FCC Test Report

FCC ID	:	**2AJ4H-T816**
Equipment	:	**TPMS Sensor**
Model No.	:	**TIY-081006**
Brand Name	:	**TYC-TIY**
Applicant	:	**I YUAN PRECISION INDUSTRIAL CO., LTD.**
Address	:	**NO.24, Dinghu Rd., Guishan Dist., Taoyuan City 33378, Taiwa(R.O.C.)**
Standard	:	**47 CFR FCC Part 15.231**
Received Date	:	**Oct. 30, 2019**
Tested Date	:	**Nov. 22 ~ Nov. 26, 2019**

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by: **Approved by:**

Along Chen / Assistant Manager **Gary Chang / Manager**

Testing Laboratory 2732

Table of Contents

1 GENERAL DESCRIPTION 5

1.1 Information 5
1.2 Local Support Equipment List 6
1.3 Test Setup Chart 6
1.4 The Equipment List 7
1.5 Test Standards 8
1.6 Deviation from Test Standard and Measurement Procedure 8
1.7 Measurement Uncertainty 8

2 TEST CONFIGURATION 9

2.1 Testing Condition 9
2.2 The Worst Test Modes and Channel Details 9

3 TRANSMITTER TEST RESULTS 10

3.1 Radiated Emission 10
3.2 Transmission and Deactivation Time 41
3.3 20dB and Occupied Bandwidth 54

4 TEST LABORATORY INFORMATION 59

Release Record

Report No.	Version	Description	Issued Date
FR9O3002	Rev. 01	Initial issue	Apr. 29, 2020

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	AC Power Line Conducted Emissions	Note[1]	N/A
15.231(b)	Field Strength of Fundamental emissions	Meet the requirement of limit	Pass
15.231(b) 15.209	Unwanted Emissions	Meet the requirement of limit	Pass
15.231(a)	Transmission and Deactivation Time	Meet the requirement of limit	Pass
15.231(c)	20dB bandwidth	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass
N/A means Not Applicable. Note[1]: The EUT consumes DC power from battery, so the test is not required.			

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information				
Frequency Range (MHz)	**Modulation**	**Ch. Freq. (MHz)**	**Channel Number**	**Channel Bandwidth (kHz)**
315	ASK	315	1	---
315	FSK	315	1	---
433	ASK	433	1	---
433	FSK	433	1	---
Note: The device supports below 3 modes: 1) Rotating mode 2) Stationary mode 3) Alert mode				

1.1.2 Antenna Details

Ant. No.	Type	Gain (dBi)	Connector
1	Monopole	---	---

1.1.3 EUT Operational Condition

Power Supply Type	3Vdc from battery

1.1.4 Accessories

Accessories		
No.	**Equipment**	**Description**
1	Battery	Brand: maxell Model: CR2450W Power Rating: 3Vdc

1.2 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Remarks
1	315MHz controller	---	TIY tool	---	provided by applicant

1.3 Test Setup Chart

Test Setup Diagram

1.4 The Equipment List

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101498	Dec. 27, 2018	Dec. 26, 2019
Receiver	R&S	ESR3	101658	Dec. 11, 2018	Dec. 10, 2019
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Jul. 12, 2019	Jul. 11, 2020
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 18, 2018	Dec. 17, 2019
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 15, 2019	Nov. 14, 2020
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 13, 2019	Nov. 12, 2020
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 07, 2019	Oct. 06, 2020
Preamplifier	EMC	EMC02325	980225	Jul. 09, 2019	Jul. 08, 2020
Preamplifier	Agilent	83017A	MY39501308	Oct. 08, 2019	Oct. 07, 2020
Preamplifier	EMC	EMC184045B	980192	Aug. 01, 2019	Jul. 31, 2020
RF Cable	EMC	EMC104-SM-SM-8000	181106	Oct. 07, 2019	Oct. 06, 2020
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Oct. 07, 2019	Oct. 06, 2020
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Oct. 07, 2019	Oct. 06, 2020
LF cable 1M	EMC	EMCCFD400-NM-NM-1000	160502	Oct. 07, 2019	Oct. 06, 2020
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Oct. 07, 2019	Oct. 06, 2020
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-002	Oct. 07, 2019	Oct. 06, 2020
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.231
ANSI C63.10-2013

1.6 Deviation from Test Standard and Measurement Procedure

None

1.7 Measurement Uncertainty

The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty	
Parameters	**Uncertainty**
Radiated emission ≤ 1GHz	±3.41dB
Radiated emission > 1GHz	±4.59 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
Radiated Emissions	03CH01-WS	22-24°C / 64-66%	Aska Huang
RF Conducted	TH01-WS	22°C / 63%	Aska Huang

- FCC Designation No.: TW2732
- FCC site registration No.: 181692
- ISED#: 10807A
- CAB identifier: TW2732

2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Test Configuration
Field Strength of Fundamental emissions	ASK, FSK	315 433	a
Unwanted Emissions	ASK, FSK	315 433	a
Deactivation Time	ASK, FSK	315 433	a / b / c
20dB bandwidth	ASK, FSK	315 433	a

Note:

1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **X-plane** results were found as the worst case and were shown in this report.
2. Three test configurations are listing as follows:
   Configuration a: Rotating mode.
   Configuration b: Stationary mode.
   Configuration c: Alert mode.
3. The output power of above 3 configurations is same thus only one mode (Configuration a) is selected to perform emission and 20 dB bandwidth test item.

3 Transmitter Test Results

3.1 Radiated Emission

This section includes field strength of fundamental, field strength of harmonics and emissions radiated outside of the operating frequency bands.

3.1.1 Limit of field strength of fundamental and field strength of harmonics

Fundamental Frequency (MHz)	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
40.66~40.70	1000	100
70 -130	500	50
130 -174	500 to 1500 Note	50 to 150 Note
174 -260	1500	150
260 -470	1500 to 5000 Note	150 to 500 Note
above 470	5000	500
Note: Linear interpolations.		

3.1.2 Limit of Unwanted Emissions

The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

Radiated emission limits			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit
Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.1.3 Test Procedures

1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

1. Radiated emission below 1GHz
120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission
2. Radiated emission Peak value for harmonics
RBW=1MHz, VBW=1/T and Peak detector
3. Radiated emission Peak value for fundamental
RBW=1MHz, VBW=1/T and Peak detector

   Radiated emission Average value for field strength of fundamental and harmonics
   The average value is: Average = Peak value + 20log(Duty cycle) Where the duty factor is calculated from following formula:

4. 315MHz ASK mode

$$20\log(\text{Duty cycle}) = 20\log\frac{32.043\text{ms}}{100\text{ ms}} = -9.89\text{dB}$$

Please see page 19 for plotted duty

315MHz FSK mode

$$20\log(\text{Duty cycle}) = 20\log\frac{15.072\text{ms}}{100\text{ ms}} = -16.44\text{dB}$$

Please see page 26 for plotted duty

433.92MHz ASK mode

$$20\log(\text{Duty cycle}) = 20\log\frac{31.884\text{ms}}{100\text{ ms}} = -9.93\text{dB}$$

Please see page 33 for plotted duty

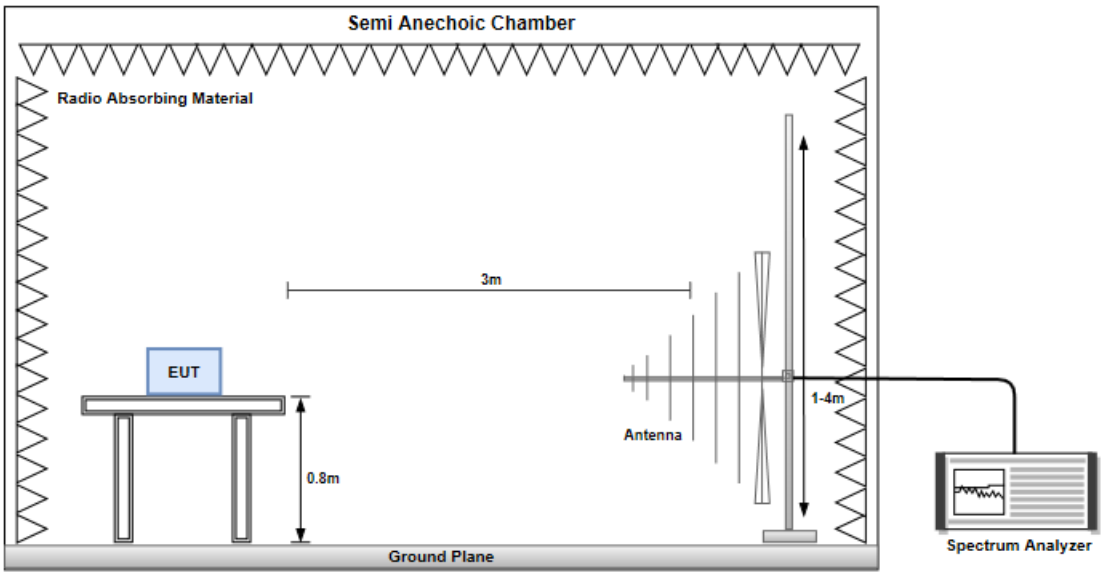
433.92MHz FSK mode

$$20\log(\text{Duty cycle}) = 20\log\frac{15.217\text{ ms}}{100\text{ ms}} = -16.35\text{dB}$$

