)

Correction for pulse operation (duty cycle)



2 Marker Table

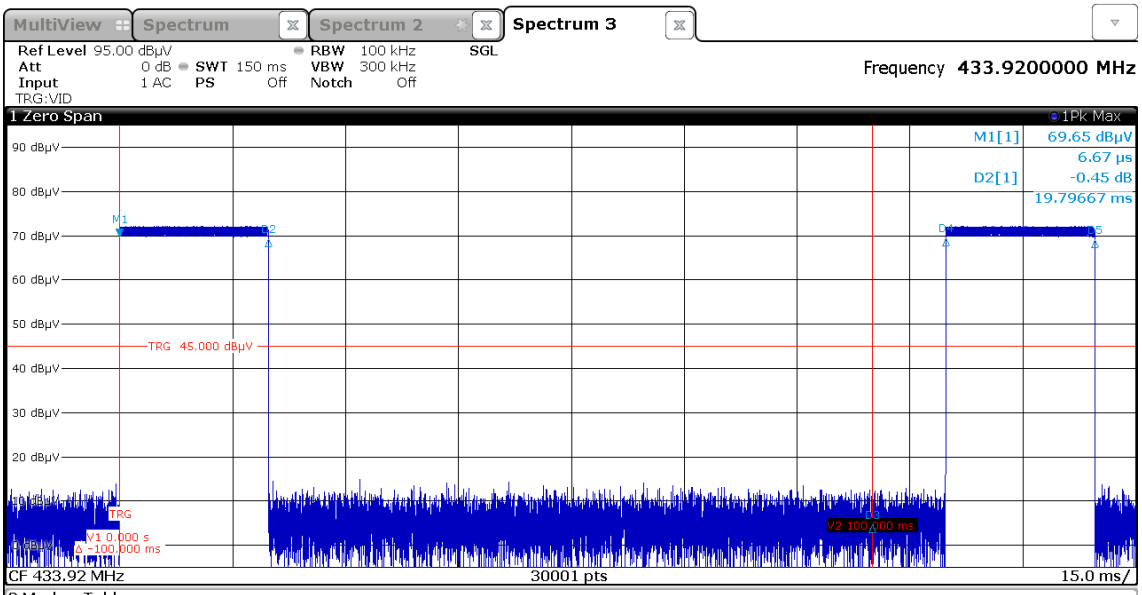
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	6.7 µs	72.03 dBµV		
D2	M1	1	32.17141 s	0.01 dB		
D3	M1	1	64.34499 s	-0.03 dB		
D4	M1	1	96.52732 s	-0.01 dB		
D5	M1	1	128.70499 s	0.01 dB		



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	6.7 µs	70.24 dBµV		
D2	M1	1	109.7467 ms	1.67 dB		
D3	M1	1	219.4 ms	1.70 dB		
D4	M1	1	328.9833 ms	1.74 dB		
D5	M1	1	438.5833 ms	1.69 dB		
D6	M1	1	548.1933 ms	1.75 dB		
D7	M1	1	657.7933 ms	1.73 dB		
D8	M1	1	767.4433 ms	1.75 dB		
D9	M1	1	877.0433 ms	1.68 dB		

