TEST REPORT

Part 15 Subpart C 15.231 & RSS-210 (Issue 10)

Equipment under test	Remote Keyless Entry Transmitter
Model name	MBEC7FOB2208
FCC ID	NYOMBEC7FOB2208
IC number	3109A-MBEC7FOB228
Applicant	MOBASE ELECTRONICS CO., LTD.
Manufacturer	MOBASE ELECTRONICS CO., LTD.
Date of test(s)	2022.05.23 ~ 2022.05.27
Date of issue	2022.05.30

Issued to
MOBASE ELECTRONICS CO., LTD.
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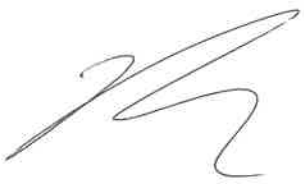
Test and report completed by :	**Report approval by :**
	
Gu-Bong, Kang Test engineer	Yeong-Jun, Cho Technical manager

This test report is not related to KS Q ISO/IEC 17025 and KOLAS.

Revision history

Revision	Date of issue	Test report No.	Description
-	2022.05.30	KES-RF1-22T0048	Initial

TABLE OF CONTENTS

1. General information

Applicant:	MOBASE ELECTRONICS CO., LTD.
Applicant address:	100, Saneop-ro, 156beon-gil, Gwonseon-gu, Suwon-si, Gyeonggi-do, South Korea
Test site:	KES Co., Ltd.
Test site address:	☐ 3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea ☒ 473-29, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea
Test Facility	FCC Accreditation Designation No.: KR0100, Registration No.: 444148 ISED Registration No.: 23298
FCC rule part(s):	15.231
IC rule part(s):	RSS-210
FCC ID:	NYOMBEC7FOB2208
IC number:	3109A-MBEC7FOB228
Test device serial No.:	☒ Production ☐ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test	Remote Keyless Entry Transmitter
Frequency range	433.92 ㎒
Model	MBEC7FOB2208
Modulation technique	FSK
Number of channels	433.92 ㎒ : 1ch
Antenna specification	Antenna type: Loop antenna, Peak gain: -20 ㏈i
Power source	DC 3.0 V (Battery)
H/W Version	V1.0
S/W Version	V1.0

1.2. Test configuration

The **MOBASE ELECTRONICS CO., LTD. // Remote Keyless Entry Transmitter // MBEC7FOB2208 // FCC ID: NYOMBEC7FOB2208 // IC number : 3109A-MBEC7FOB228** was tested according to the specification of EUT, the EUT must comply with following standards and KDB documents.

FCC Subpart C 15.231
RSS-GEN (Issue 5)
RSS-210 (Issue 10)
KDB 558074 D01 V05r02
ANSI C63.10-2013

1.3. Device modifications

N/A

1.4. Derivation model information

N/A

1.5. Frequency/channel operations

Ch.	Frequency (㎒)
01	433.92

2. Summary of tests

Section in FCC Part 15	Section in RSS-210 & Gen	Parameter	Test results
15.209(a) 15.231(b)	RSS-210 Annex A.1.2 (a), (b)	Radiated emission, Spurious emission and Field Strength of Fundamental	Pass
15.231(c)	RSS-210 Annex A.1.3	Bandwidth of operation frequency	Pass
15.231(a)	RSS-210 Annex A.1.1 (a)	Transmission time	Pass
15.207(a)	RSS-Gen 8.8	AC conducted emissions	N/A[1)]

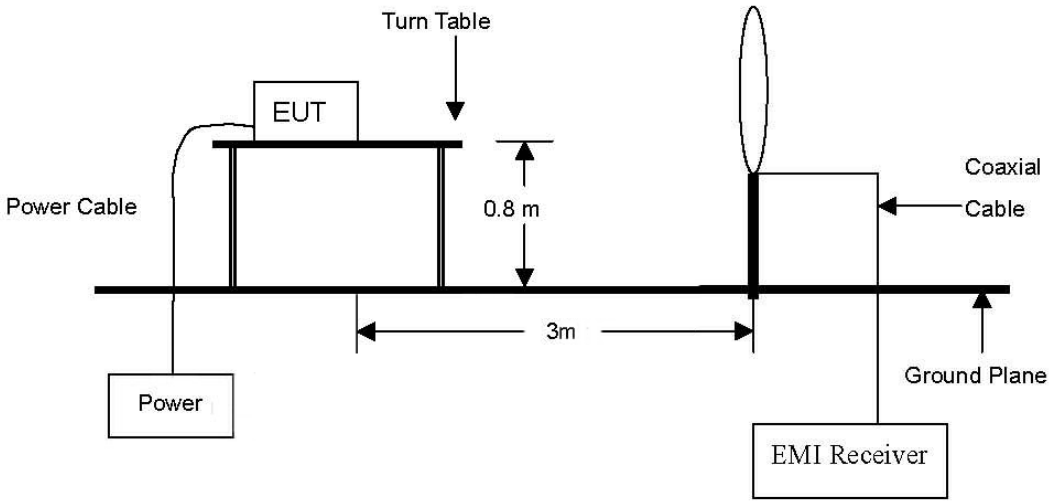
Note.
1. This product is powered by battery.