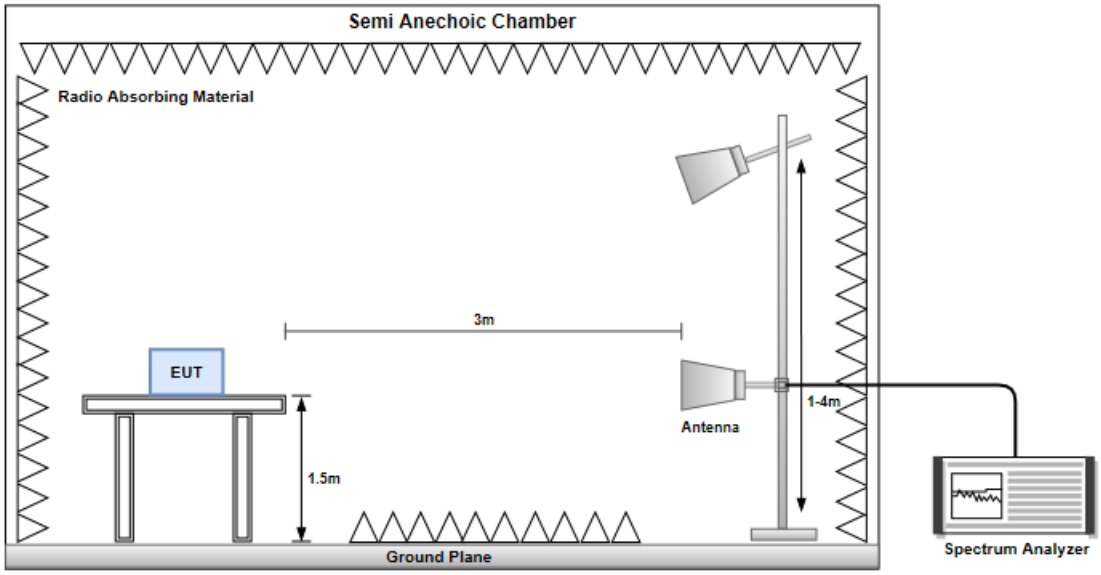
Please see page 40 for plotted duty

3.1.4 Test Setup

Radiated Emissions below 1 GHz



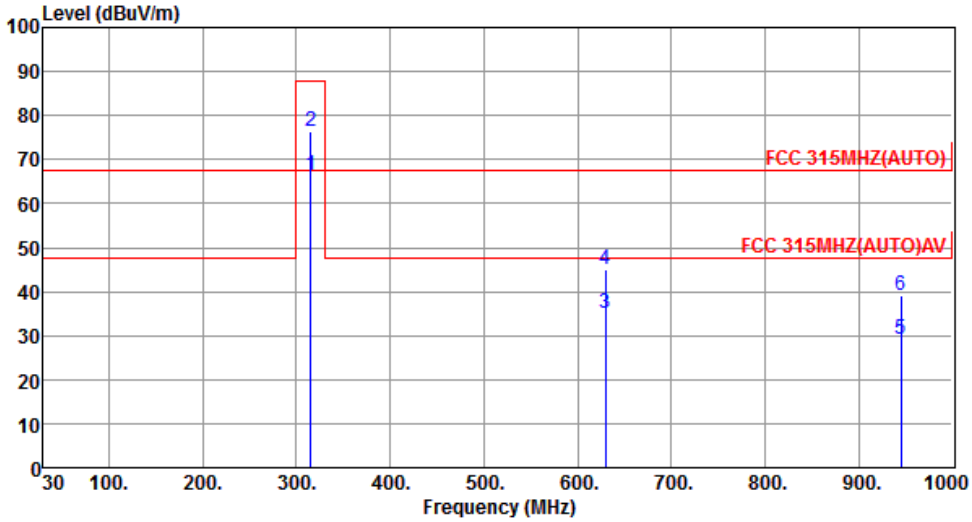
Radiated Emissions above 1 GHz



ASK mode_315MHz

3.1.5 Transmitter Field strength of fundamental emissions and harnonics

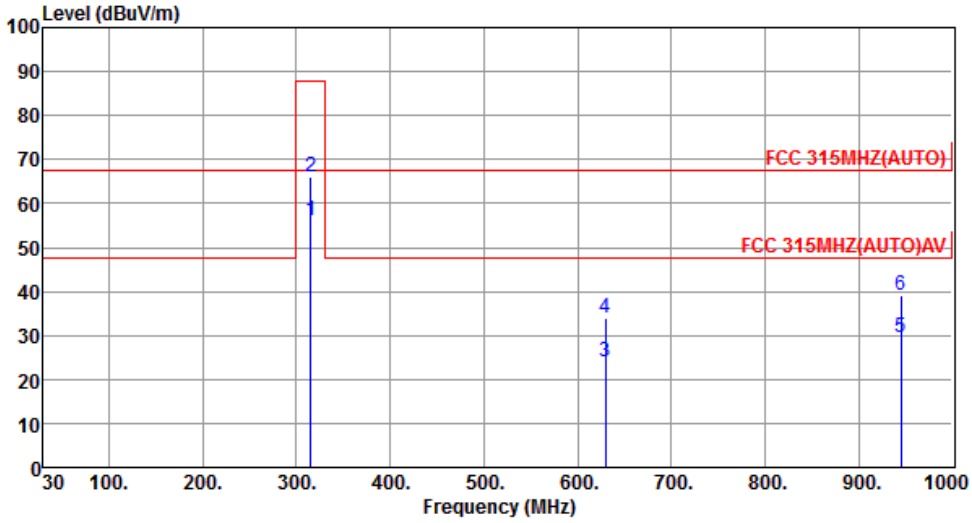
Modulation	ASK	Test Freq. (MHz)	315
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	315.00	66.35	67.66	-1.31	73.87	-7.52	Average	100	254
2	315.00	76.24	87.66	-11.42	83.76	-7.52	Peak	100	254
3	630.00	35.02	47.66	-12.64	35.48	-0.46	Average	116	269
4	630.00	44.91	67.66	-22.75	45.37	-0.46	Peak	116	269
5	945.00	29.15	47.66	-18.51	24.47	4.68	Average	100	306
6	945.00	39.04	67.66	-28.62	34.36	4.68	Peak	100	306

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	ASK	Test Freq. (MHz)	315
Polarization	Vertical		

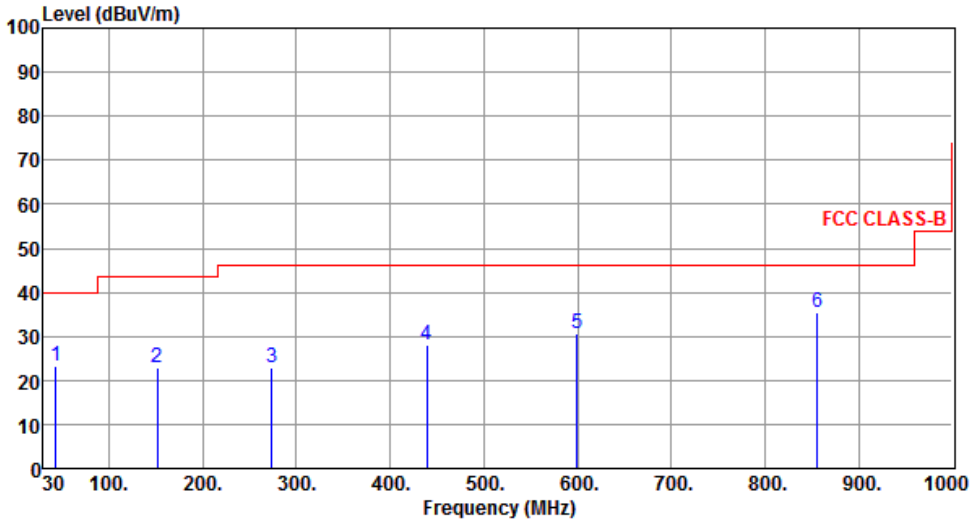


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	315.00	56.11	67.66	-11.55	63.63	-7.52	Average	135	48
2	315.00	66.00	87.66	-21.66	73.52	-7.52	Peak	135	48
3	630.00	24.13	47.66	-23.53	24.59	-0.46	Average	100	115
4	630.00	34.02	67.66	-33.64	34.48	-0.46	Peak	100	115
5	945.00	29.38	47.66	-18.28	24.70	4.68	Average	100	47
6	945.00	39.27	67.66	-28.39	34.59	4.68	Peak	100	47

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.1.6 Transmitter Radiated Unwanted Emissions (Below 1GHz)

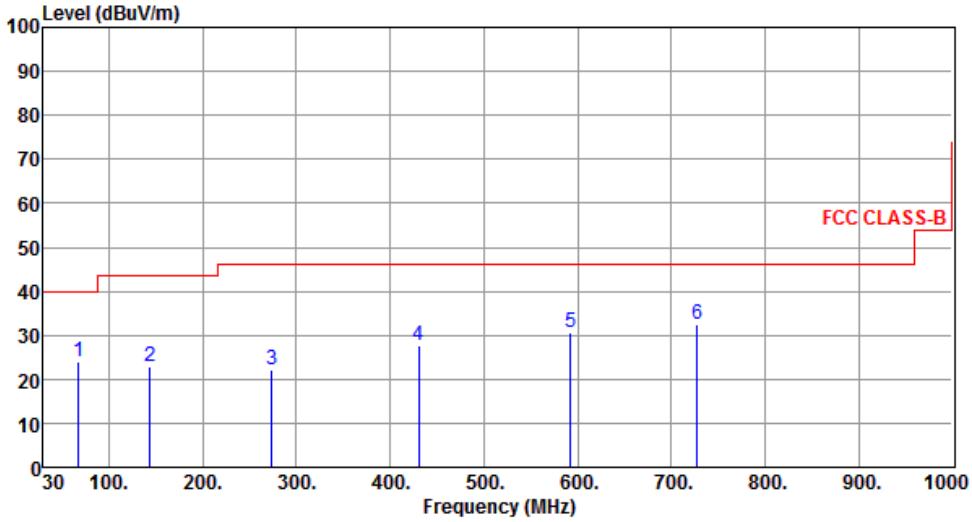
Modulation	ASK	Test Freq. (MHz)	315
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	43.58	23.17	40.00	-16.83	31.39	-8.22	Peak	---	---
2	151.25	22.88	43.50	-20.62	31.25	-8.37	Peak	---	---
3	273.47	23.05	46.00	-22.95	31.92	-8.87	Peak	---	---
4	439.34	27.90	46.00	-18.10	32.24	-4.34	Peak	---	---
5	599.39	30.60	46.00	-15.40	31.58	-0.98	Peak	---	---
6	855.47	35.54	46.00	-10.46	32.39	3.15	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation	ASK	Test Freq. (MHz)	315
Polarization	Vertical		

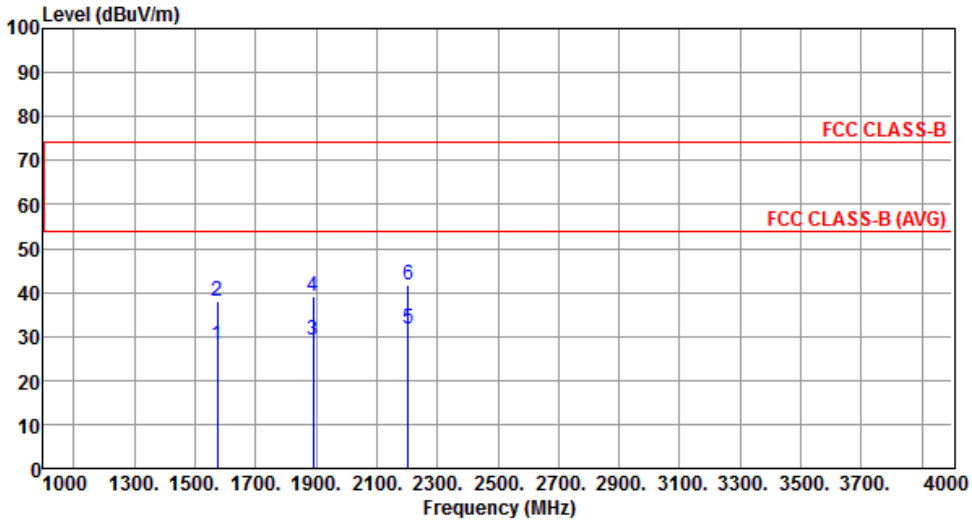


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	67.83	24.09	40.00	-15.91	34.05	-9.96	Peak	---	---
2	143.49	23.06	43.50	-20.44	31.66	-8.60	Peak	---	---
3	273.47	22.11	46.00	-23.89	30.98	-8.87	Peak	---	---
4	430.61	27.83	46.00	-18.17	32.47	-4.64	Peak	---	---
5	592.60	30.45	46.00	-15.55	31.63	-1.18	Peak	---	---
6	727.43	32.60	46.00	-13.40	31.58	1.02	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