FCC ID: 2AUZ3030198 IC: 25799-030198



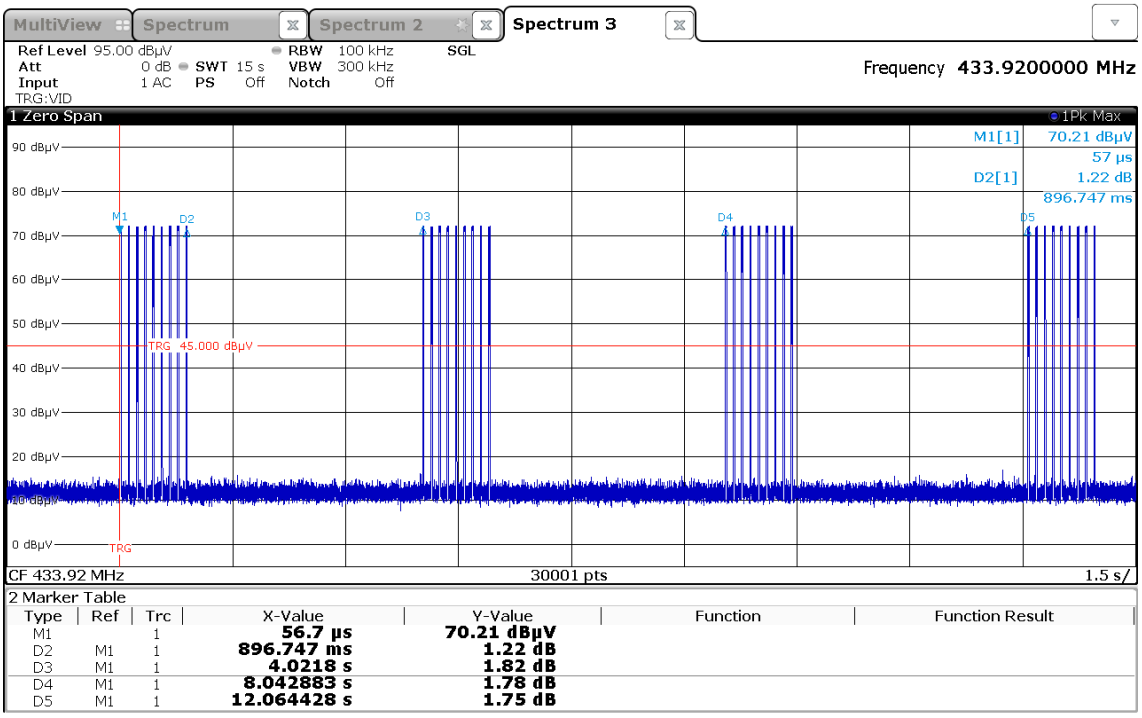
2 Marker Table

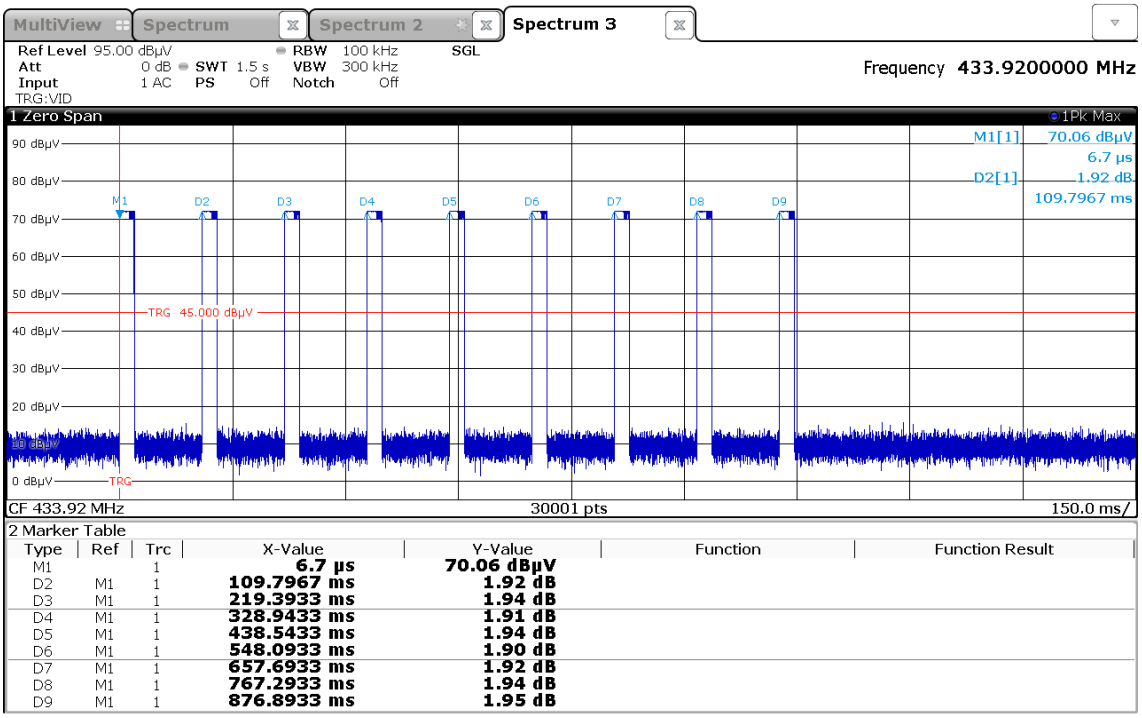
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**6.67 µs**	**69.65 dBµV**		
D2	M1	1	**19.79667 ms**	**-0.45 dB**		
D3	M1	1	**100.0 ms**	**-64.91 dB**		
D4	M1	1	**109.73333 ms**	**-0.10 dB**		
D5	M1	1	**129.53333 ms**	**-0.49 dB**		

FCC ID: 2AUZ3030198 IC: 25799-030198

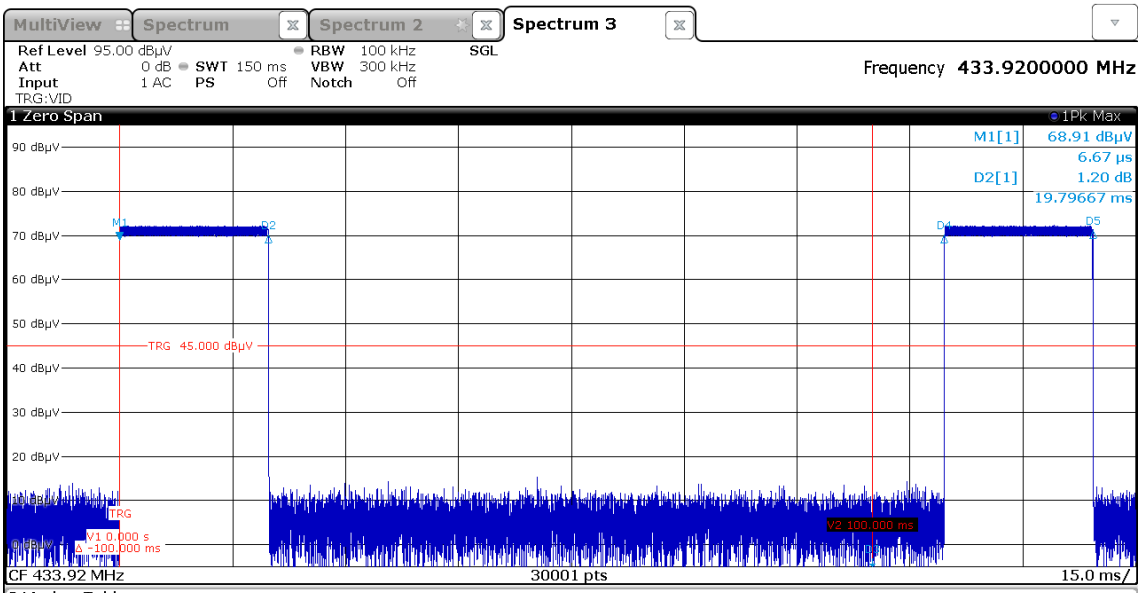
5.4.9 Test protocol – 433.92 MHz (alarm mode)

Correction for pulse operation (duty cycle)





FCC ID: 2AUZ3030198 **IC: 25799-030198**



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**6.67 µs**	**68.91 dBµV**		
D2	M1	1	**19.79667 ms**	**1.20 dB**		
D3	M1	1	**100.0 ms**	**-75.08 dB**		
D4	M1	1	**109.58333 ms**	**1.17 dB**		
D5	M1	1	**129.37833 ms**	**2.16 dB**		

FCC ID: 2AUZ3030198 IC: 25799-030198

5.5 Emission bandwidth and OBW99

For test instruments and accessories used see section 6 Part **MB**.