3. Test results

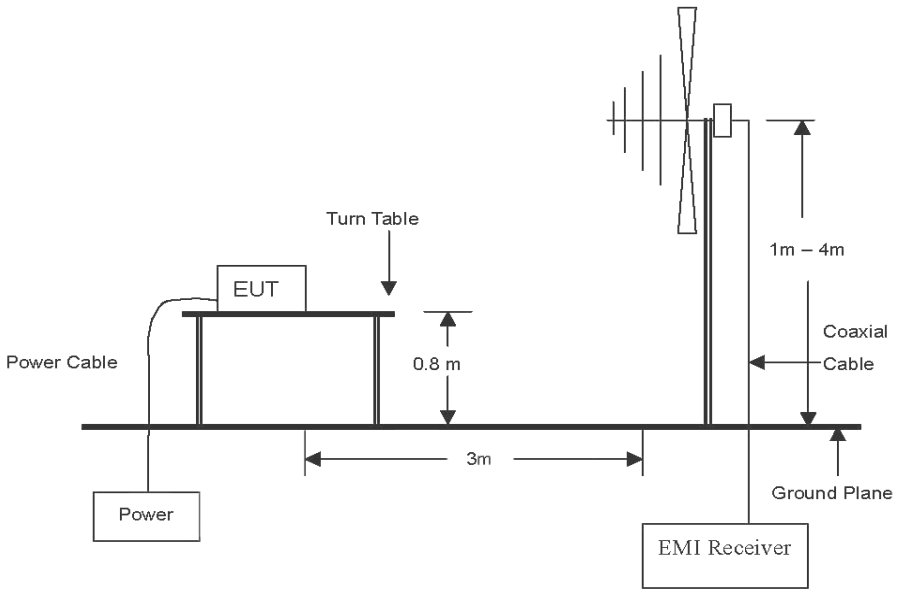
3.1. Field strength of fundamental and the field strength of spurious emission

Test setup

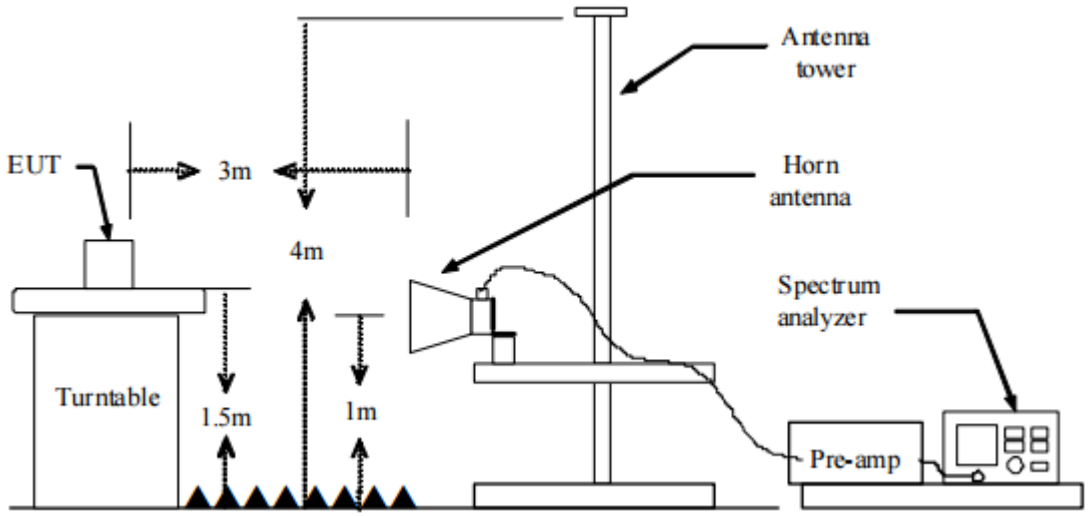
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to the tenth harmonic of the highest fundamental frequency or to 40 ㎓ emissions, whichever is lower.



Test procedure below 30 ㎒

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum hold mode.