3.1.7 Transmitter Radiated Unwanted Emissions (Above 1GHz)

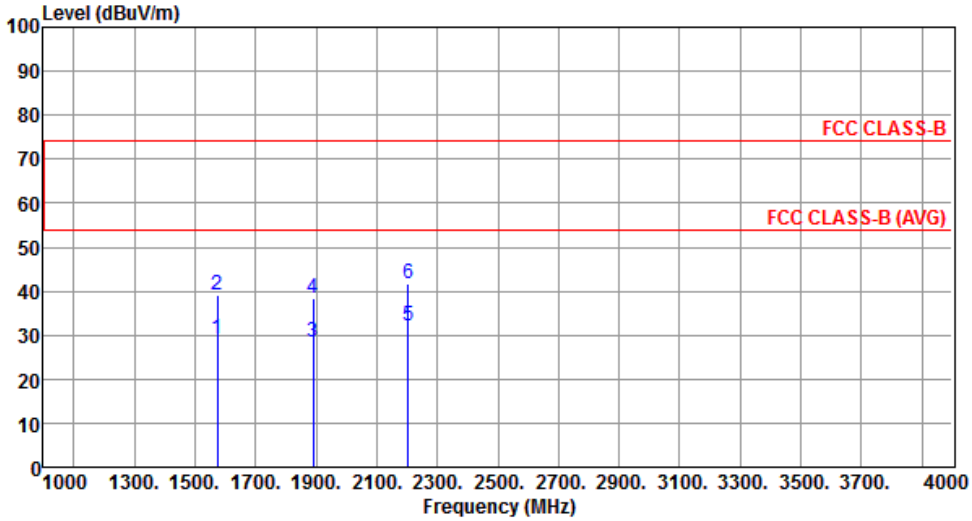
Modulation	ASK	Test Freq. (MHz)	315
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1575.00	28.21	54.00	-25.79	34.88	-6.67	Average	100	25
2	1575.00	38.10	74.00	-35.90	44.77	-6.67	Peak	100	25
3	1890.00	29.18	54.00	-24.82	35.06	-5.88	Average	100	72
4	1890.00	39.07	74.00	-34.93	44.95	-5.88	Peak	100	72
5	2205.00	31.67	54.00	-22.33	34.32	-2.65	Average	100	255
6	2205.00	41.56	74.00	-32.44	44.21	-2.65	Peak	100	255

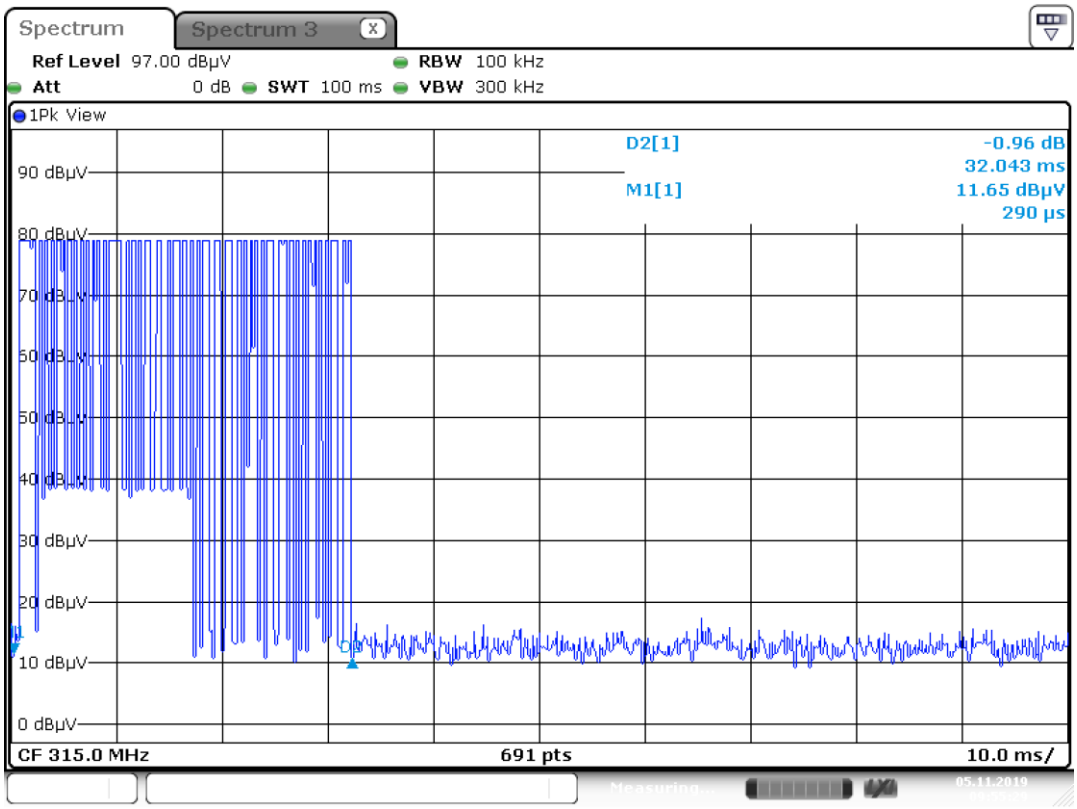
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	ASK	**Test Freq. (MHz)**	315
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1575.00	29.05	54.00	-24.95	35.72	-6.67	Average	100	334
2	1575.00	38.94	74.00	-35.06	45.61	-6.67	Peak	100	334
3	1890.00	28.59	54.00	-25.41	34.47	-5.88	Average	100	121
4	1890.00	38.48	74.00	-35.52	44.36	-5.88	Peak	100	121
5	2205.00	31.92	54.00	-22.08	34.57	-2.65	Average	100	260
6	2205.00	41.81	74.00	-32.19	44.46	-2.65	Peak	100	260

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

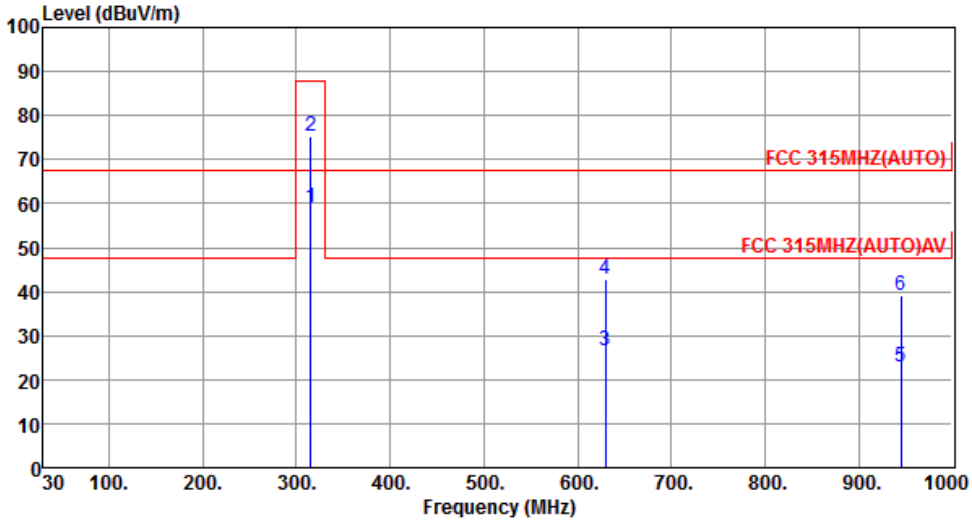


$$20\log(\text{Duty cycle}) = 20\log\frac{32.043\text{ms}}{100\text{ ms}} = -9.89\text{dB}$$

FSK mode_315MHz

3.1.8 Transmitter Field strength of fundamental emissions and harnonics

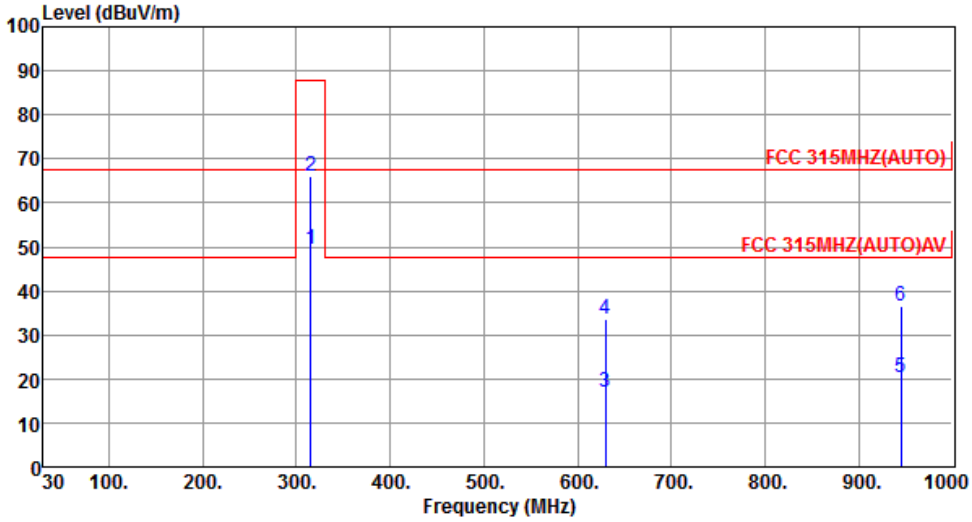
Modulation	FSK	Test Freq. (MHz)	315
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	315.00	58.90	67.66	-8.76	66.42	-7.52	Average	100	266
2	315.00	75.34	87.66	-12.32	82.86	-7.52	Peak	100	266
3	630.00	26.48	47.66	-21.18	26.94	-0.46	Average	124	90
4	630.00	42.92	67.66	-24.74	43.38	-0.46	Peak	124	90
5	945.00	22.81	47.66	-24.85	18.13	4.68	Average	100	295
6	945.00	39.25	67.66	-28.41	34.57	4.68	Peak	100	295

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	FSK	Test Freq. (MHz)	315
Polarization	Vertical		

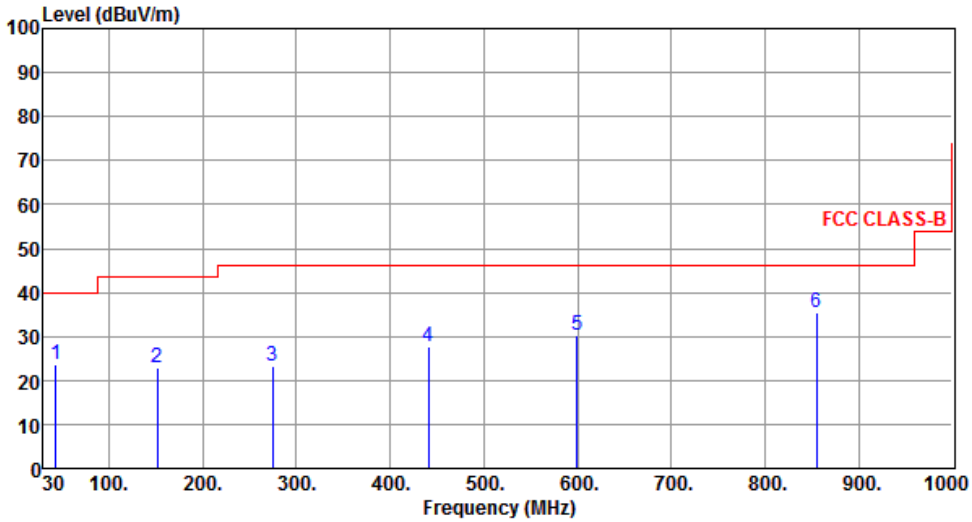


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	315.00	49.47	67.66	-18.19	56.99	-7.52	Average	126	40
2	315.00	65.91	87.66	-21.75	73.43	-7.52	Peak	126	40
3	630.00	16.99	47.66	-30.67	17.45	-0.46	Average	100	151
4	630.00	33.43	67.66	-34.23	33.89	-0.46	Peak	100	151
5	945.00	20.20	47.66	-27.46	15.52	4.68	Average	100	315
6	945.00	36.64	67.66	-31.02	31.96	4.68	Peak	100	315

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.1.9 Transmitter Radiated Unwanted Emissions (Below 1GHz)