5.5.1 Description of the test location

Test location: Shielded Room S4

5.5.2 Photo documentation of the test set-up – see ATTACHMENT B

5.5.3 Applicable standard

According to FCC Part 15C, Section 15.231(c) and RSS-210, Section A.1.3:

5.5.4 Description of Measurement

In accordance to ANSI C63.10, Item 6.9.

Analyser settings:
Span: 500 kHz, RBW: 3 kHz VBW: 10 kHz Detector: max. peak

5.5.5 Test result

Typical transmission

Fundamental frequency (MHz)	20 dB bandwidth *f1* (MHz)	20 dB bandwidth *f2* (MHz)	Emission bandwidth (kHz)	Limit (kHz)
315.00	314.9373	315.0552	117.9	787.5

Fundamental frequency (MHz)	99% bandwidth *f1* (MHz)	99% bandwidth *f2* (MHz)	Occupied bandwidth (kHz)	Limit (kHz)
315.00	314.9289	315.0625	133.6	787.5

Alarm mode

Fundamental frequency (MHz)	20 dB bandwidth *f1* (MHz)	20 dB bandwidth *f2* (MHz)	Emission bandwidth (kHz)	Limit (kHz)
315.00	314.9373	315.0553	118.0	787.5

Fundamental frequency (MHz)	99% bandwidth *f1* (MHz)	99% bandwidth *f2* (MHz)	Occupied bandwidth (kHz)	Limit (kHz)
315.00	314.9289	315.0624	133.5	787.5

FCC ID: 2AUZ3030198 IC: 25799-030198

Typical transmission

Fundamental frequency (MHz)	20 dB bandwidth *f1* (MHz)	20 dB bandwidth *f2* (MHz)	Emission bandwidth (kHz)	Limit (kHz)
433.92	433.8539	433.9721	118.2	1084.8

Fundamental frequency (MHz)	99% bandwidth *f1* (MHz)	99% bandwidth *f2* (MHz)	Occupied bandwidth (kHz)	Limit (kHz)
433.92	433.8459	433.9794	133.5	1084.8

Alarm mode

Fundamental frequency (MHz)	20 dB bandwidth *f1* (MHz)	20 dB bandwidth *f2* (MHz)	Emission bandwidth (kHz)	Limit (kHz)
433.92	433.8539	433.9723	118.4	1084.8

Fundamental frequency (MHz)	99% bandwidth *f1* (MHz)	99% bandwidth *f2* (MHz)	Occupied bandwidth (kHz)	Limit (kHz)
433.92	433.8460	433.9795	133.6	1084.8

Limit according to FCC Part 15C, Section 15.231(c) and RSS-210, Section A.1.3:

Frequency (MHz)	The bandwidth limit dependent of the carrier (%)
70 – 900	0.25
above 900	0.50

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 (OBW 99%) down from the modulated carrier.

The requirements are **FULFILLED.**

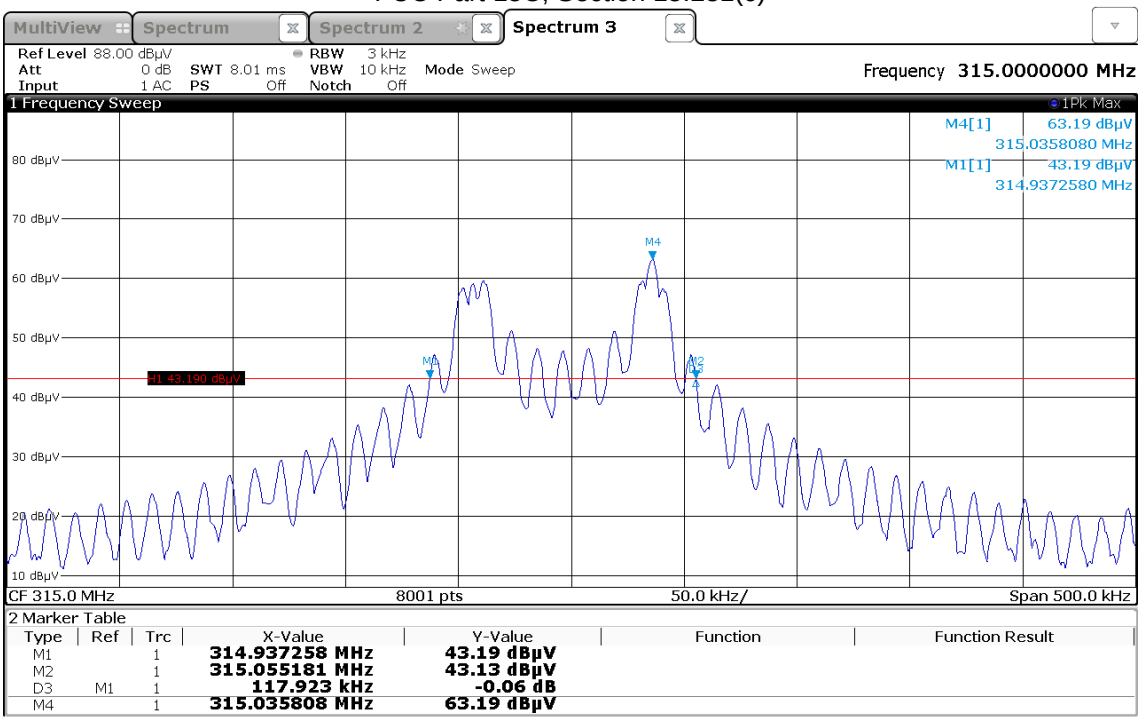
Remarks: For detailed test results please see the following test protocols.