Test procedure above 30 ㎒

1. Spectrum analyzer settings for f < 1 ㎓:
   ① Span = wide enough to fully capture the emission being measured
   ② RBW = 100 ㎑
   ③ VBW ≥ RBW
   ④ Detector = Peak detection (PK) or Quasi-peak detection (QP)
   ⑤ Sweep time = auto
   ⑥ Trace = max hold
2. Spectrum analyzer settings for f ≥1 ㎓: Peak
   ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
   ② RBW = 1 ㎒
   ③ VBW ≥ 3 ㎒
   ④ Detector = peak
   ⑤ Sweep time = auto
   ⑥ Trace = max hold
   ⑦ Trace was allowed to stabilize

Note.

1. f<30 ㎒, extrapolation factor of 40 ㏈/decade of distance. $F_d = 40\log(D_m/Ds)$
   f ≥30 ㎒, extrapolation factor of 20 ㏈/decade of distance. $F_d = 20\log(D_m/Ds)$
   Where:
   F_d = Distance factor in ㏈
   D_m = Measurement distance in meters
   D_s = Specification distance in meters
2. CF(Correction factors(㏈)) = Antenna factor(㏈/m) + Cable loss(㏈) + or Amp. gain(㏈) + or F_d(㏈)
3. Field strength(㏈㎶/m) = Level(㏈㎶) + CF (㏈) + or DCF(㏈)
4. Margin(㏈) = Limit(㏈㎶/m) - Field strength(㏈㎶/m)
5. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z, it was determined that **X orientation** was worst-case orientation; therefore, all final radiated testing was performed with the EUT in **X orientation.**
6. The emissions are reported however whose levels were not within 20 ㏈ of respective limits were not reported.

Limit

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (㎒)	Distance (Meters)	Radiated (㎶/m)
0.009 ~ 0.490	300	2400/F(㎑)
0.490 ~ 1.705	30	24000/F(㎑)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 ~ 72 ㎒, 76 ~ 88 ㎒, 174 ~ 216 ㎒ or 470 ~ 806 ㎒. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

According to 15.231(b), in addition to the provisions of section 15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (㎒)	Field strength of fundamental (microvolts / meter)	Field strength of spurious emission (microvolts / meter)
40.66 ~ 40.70	2,250	225
70 ~ 130	1,250	125
130 ~ 174	1,250 to 3,750**	125 to 375**
174 ~ 260	3,750	375
260 ~ 470	3,750 to 12,500**	375 to 1,250**
Above 470	12,500	1,250

**Where F is the frequency in ㎒, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130 ~ 174 ㎒, ㎶/m at 3 meters = 56.81818(F) – 6136.3636; for the band 260 ~ 470 ㎒, ㎶/m at 3 meters = 41.6667(F) – 7083.333. The maximum permitted unwanted emission level is 20 ㏈ below the maximum permitted fundamental level.

According to RSS-Gen, Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emissi on.

Frequency (㎒)	Distance (Meters)	Radiated (㎶/m)
0.009 – 0.490 Note 1	6.37/F (F in kHz)	300
0.490 – 1.705	63.7/F (F in kHz)	30
1.705 - 30	0.08	30
30 ~ 88	3	100
88 ~ 216	3	150
216 ~ 960	3	200
Above 960*	3	500

Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

According to RSS-210 A1.2, The field strength of emissions from momentarily operated intentional radiators shall not exceed the limits in table A1, based on the average value of the measured emiss ions. The requirements of the "Pulsed operation" section of RSS-Gen apply for averaging pulsed em issions and limiting peak emissions.
Alternatively, compliance with the limits in table A1 may be demonstrated using an International Sp ecial Committee on Radio Interference (CISPR) quasi-peak detector.

Frequency (㎒)	Distance (Meters)	Radiated (㎶/m)
70-130	30	1 250
130-174	3	1 250 to 3 750
174-260**	3	3 750
260-470**	3	3 750 to 12 500*
Above 470	3	12 500

* Linear interpolation with frequency, f, in MHz:
For 130-174 MHz: Field Strength (μV/m) = (56.82 x f)-6136
For 260-470 MHz: Field Strength (μV/m) = (41.67 x f)-7083

** Frequency bands 225-328.6 MHz and 335.4-399.9 MHz are designated for the exclusive use of t he Government of Canada. Manufacturers should be aware of possible harmful interference and degr adation of their licence-exempt radio equipment in these frequency bands.