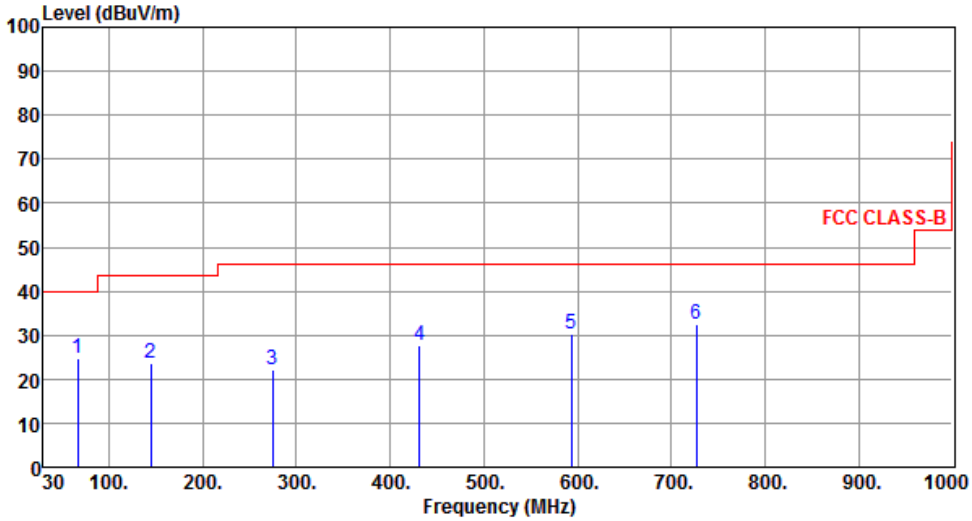
Modulation	FSK	Test Freq. (MHz)	315
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	43.22	23.52	40.00	-16.48	31.74	-8.22	Peak	---	---
2	151.55	22.96	43.50	-20.54	31.35	-8.39	Peak	---	---
3	274.55	23.25	46.00	-22.75	32.06	-8.81	Peak	---	---
4	440.84	27.85	46.00	-18.15	32.14	-4.29	Peak	---	---
5	599.52	30.24	46.00	-15.76	31.22	-0.98	Peak	---	---
6	854.99	35.41	46.00	-10.59	32.27	3.14	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation	FSK	**Test Freq. (MHz)**	315
Polarization	Vertical		

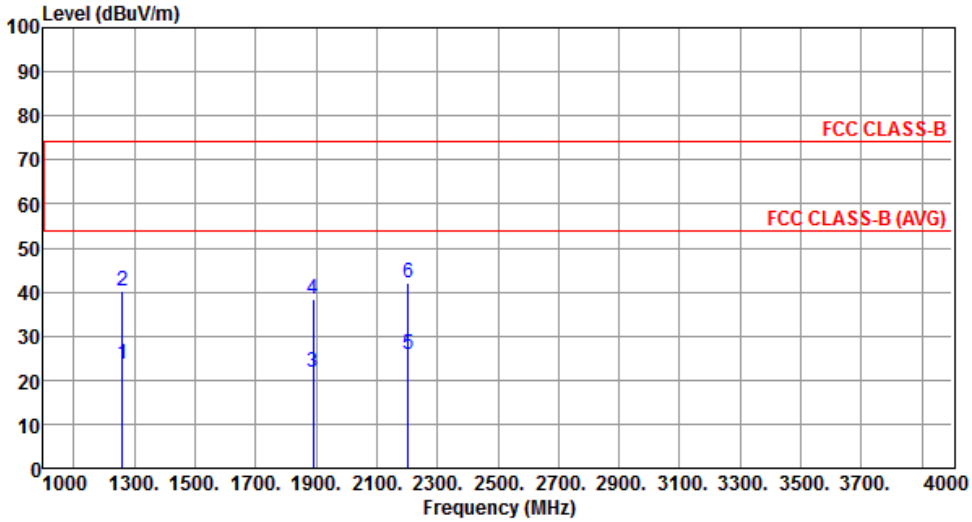


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	66.86	24.55	40.00	-15.45	34.52	-9.97	Peak	---	---
2	144.25	23.52	43.50	-19.98	32.09	-8.57	Peak	---	---
3	274.24	22.25	46.00	-23.75	31.08	-8.83	Peak	---	---
4	431.23	27.84	46.00	-18.16	32.44	-4.60	Peak	---	---
5	593.25	30.14	46.00	-15.86	31.29	-1.15	Peak	---	---
6	727.11	32.52	46.00	-13.48	31.52	1.00	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

3.1.10 Transmitter Radiated Unwanted Emissions (Above 1GHz)

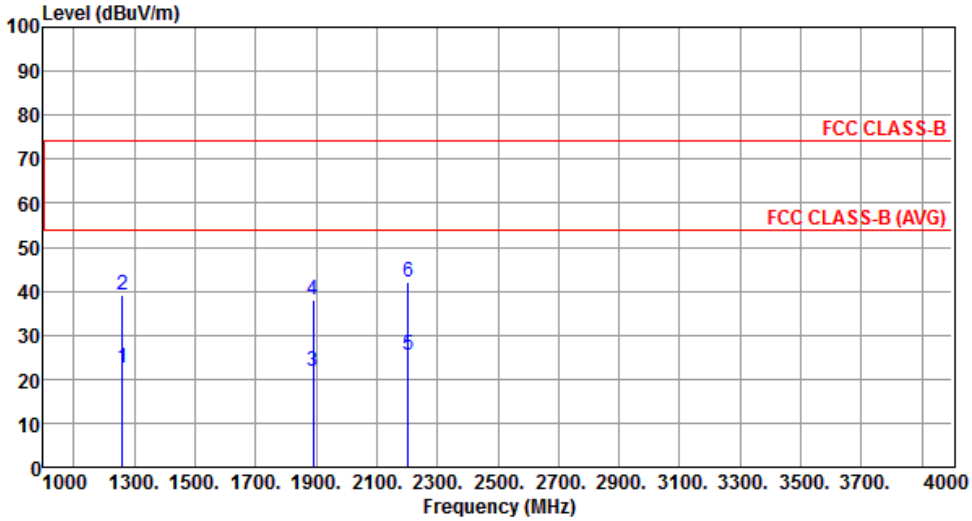
Modulation	FSK	Test Freq. (MHz)	315
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1260.00	23.64	54.00	-30.36	31.14	-7.50	Average	100	212
2	1260.00	40.08	74.00	-33.92	47.58	-7.50	Peak	100	212
3	1890.00	21.94	54.00	-32.06	27.82	-5.88	Average	100	104
4	1890.00	38.38	74.00	-35.62	44.26	-5.88	Peak	100	104
5	2205.00	25.76	54.00	-28.24	28.41	-2.65	Average	100	73
6	2205.00	42.20	74.00	-31.80	44.85	-2.65	Peak	100	73

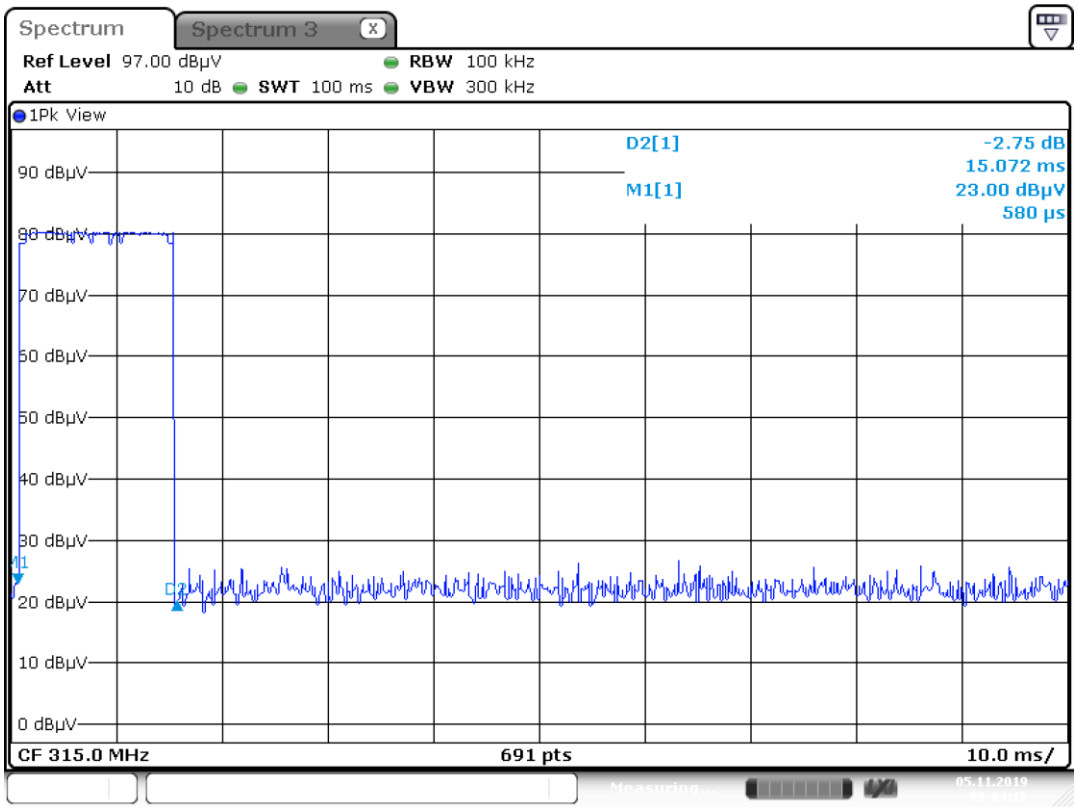
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	FSK	**Test Freq. (MHz)**	315
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1260.00	22.53	54.00	-31.47	30.03	-7.50	Average	100	132
2	1260.00	38.97	74.00	-35.03	46.47	-7.50	Peak	100	132
3	1890.00	21.64	54.00	-32.36	27.52	-5.88	Average	100	24
4	1890.00	38.08	74.00	-35.92	43.96	-5.88	Peak	100	24
5	2205.00	25.45	54.00	-28.55	28.10	-2.65	Average	100	219
6	2205.00	41.89	74.00	-32.11	44.54	-2.65	Peak	100	219

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

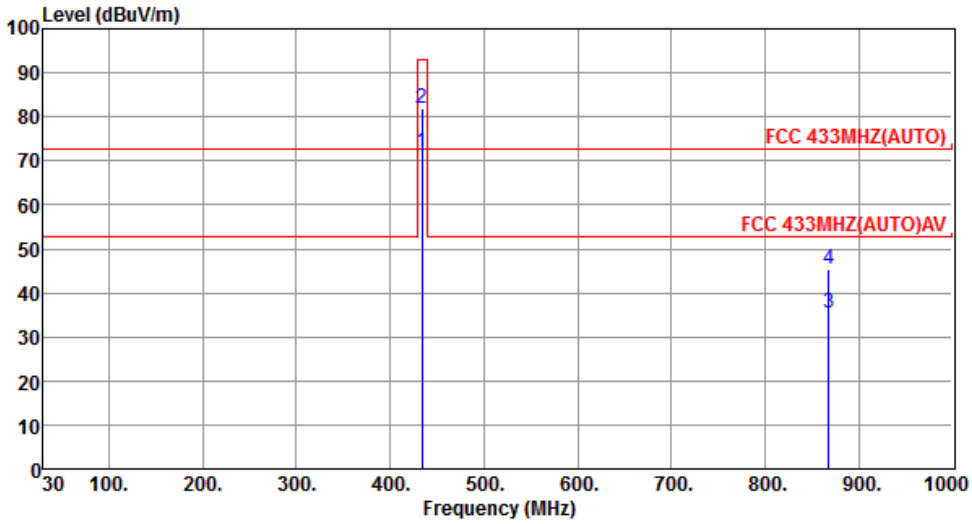


$$20\log(\text{Duty cycle}) = 20\log\frac{15.072\ \text{ms}}{100\ \text{ms}} = -16.44\text{dB}$$