FCC ID: 2AUZ3030198 IC: 25799-030198

5.5.6 Test protocol – 315 MHz (typical)

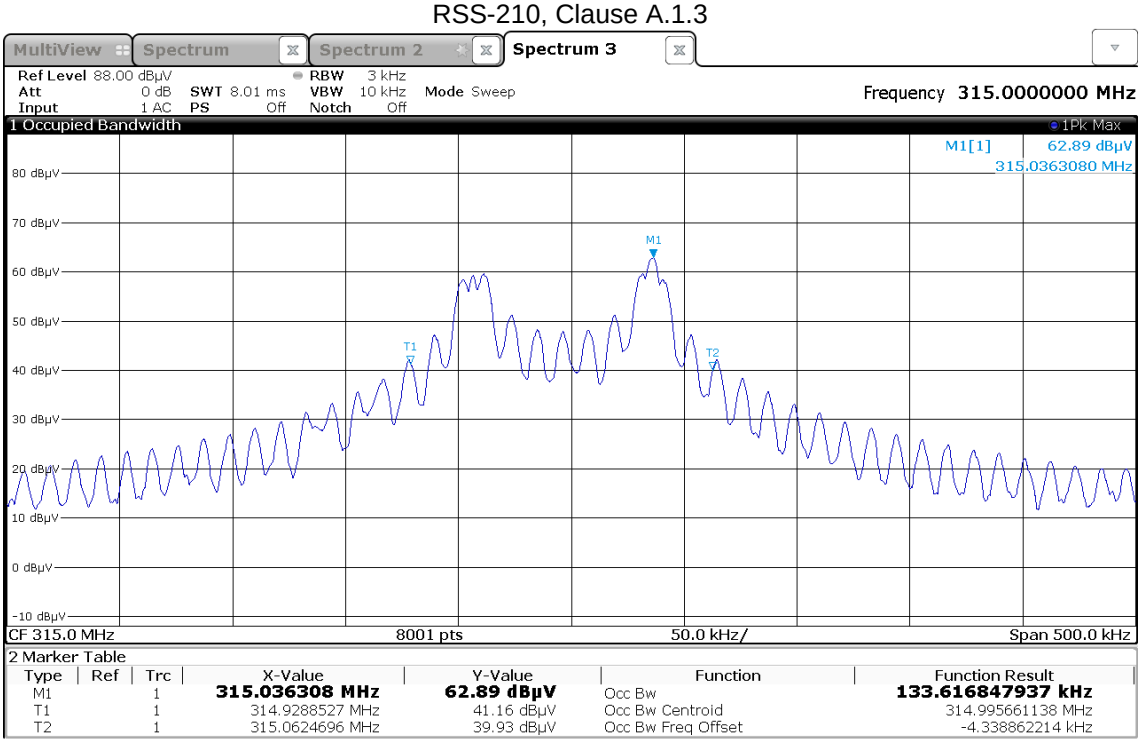
Emission bandwidth

FCC Part 15C, Section 15.231(c)