Field strength

Test results

Mode: FSK

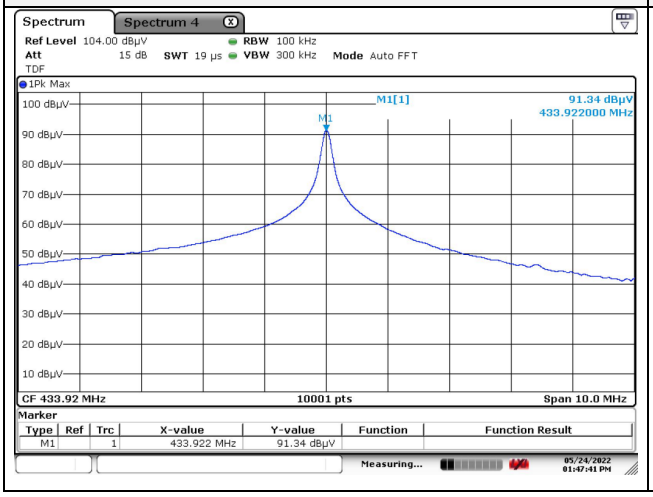
Distance of measurement: 3 meter

Channel: 1

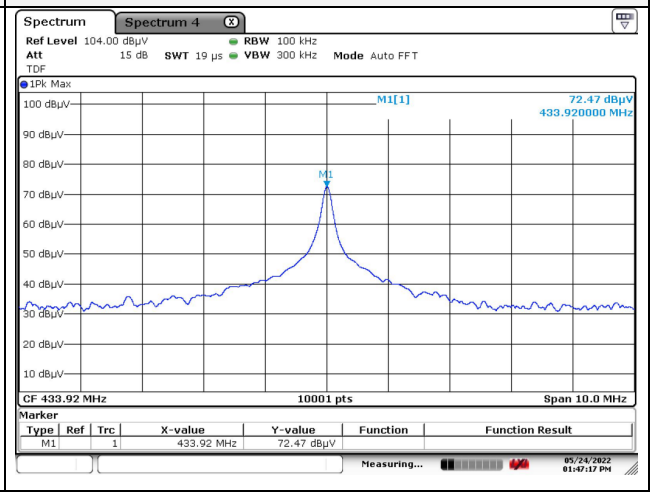
Frequency (㎒)	Level (dB㎶)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
433.92	91.34	Peak	H	-15.22	-	76.12	100.83	24.71
		Average	H	-15.22	-30.10	46.02	80.83	34.81
433.92	72.47	Peak	V	-15.22	-	57.25	100.83	43.58
		Average	V	-15.22	-30.10	27.15	80.83	53.68

Test plots

Horizontal // Peak



Vertical // Peak



Note.

1. 3m Average Limit(dB㎶/m) = 20log[41.6667($F_{(㎒)}$-7083.3333) = 80.83
   3m Peak Limit(dB㎶/m) = Average limit + 20 = 100.83
   Average Field strength = Peak Field strength + Duty Cycle Correction Factor
2. Duty Cycle Correction Factor : 20log(Ton / 100 ms) = 20log(3.127 / 100) = -30.10
   $Tx_{\text{on time}}$ = 3.127 ms
   $Tx_{\text{on+off}}$ ≥ 100 ms (pulse train is 100 ms)
3. Tests were performed only on the worst axis.

Spurious emission

Test results (Below 30 ㎒)