ASK mode_433.92MHz

3.1.11 Transmitter Field strength of fundamental emissions and harnonics

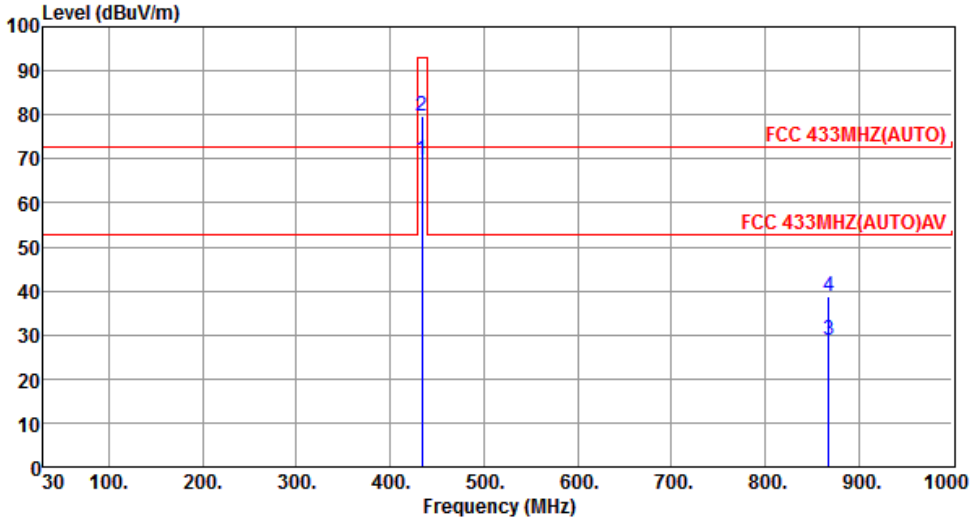
Modulation	ASK	Test Freq. (MHz)	433.92
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	433.92	72.06	72.87	-0.81	76.54	-4.48	Average	201	54
2	433.92	81.99	92.87	-10.88	86.47	-4.48	Peak	201	54
3	867.84	35.56	52.87	-17.31	32.25	3.31	Average	100	244
4	867.84	45.49	72.87	-27.38	42.18	3.31	Peak	100	244

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	ASK	**Test Freq. (MHz)**	433.92
Polarization	Vertical		

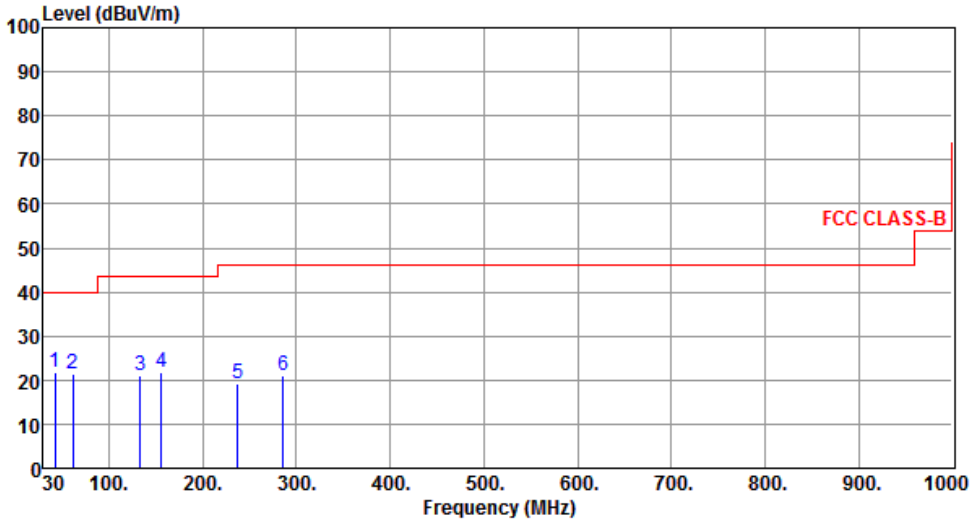


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	433.92	69.81	72.87	-3.06	74.29	-4.48	Average	136	263
2	433.92	79.74	92.87	-13.13	84.22	-4.48	Peak	136	263
3	867.84	28.96	52.87	-23.91	25.65	3.31	Average	100	356
4	867.84	38.89	72.87	-33.98	35.58	3.31	Peak	100	356

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.1.12 Transmitter Radiated Unwanted Emissions (Below 1GHz)

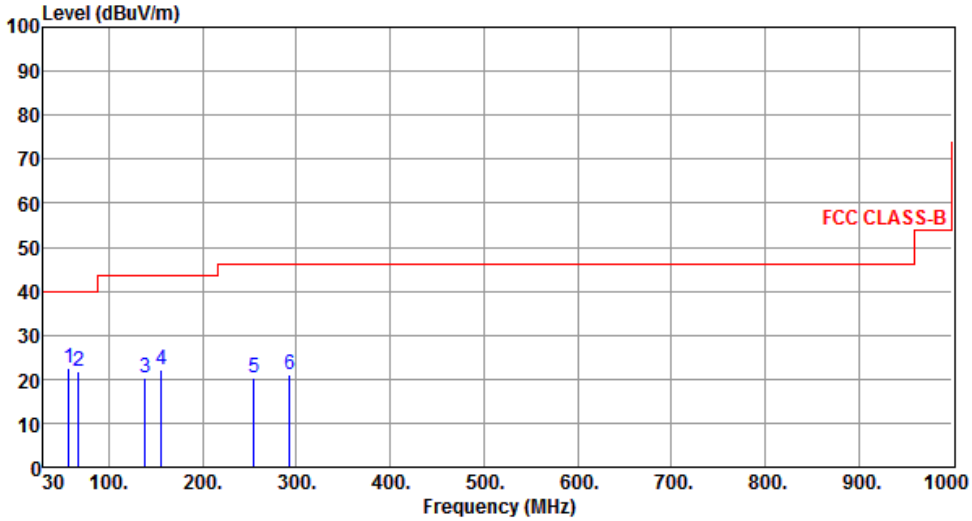
Modulation	ASK	**Test Freq. (MHz)**	433.92
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	42.51	21.70	40.00	-18.30	29.97	-8.27	Peak	---	---
2	61.91	21.27	40.00	-18.73	30.44	-9.17	Peak	---	---
3	133.70	21.04	43.50	-22.46	30.37	-9.33	Peak	---	---
4	156.01	21.91	43.50	-21.59	30.24	-8.33	Peak	---	---
5	237.50	19.24	46.00	-26.76	29.73	-10.49	Peak	---	---
6	286.01	21.03	46.00	-24.97	29.45	-8.42	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation	ASK	Test Freq. (MHz)	433.92
Polarization	Vertical		

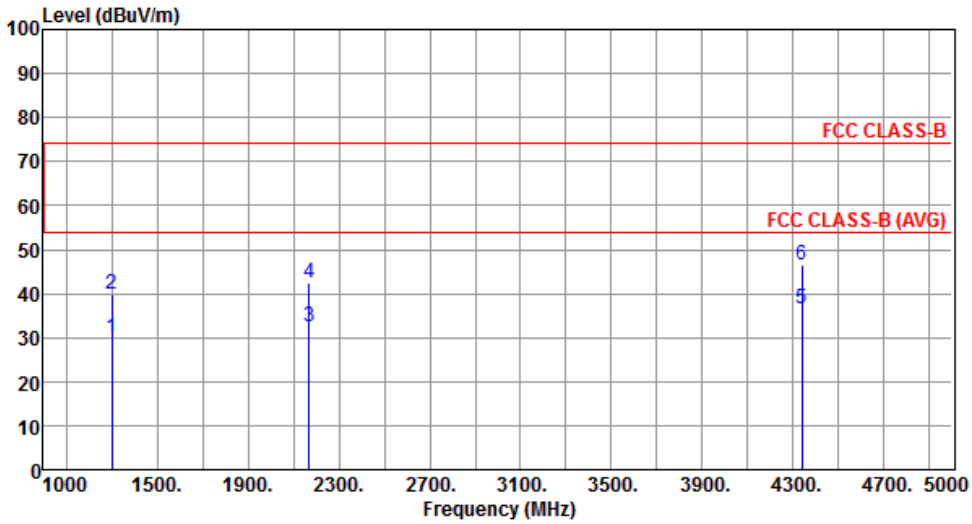


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	57.06	22.35	40.00	-17.65	31.06	-8.71	Peak	---	---
2	67.73	21.77	40.00	-18.23	31.73	-9.96	Peak	---	---
3	138.55	20.46	43.50	-23.04	29.45	-8.99	Peak	---	---
4	156.01	22.24	43.50	-21.26	30.57	-8.33	Peak	---	---
5	254.96	20.21	46.00	-25.79	29.95	-9.74	Peak	---	---
6	292.80	21.10	46.00	-24.90	29.36	-8.26	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

3.1.13 Transmitter Radiated Unwanted Emissions (Above 1GHz)

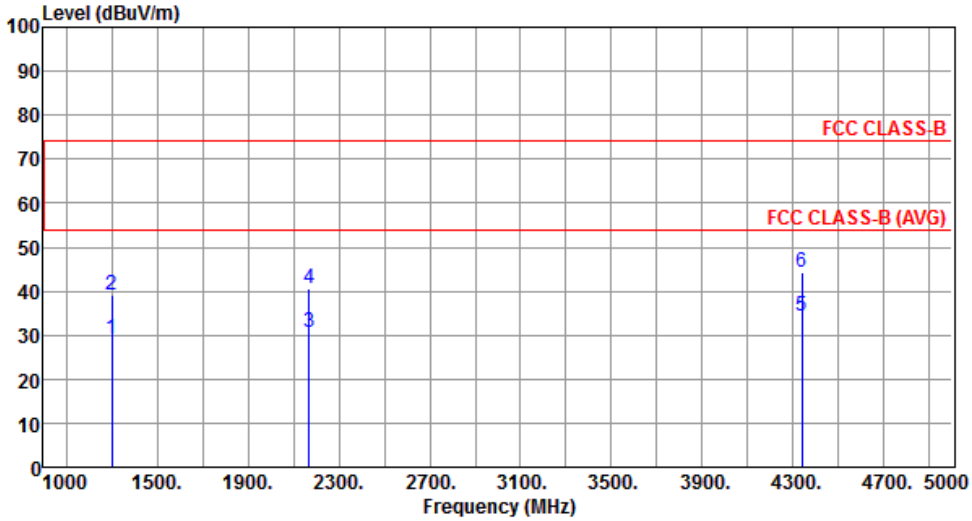
Modulation	ASK	**Test Freq. (MHz)**	433.92
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1301.76	30.05	54.00	-23.95	37.19	-7.14	Average	221	97
2	1301.76	39.98	74.00	-34.02	47.12	-7.14	Peak	221	97
3	2169.60	32.33	54.00	-21.67	35.33	-3.00	Average	100	100
4	2169.60	42.26	74.00	-31.74	45.26	-3.00	Peak	100	100
5	4339.20	36.39	54.00	-17.61	34.33	2.06	Average	100	120
6	4339.20	46.32	74.00	-27.68	44.26	2.06	Peak	100	120