Emission bandwidth

RSS-210, Clause A.1.3

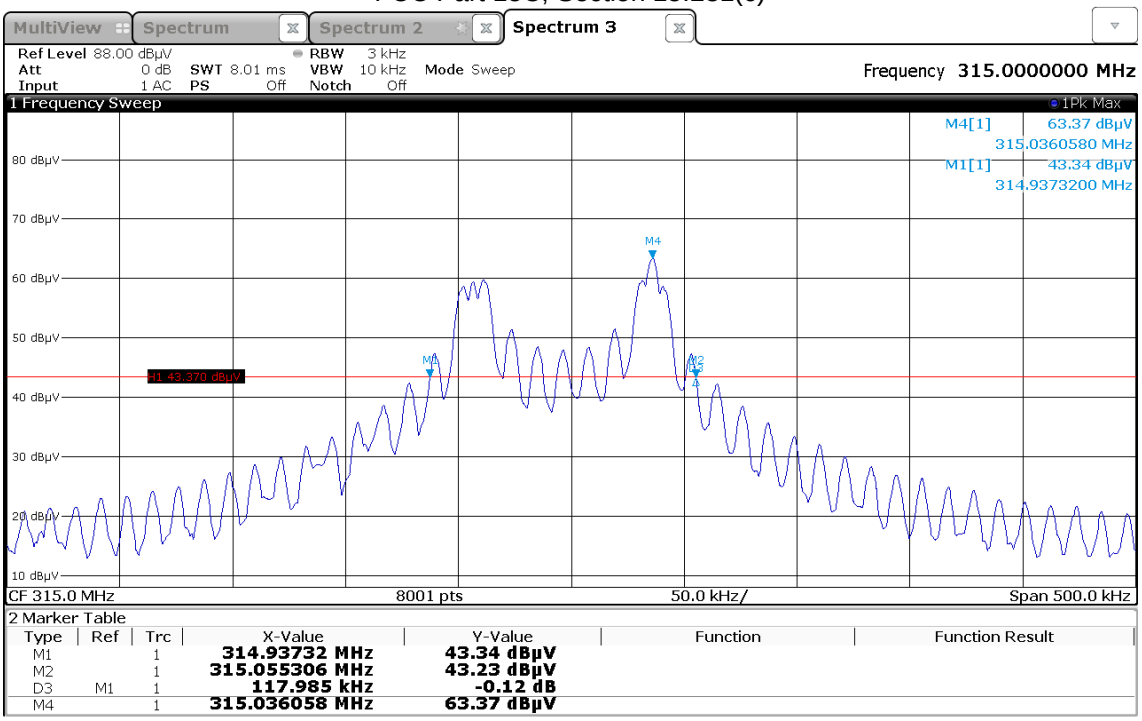


FCC ID: 2AUZ3030198 IC: 25799-030198

5.5.7 Test protocol – 315 MHz (alarm mode)

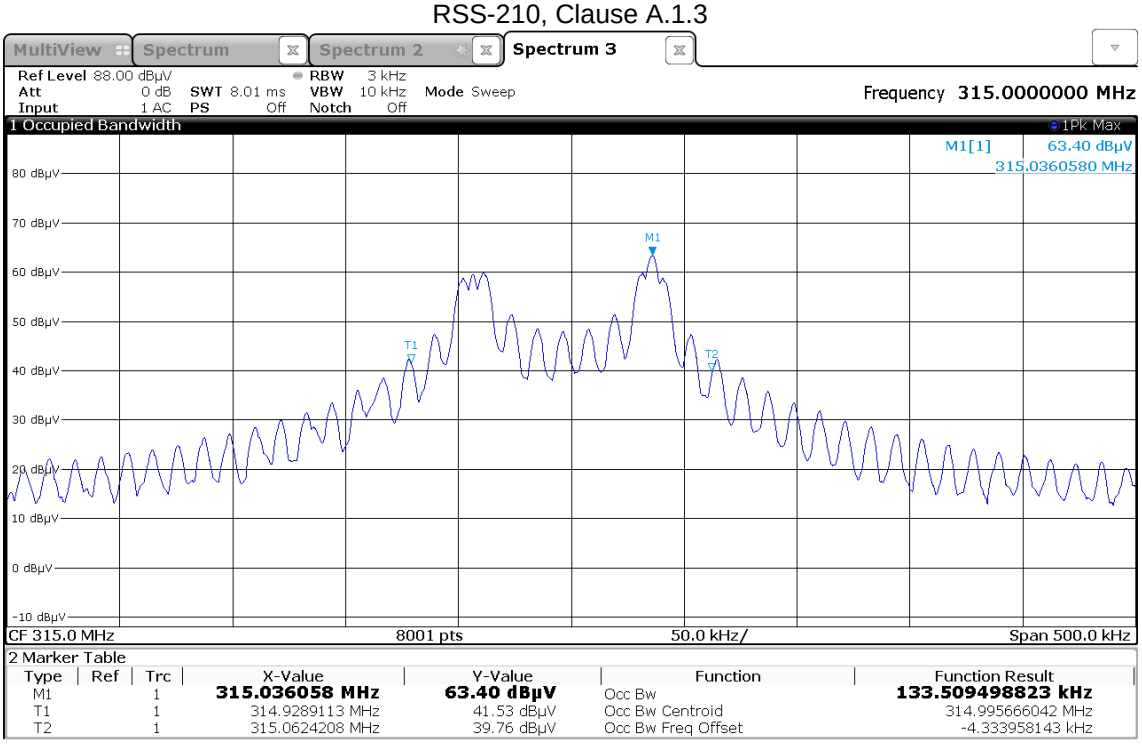
Emission bandwidth

FCC Part 15C, Section 15.231(c)