Mode: FSK

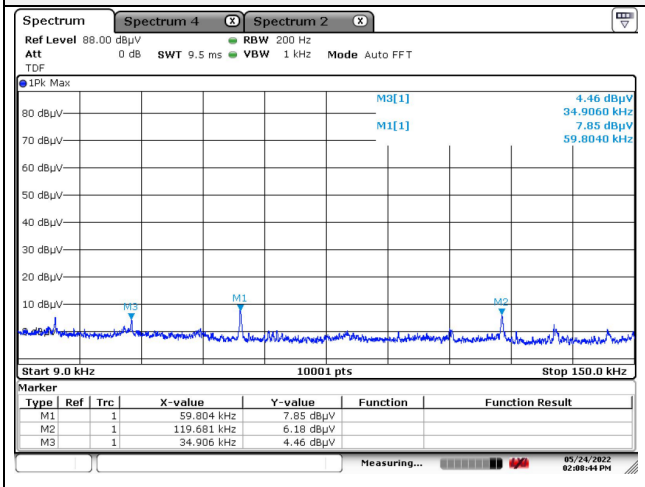
Distance of measurement: 3 meter

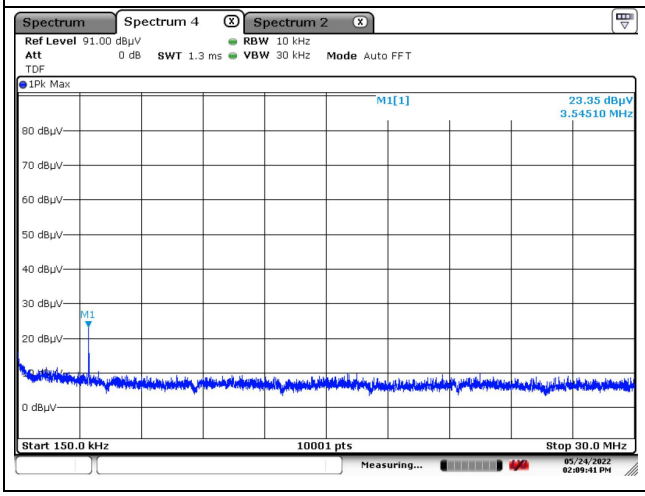
Channel: 1

Frequency (㎒)	Level (dBμV)	Ant. Pol. (H/V)	CF (dB)	Fd (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
No spurious emissions were detected within 20 dB of the limit							

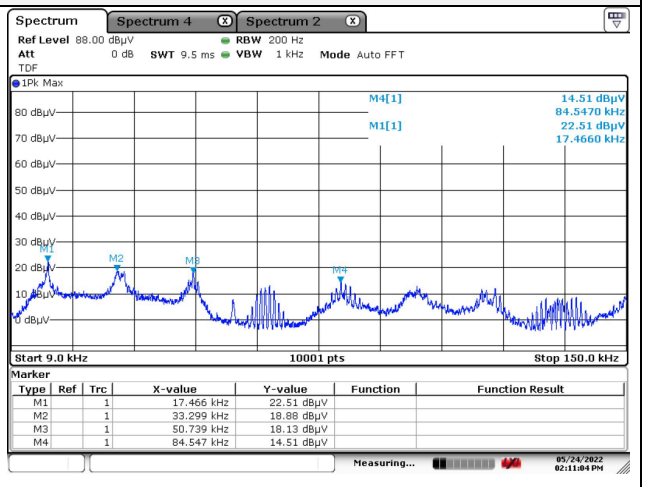
Test plots (Below 30 ㎒)

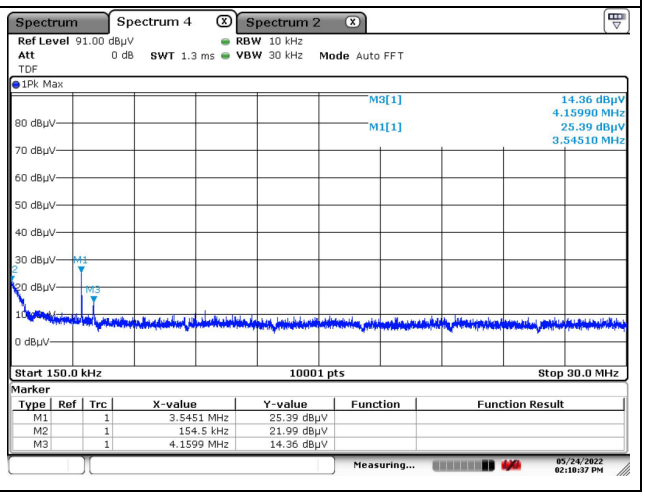
Horizontal





Vertical





Test results (Below 1 000 ㎒)