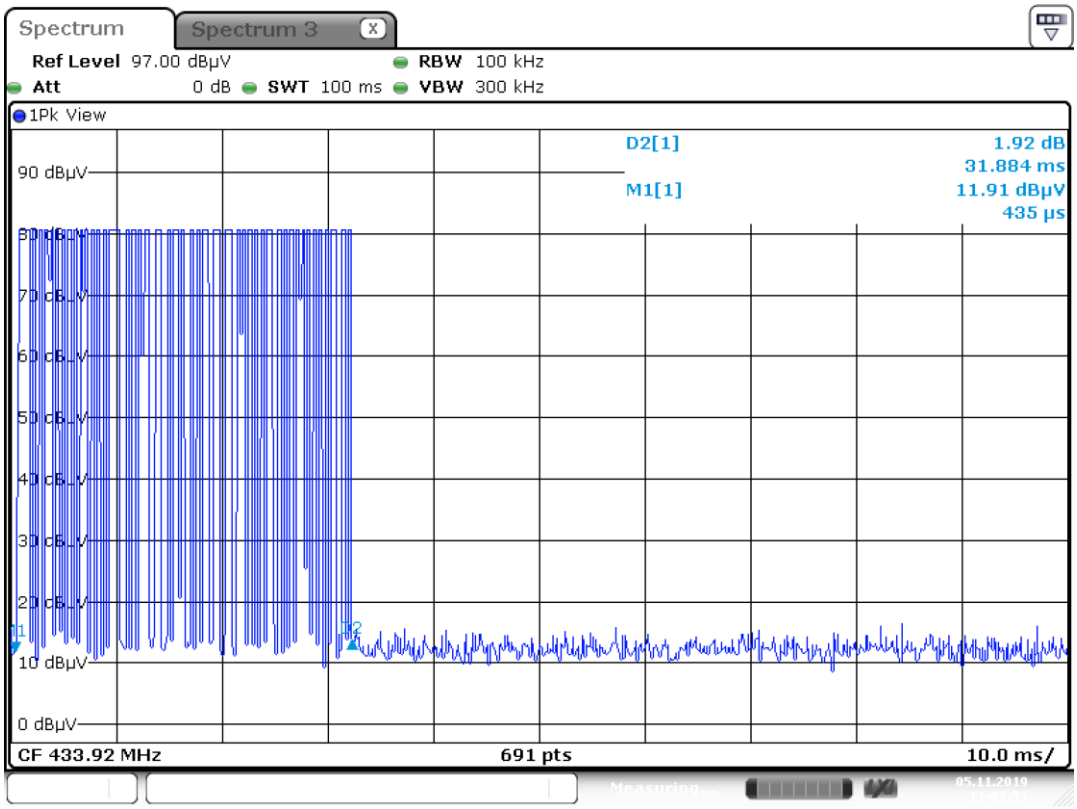
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	ASK	**Test Freq. (MHz)**	433.92
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1301.76	29.02	54.00	-24.98	36.16	-7.14	Average	100	223
2	1301.76	38.95	74.00	-35.05	46.09	-7.14	Peak	100	223
3	2169.60	30.67	54.00	-23.33	33.67	-3.00	Average	100	69
4	2169.60	40.60	74.00	-33.40	43.60	-3.00	Peak	100	69
5	4339.20	34.36	54.00	-19.64	32.30	2.06	Average	100	197
6	4339.20	44.29	74.00	-29.71	42.23	2.06	Peak	100	197

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

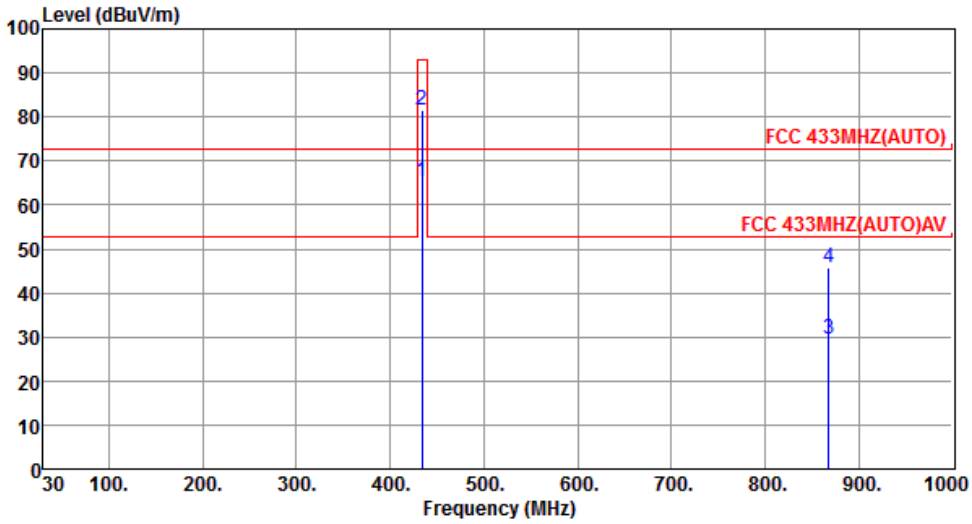


$$20\log(\text{Duty cycle}) = 20\log\frac{31.884\text{ms}}{100\text{ ms}} = -9.93\text{dB}$$

FSK mode_433.92MHz

3.1.14 Transmitter Field strength of fundamental emissions and harnonics

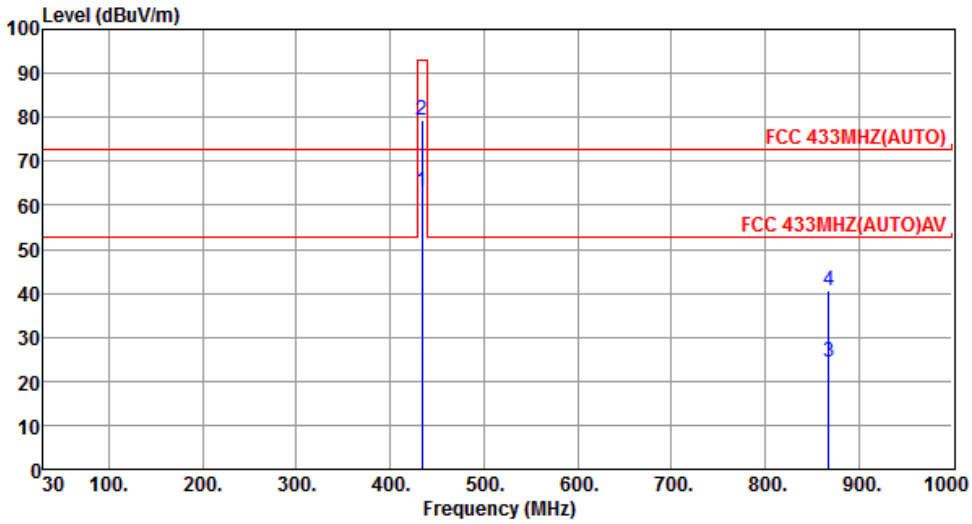
Modulation	FSK	Test Freq. (MHz)	433.92
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	433.92	65.16	72.87	-7.71	69.64	-4.48	Average	204	45
2	433.92	81.51	92.87	-11.36	85.99	-4.48	Peak	204	45
3	867.84	29.35	52.87	-23.52	26.04	3.31	Average	100	247
4	867.84	45.70	72.87	-27.17	42.39	3.31	Peak	100	247

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	FSK	**Test Freq. (MHz)**	433.92
Polarization	Vertical		

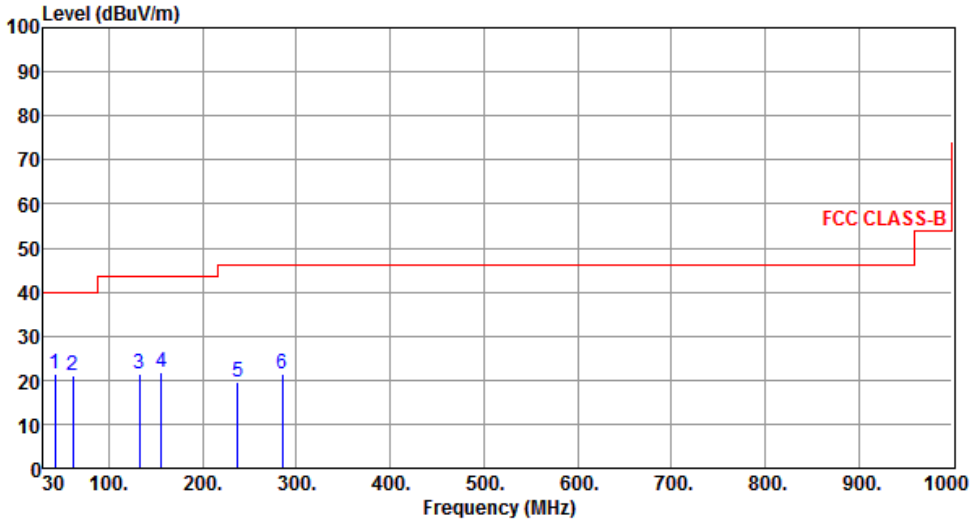


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	433.92	62.99	72.87	-9.88	67.47	-4.48	Average	132	80
2	433.92	79.34	92.87	-13.53	83.82	-4.48	Peak	132	80
3	867.84	24.18	52.87	-28.69	20.87	3.31	Average	175	335
4	867.84	40.53	72.87	-32.34	37.22	3.31	Peak	175	335

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.1.15 Transmitter Radiated Unwanted Emissions (Below 1GHz)

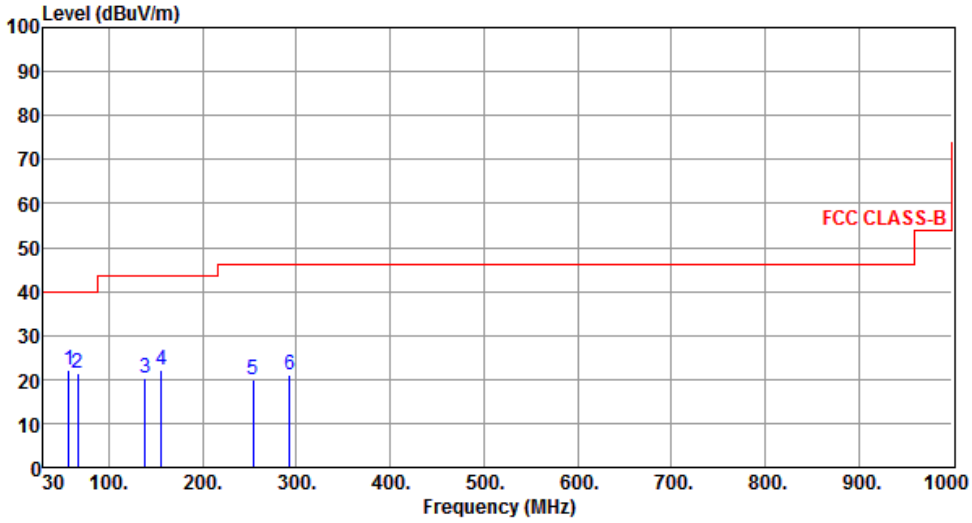
Modulation	FSK	**Test Freq. (MHz)**	433.92
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	42.25	21.45	40.00	-18.55	29.76	-8.31	Peak	---	---
2	61.88	21.15	40.00	-18.85	30.32	-9.17	Peak	---	---
3	132.52	21.52	43.50	-21.98	30.99	-9.47	Peak	---	---
4	155.88	21.81	43.50	-21.69	30.14	-8.33	Peak	---	---
5	236.95	19.52	46.00	-26.48	30.08	-10.56	Peak	---	---
6	285.25	21.25	46.00	-24.75	29.69	-8.44	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation	FSK	Test Freq. (MHz)	433.92
Polarization	Vertical		