Emission bandwidth

RSS-210, Clause A.1.3

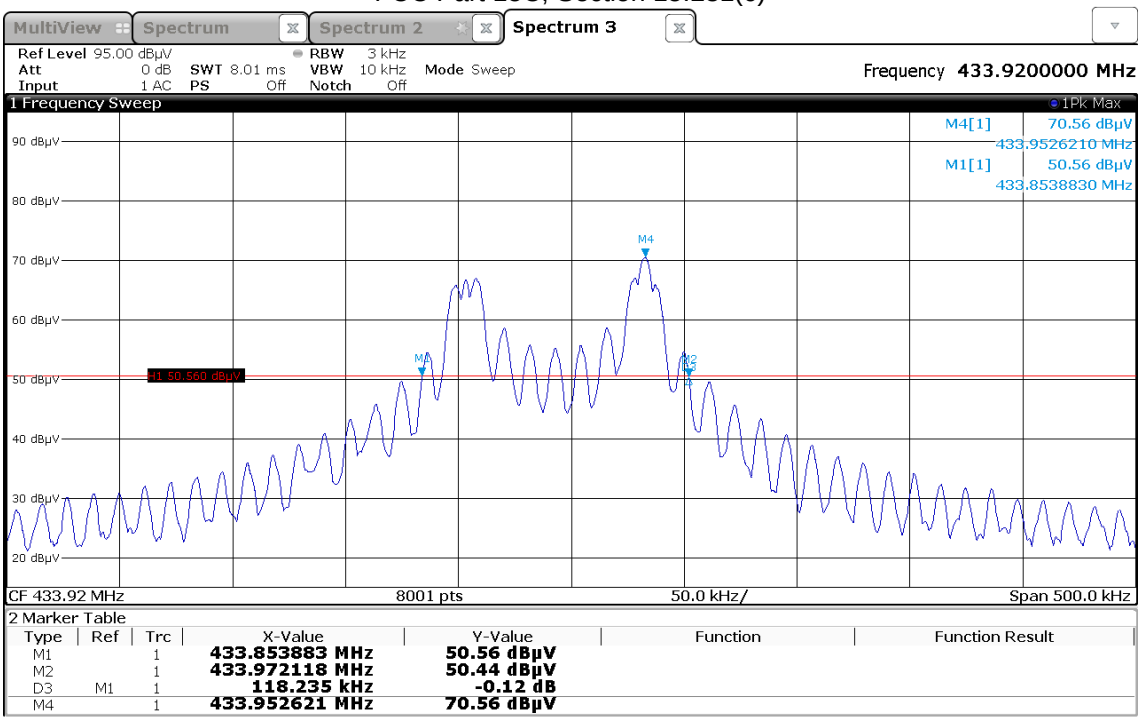


FCC ID: 2AUZ3030198 **IC: 25799-030198**

5.5.8 Test protocol – 433.92 MHz (typical)

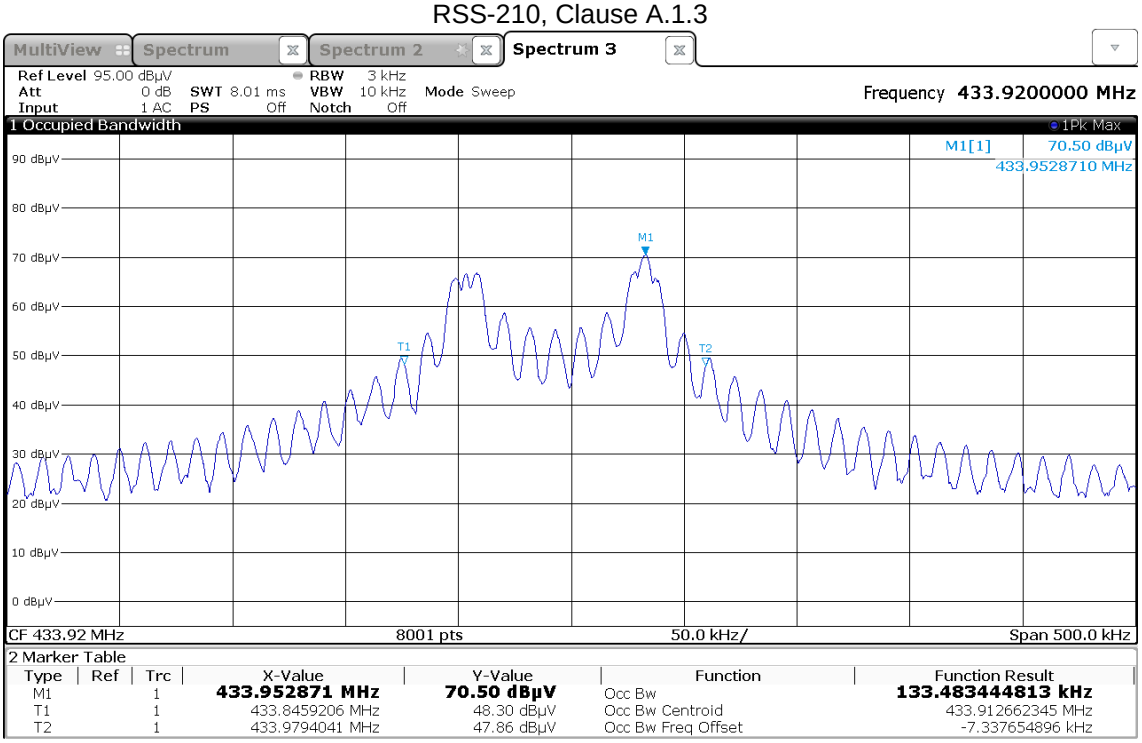
Emission bandwidth

FCC Part 15C, Section 15.231(c)