Mode: FSK

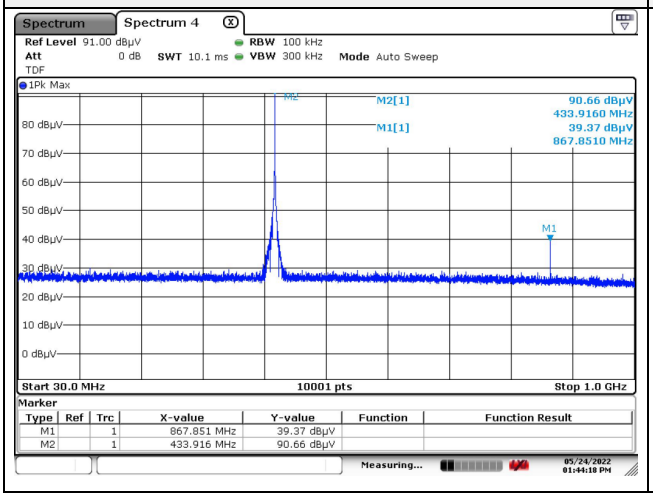
Distance of measurement: 3 meter

Channel: 1

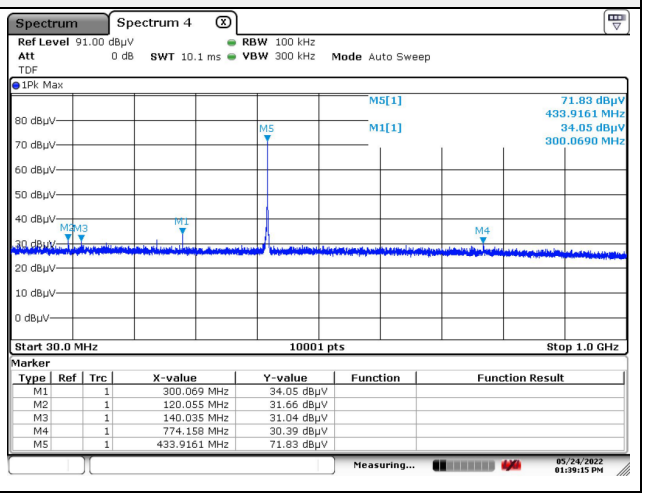
Frequency (㎒)	Level (dB㎶)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
120.055	31.66	Peak	V	-22.33	-	9.33	43.52	34.19
140.035	31.04	Peak	V	-23.95	-	7.09	43.52	36.43
300.069	34.05	Peak	V	-18.12	-	15.93	46.02	30.09
774.158	30.39	Peak	V	-9.64	-	20.75	46.02	25.27
867.851	39.37	Peak	H	-7.92	-	31.45	46.02	14.57

Test plots (Below 1 000 ㎒)

Horizontal



Vertical



Test results (Above 1 000 ㎒)

Mode: FSK

Distance of measurement: 3 meter

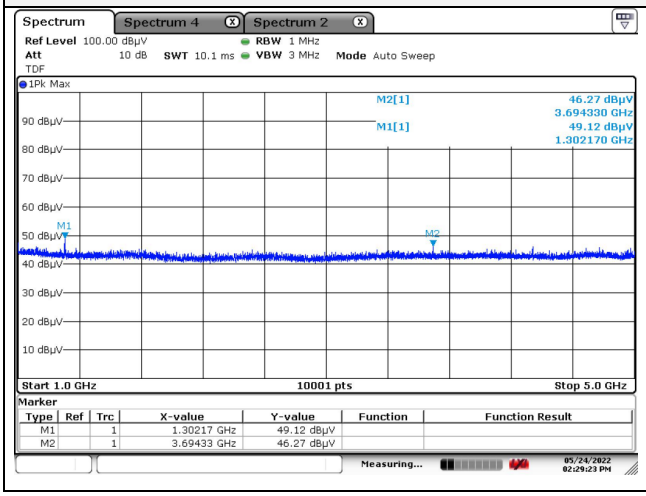
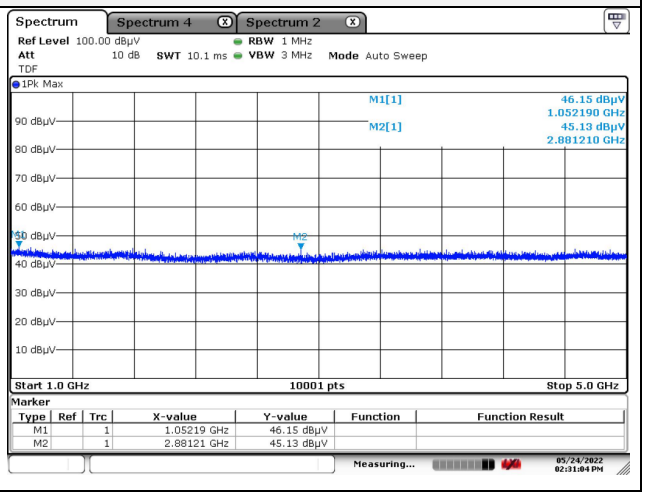
Channel: 1

Frequency (㎒)	Level (dB㎶)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*1052.19	46.15	Peak	V	-10.88	-	42.17	74.00	31.83
*1302.17	49.12	Peak	H	-10.45	-	43.04	74.00	30.96
*2881.21	45.13	Peak	V	-10.37	-	42.46	74.00	31.54
*3694.33	46.27	Peak	H	-10.28	-	41.69	74.00	32.31

Note.