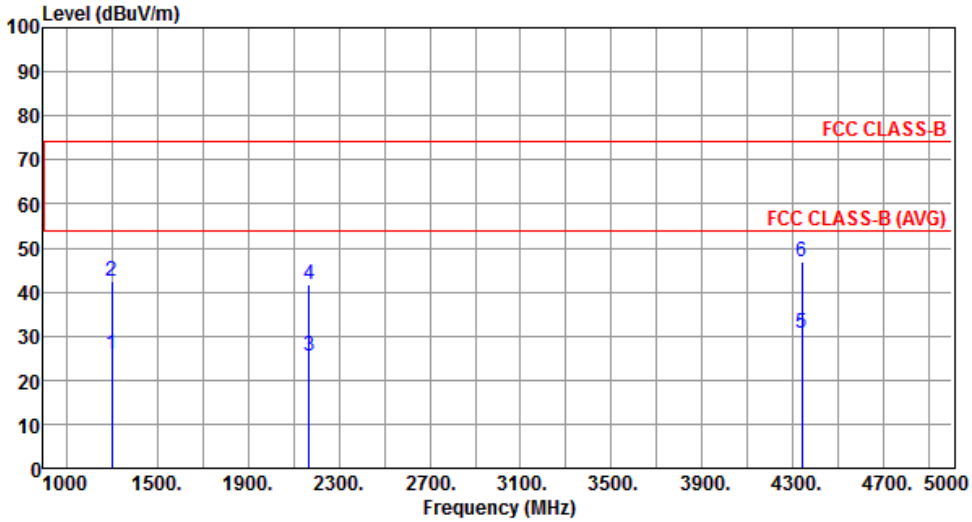


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	56.88	22.12	40.00	-17.88	30.81	-8.69	Peak	---	---
2	66.88	21.52	40.00	-18.48	31.49	-9.97	Peak	---	---
3	138.41	20.15	43.50	-23.35	29.16	-9.01	Peak	---	---
4	155.75	22.15	43.50	-21.35	30.48	-8.33	Peak	---	---
5	253.63	20.05	46.00	-25.95	29.84	-9.79	Peak	---	---
6	292.52	21.02	46.00	-24.98	29.29	-8.27	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

3.1.16 Transmitter Radiated Unwanted Emissions (Above 1GHz)

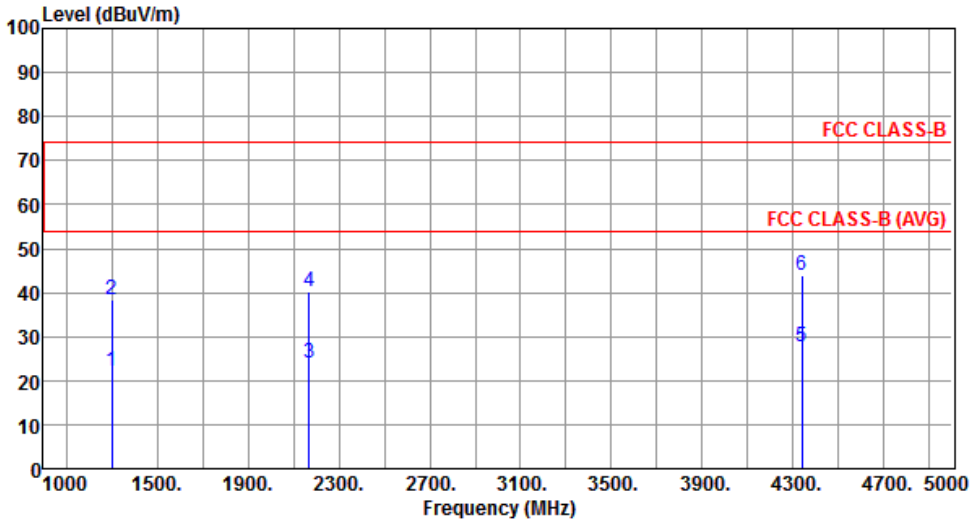
Modulation	FSK	**Test Freq. (MHz)**	433.92
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1301.76	25.91	54.00	-28.09	33.05	-7.14	Average	100	83
2	1301.76	42.26	74.00	-31.74	49.40	-7.14	Peak	100	83
3	2169.60	25.47	54.00	-28.53	28.47	-3.00	Average	100	80
4	2169.60	41.82	74.00	-32.18	44.82	-3.00	Peak	100	80
5	4339.20	30.53	54.00	-23.47	28.47	2.06	Average	100	266
6	4339.20	46.88	74.00	-27.12	44.82	2.06	Peak	100	266

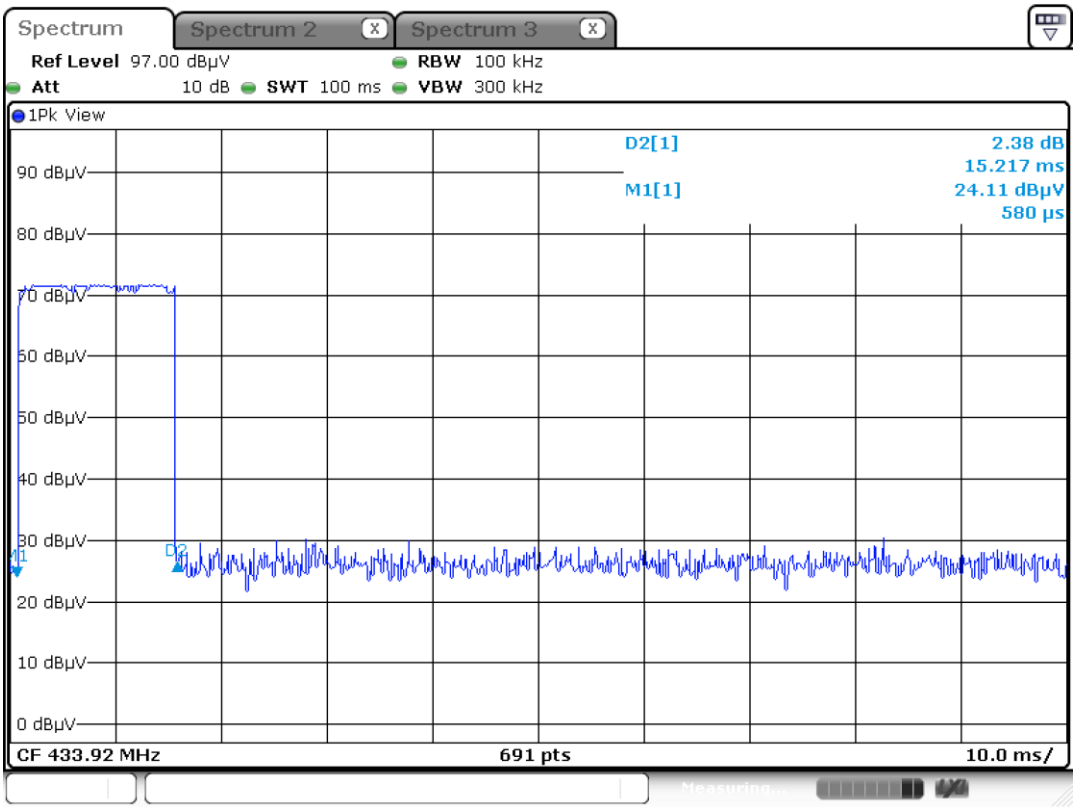
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	FSK	**Test Freq. (MHz)**	433.92
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1301.76	22.17	54.00	-31.83	29.31	-7.14	Average	100	215
2	1301.76	38.52	74.00	-35.48	45.66	-7.14	Peak	100	215
3	2169.60	23.95	54.00	-30.05	26.95	-3.00	Average	100	174
4	2169.60	40.30	74.00	-33.70	43.30	-3.00	Peak	100	174
5	4339.20	27.57	54.00	-26.43	25.51	2.06	Average	100	2
6	4339.20	43.92	74.00	-30.08	41.86	2.06	Peak	100	2

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).



$$20\log(\text{Duty cycle}) = 20\log\frac{15.217\ \text{ms}}{100\ \text{ms}} = -16.35\text{dB}$$

3.2 Transmission and Deactivation Time

3.2.1 Limit of Transmission and Deactivation Time

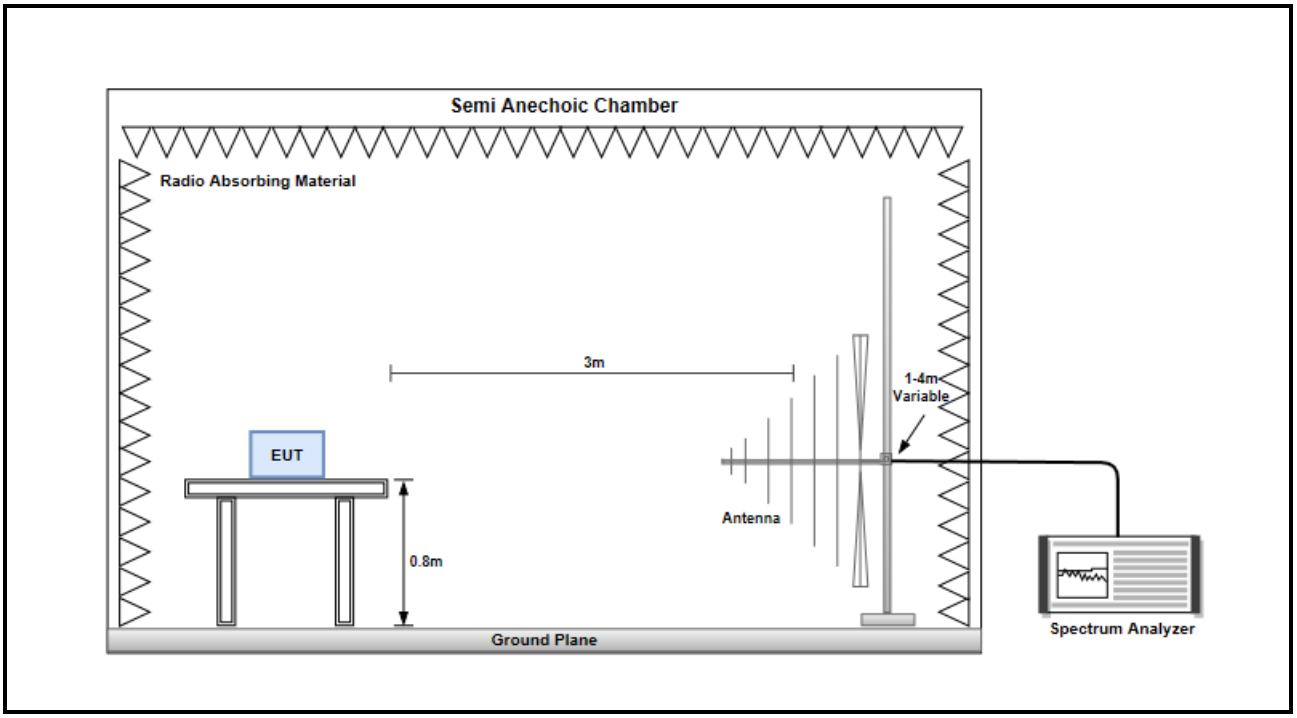
A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

Devices 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.

3.2.2 Test Procedures

1. Set resolution bandwidth (RBW) = 100 kHz, Video bandwidth = 300 kHz.
2. Detector = Peak, Trace mode = max hold.
3. Set Sweep = fitting time as shown on plots of next pages, Allow the trace to stabilize.
4. Set the EUT to operates at operation modes then record the transmission and deactivation time.