Emission bandwidth

RSS-210, Clause A.1.3

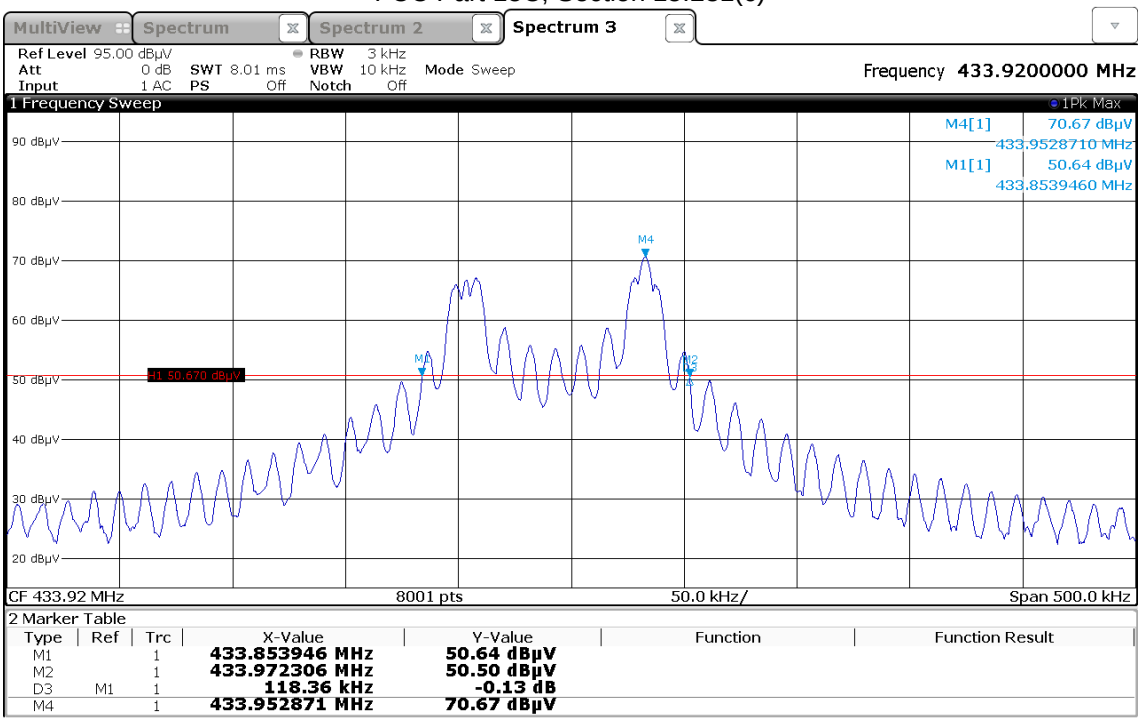


FCC ID: 2AUZ3030198 IC: 25799-030198

5.5.9 Test protocol – 433.92 MHz (alarm mode)

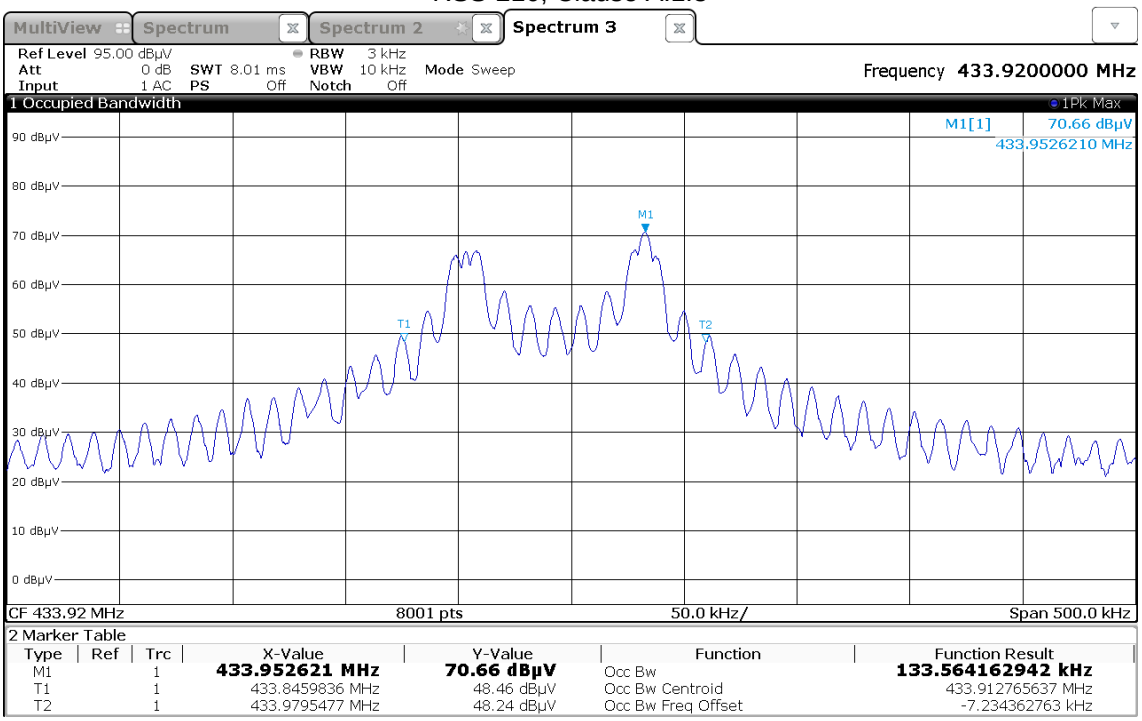
Emission bandwidth

FCC Part 15C, Section 15.231(c)



Emission bandwidth

RSS-210, Clause A.1.3



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5.6 On / Off Period – Typical transmission

For test instruments and accessories used see section 6 Part **MB**.

5.6.1 Description of the test location

Test location: Shielded room S4

5.6.2 Photo documentation of the test set-up – see ATTACHMENT B

5.6.3 Applicable standard

According to FCC Part 15C, Section 15.231(e) and RSS-210, Section A.1.1 (c) and A.1.4 (b):

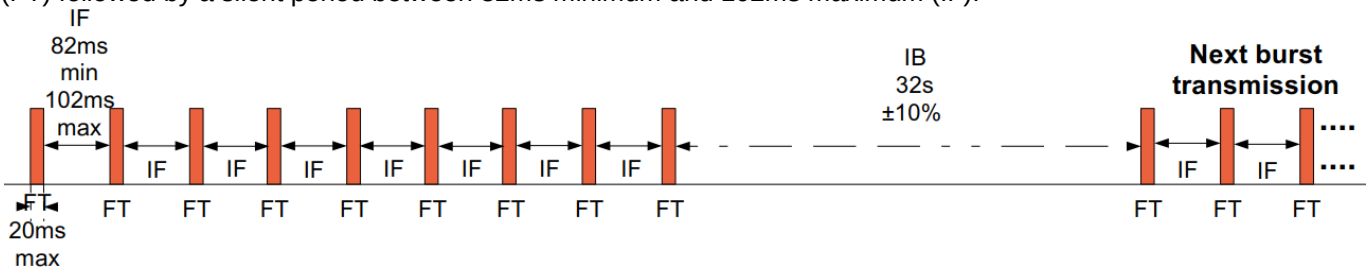
5.6.4 Description of Measurement

The duration of transmission is measured with the spectrum analyzer. The sweep points were set to maximum for higher the time resolution. The signal is modulated; the marker of the analyzer is set to maximum amplitude at normal temperature and zero span. The analyser was set to single sweep and triggered on the button, the marker was set to the edges in order to measure the duration time and then recorded.