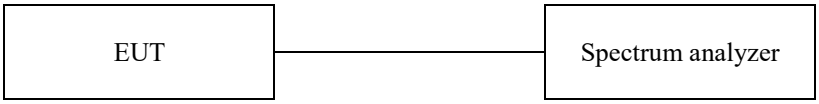
1. 3m PeakLimit(dB㎶/m) = 20log[41.6667($F_{(㎒)}$-7083.3333) = 80.83
   3m Average Limit(dB㎶/m) = Peak limit - 20 = 60.83
   Average Field strength = Peak Field strength + Duty Cycle Correction Factor
2. Correction Factors = Antenna Factor + Cable Loss + Amp.Gain
3. "*"means the restricted band.
4. Average test would not be applied if the peak results were lower than the average limit.
5. Duty Cycle Correction Factor : 20log(Ton / 100 ms) = 20log(3.127 / 100) = -30.10
   $Tx_{\text{on time}}$ = 3.127 ms
   $Tx_{\text{on+off}} \geq$ 100 ms (pulse train is 100 ms)

Test plots (Above 1 000 ㎒)

Horizontal	Vertical
	

3.2. Bandwidth of operation frequency

Test setup



Test procedure

1. Use the following spectrum analyzer setting
2. RBW = 10 ㎑
3. VBW = 30 ㎑ (≥ RBW)
4. Span = 1 ㎒
5. Detector function = peak
6. Trace = max hold

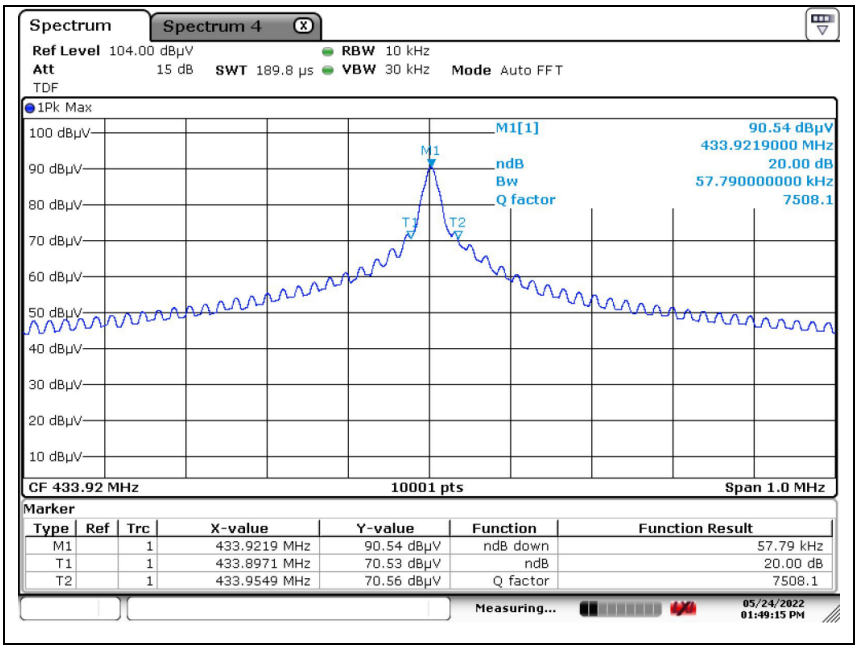
Limit

According to 15.231(c), The bandwidth of the emissions shall be no wider than 0.25 % of the center frequency for devices operating above 70 ㎒ and below 900 ㎒. Bandwidth is determined at the points 20 ㏈ down from the modulated carrier.

According to RSS-210 Annex A.1.3, The occupied bandwidth of momentarily operated devices shall be less than or equal to 0.25% of the centre frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the occupied bandwidth shall be less than or equal to 0.5% of the centre frequency.

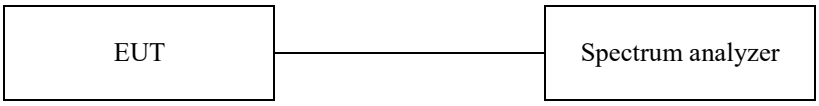
Test results

Frequency(㎒)	Bandwidth(㎑)	Limit (㎑)
433.92	57.79	1 084.80



3.3. Transmission time

Test setup



Test procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW=100 ㎑, VBW=100 ㎑, Span=0 ㎐.

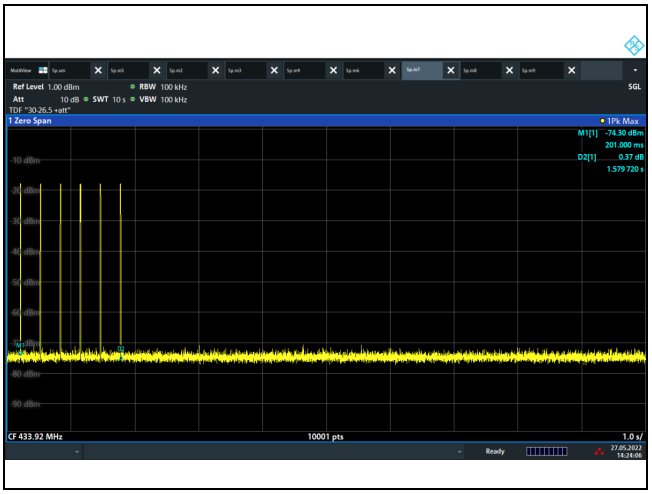
Limit

According to 15.231(a), A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

According to RSS-210 Annex A1.1 (a), A manually operated transmitter shall be equipped with a push-to-operate switch and be under manual control at all times during transmission. When released, the transmitter shall cease transmission within no more than 5 seconds of being released.