5.6.5 Test result

Typical transmission:

RF burst emissions are periodic, they are composed of 9 frames with a maximum transmission on time of 20ms (FT) followed by a silent period between 82ms minimum and 102ms maximum (IF).



Each burst are followed by a minimum silent period of 32 seconds ±10% (IB) before the next burst transmission.

Typical transmission for 315.00 MHz and 433.92 MHz:

Frequency (MHz)	Duration of transmission (ms)	Limit (s)
315.00	896.84	<1.0
433.92	896.84	<1.0

Frequency (MHz)	Silent period (s)	Limit (s)
315.00	31.28	>10.0
433.92	31.28	>10.0

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Limit according to FCC Part 15C, Section 15.231(e):

In addition, 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.

Limit according to RSS-210, Section A.1.4(b):

In addition, 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.

The requirements are **FULFILLED.**

Remarks: For detailed test results, please see clause 5.5.6 and 5.5.8.

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5.7 On / Off Period – Alarm mode

For test instruments and accessories used see section 6 Part **MB**.

5.7.1 Description of the test location

Test location: Shielded Room S4

5.7.2 Photo documentation of the test set-up – see ATTACHMENT B

5.7.3 Applicable standard

According to FCC Part 15C, Section 15.231(a)(4) and RSS-210, Section A.1.1 (c)(d):

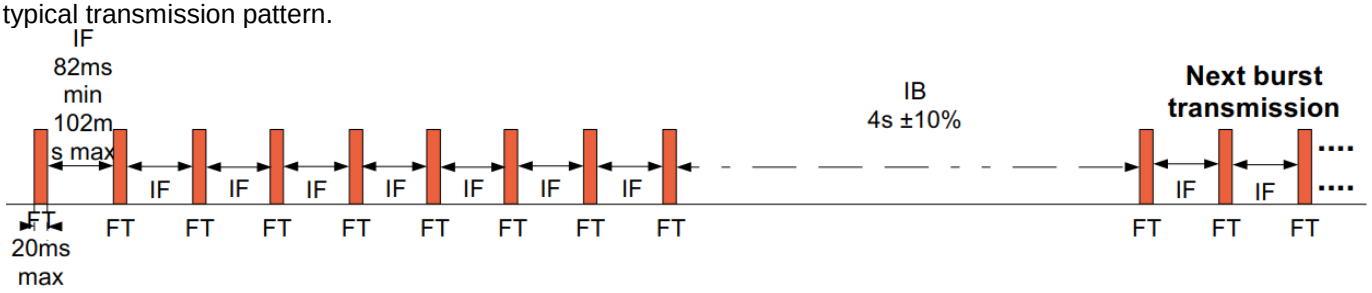
5.7.4 Description of Measurement

The duration of transmission is measured with the spectrum analyser. The sweep points were set to maximum for higher the time resolution. The signal is modulated; the marker of the analyser is set to maximum amplitude at normal temperature and zero span. The analyser is set to single sweep and triggered on the button; the marker was set to the edges in order to measure the duration time and than recorded.

5.7.5 Test result

Alarm mode:

When an alarm pressure pneumatic appears (puncture) the following pattern is transmitted:
8 burst emissions are transmitted, they are composed of 9 frames with a maximum transmission on time of 20ms (FT) followed by a silent period between 82ms minimum and 102ms maximum (IF).
Time between each burst (IB) is about 4s ±10%.
Once the eight burst sent the sensor mode switch automatically and the emission becomes consistent with the typical transmission pattern.



Alarm mode:

Frequency (MHz)	Duration of transmission (ms)
315.00	896.44
433.92	896.69

Frequency (MHz)	Silent period (s)
315.00	3.10
433.92	3.12

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Limit according to FCC Part 15C, Section 15.231(a)(4):

Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

Limit according to RSS-210, Section A.1.1 (d):

Intentional radiators used for radio control during emergencies involving fire, security of goods (e.g. burglar alarms) and safety-of-life, when activated to signal an alarm, may operate during the interval of the alarm condition.

The requirements are **FULFILLED.**

Remarks: For detailed test results, please see clause 5.5.7 and 5.5.9.

In the case of an emergency condition (rapid pressure loss), the devise will transmit tire pressure and temperature information throughout the duration of the condition.

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6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
CPR 2	ESR 7	02-02/03-17-001	29/07/2022	29/07/2021		
	VULB 9168	02-02/24-05-005	18/12/2021	18/12/2020	07/07/2022	07/07/2021
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
	50F-003 N 3 dB	02-02/50-21-010				
DC	TEM-Cell 01	01-02/24-01-012				
	ESW26	02-02/03-17-002	10/02/2022	10/02/2021		
MB	TEM-Cell 01	01-02/24-01-012				
	ESW26	02-02/03-17-002	10/02/2022	10/02/2021		
SER 1	ESR 7	02-02/03-17-001	29/07/2022	29/07/2021		
	HFH 2 - Z 2	02-02/24-05-020	17/07/2023	17/07/2020	30/06/2022	30/06/2021
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 2	ESR 7	02-02/03-17-001	29/07/2022	29/07/2021		
	VULB 9168	02-02/24-05-005	18/12/2021	18/12/2020	07/07/2022	07/07/2021
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
	50F-003 N 3 dB	02-02/50-21-010				
SER 3	FSW43	02-02/11-21-001	08/04/2022	08/04/2021		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	28/06/2022	28/06/2021		
	WHJS 1000-10EF	02-02/50-13-003				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
	BAT-EMC 3.20.0.23	02-02/68-13-001				