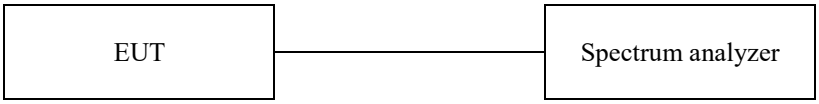
Test results

Frequency(㎒)	Transmission time (ms)	Limit (s)
433.92	201.000	Same or less than 5



3.4. Duty cycle correction factor

Test setup



Test procedure

1. The transmitter output is connected to the spectrum analyzer.
2. Set center frequency of spectrum analyzer = operating frequency.
3. Set the spectrum analyzer as RBW=100 ㎑, VBW=100 ㎑, Span=0 ㎐ and Sweep time =100 ㎳.

Limit

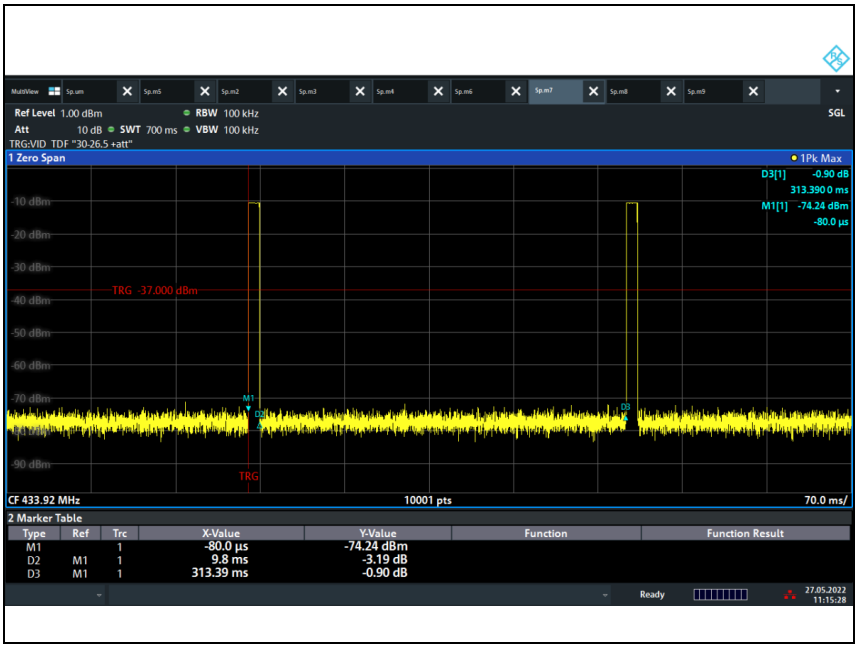
None (No dedicated Limit specified in the Rules)

Test results

Duty Cycle Correction Factor : 20log(Ton / 100 ms) = 20log(3.127 / 100) = -30.10

Tx $_{\text{on time}}$ = 3.127 ms

Tx $_{\text{on+off}}$ ≥ 100 ms (pulse train is 100 ms)



Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due
Spectrum analyzer	R&S	FSV3044	101272	1 year	2023.03.14
Spectrum Analyzer	R&S	FSV40	101725	1 year	2022.06.18
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2023.01.14
DC Power Supply	SORENSEN	DCS40-75E	1408A02745	1 year	2022.06.21
Attenuator	Mini-Circuits	BW-S10-2W263+	3	1 year	2023.01.17
Attenuator	HUBER+SHHNER	6806.17.A	NONE	1 year	2023.04.01
Loop Antenna	Schwarzbeck	FMZB1513	225	2 years	2023.01.18
BILOG ANTENNA	Schwarzbeck	VULB 9168	9168-461	2 years	2022.12.22
Horn Antenna	A.H	SAS-571	414	1 year	2023.01.18
Amplifier	SONOMA INSTRUMENT	310N	401123	1 year	2022.06.07
PREAMPLIFIER	HP	8449B	3008A00538	1 year	2022.06.21

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
-	-	-	-