3.2.3 Test Setup

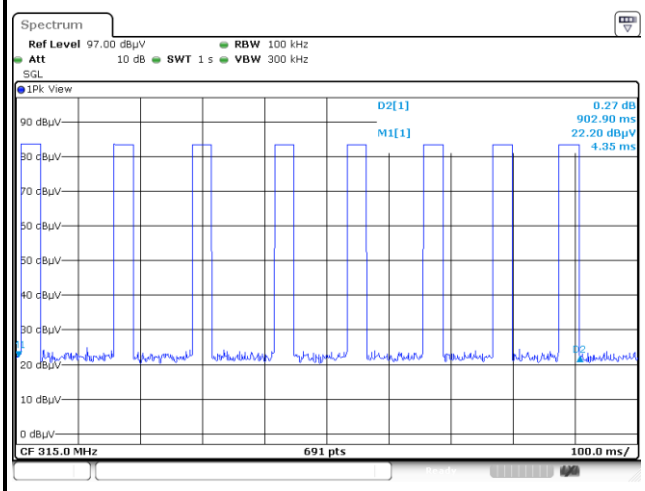
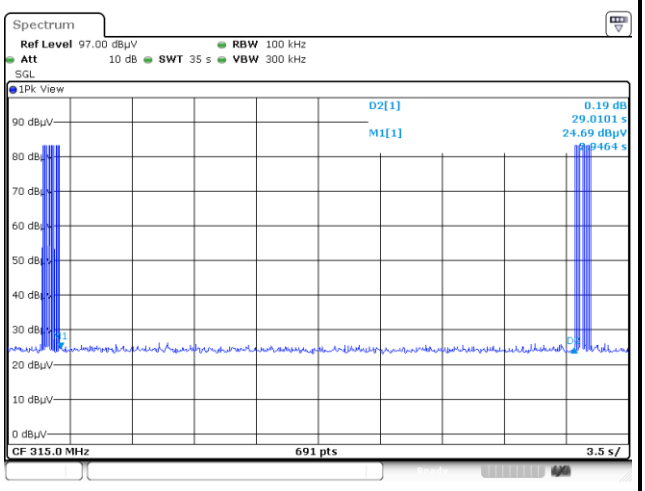


3.2.4 Test Result of Rotating mode

ASK mode_315MHz

Rotating mode			
Frequency(MHz)	**Transmission time (S)**	**Limit (s)**	**Pass/Fail**
315.00	0.902900	1.00	PASS
Frequency(MHz)	**Deactivation Time (S)**	**Limit (s)**	**Pass/Fail**
315.00	29.010100	27.09	PASS

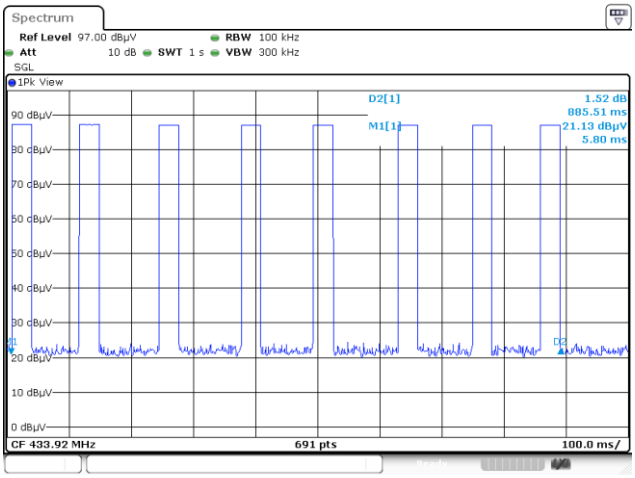
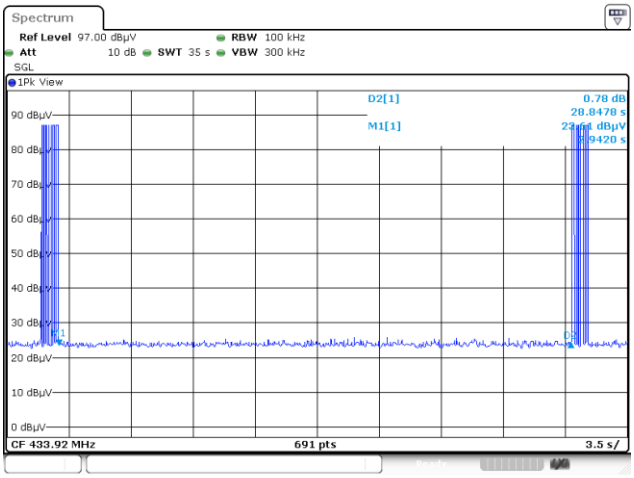
Note: The limit is longer than 10 seconds and is not shorter than transmission time multiplied by 30 (0.9029 s * 30 = 27.09 s)

Rotating mode-1	Rotating mode-2
	

ASK mode_433.92MHz

Rotating mode			
Frequency(MHz)	**Transmission time (S)**	**Limit (s)**	**Pass/Fail**
433.92	0.885510	1.00	PASS
Frequency(MHz)	**Deactivation Time (S)**	**Limit (s)**	**Pass/Fail**
433.92	28.847800	26.57	PASS

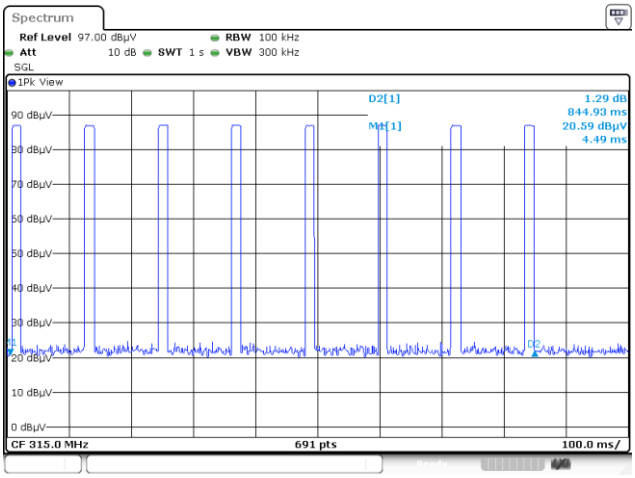
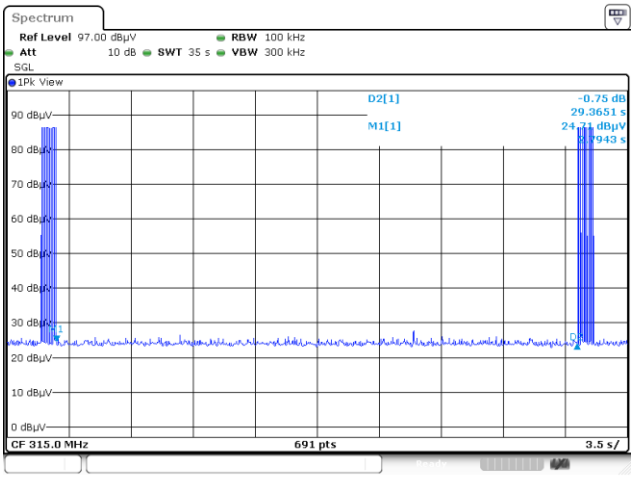
Note: The limit is longer than 10 seconds and is not shorter than transmission time multiplied by 30 (0.88551s * 30 = 26.57 s)

Rotating mode-1	Rotating mode-2
	

FSK mode_315MHz

Rotating mode			
Frequency(MHz)	**Transmission time (S)**	**Limit (s)**	**Pass/Fail**
315.00	0.844930	1.00	PASS
Frequency(MHz)	**Deactivation Time (S)**	**Limit (s)**	**Pass/Fail**
315.00	29.365100	25.35	PASS

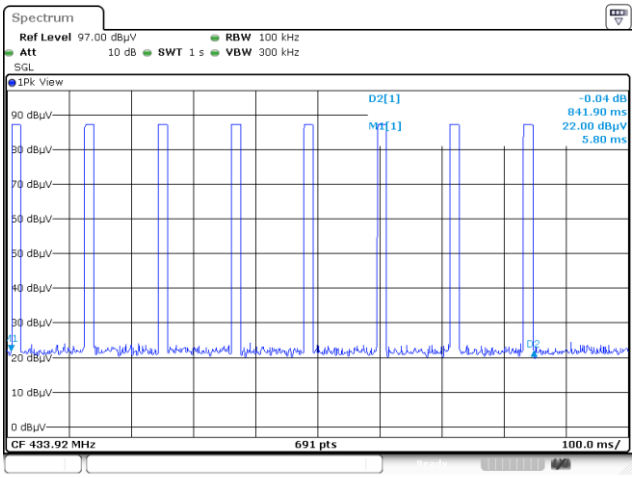
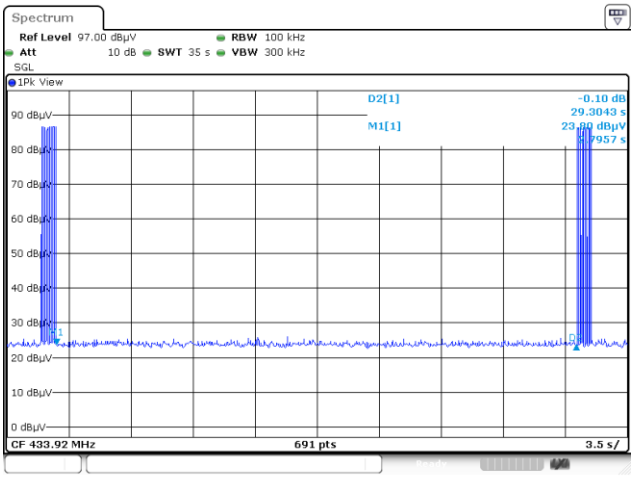
Note: The limit is longer than 10 seconds and is not shorter than transmission time multiplied by 30 (0.844930 s * 30 = 25.35 s)

Rotating mode-1	Rotating mode-2
	

FSK mode_433.92MHz

Rotating mode			
Frequency(MHz)	**Transmission time (S)**	**Limit (s)**	**Pass/Fail**
433.92	0.841900	1.00	PASS
Frequency(MHz)	**Deactivation Time (S)**	**Limit (s)**	**Pass/Fail**
433.92	29.304300	25.26	PASS

Note: The limit is longer than 10 seconds and is not shorter than transmission time multiplied by 30 (0.841900 s * 30 = 25.26 s)

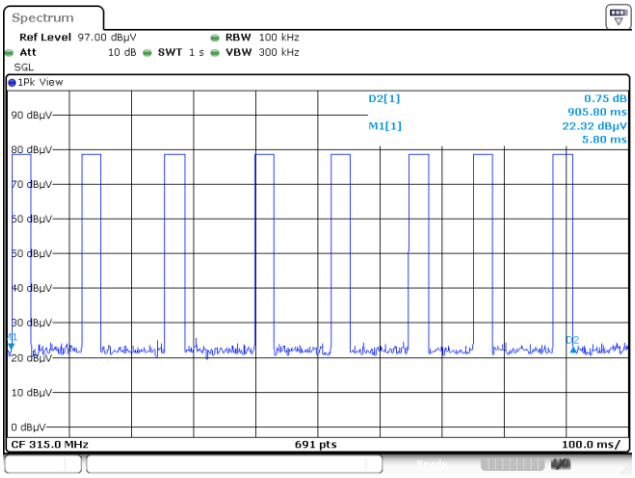
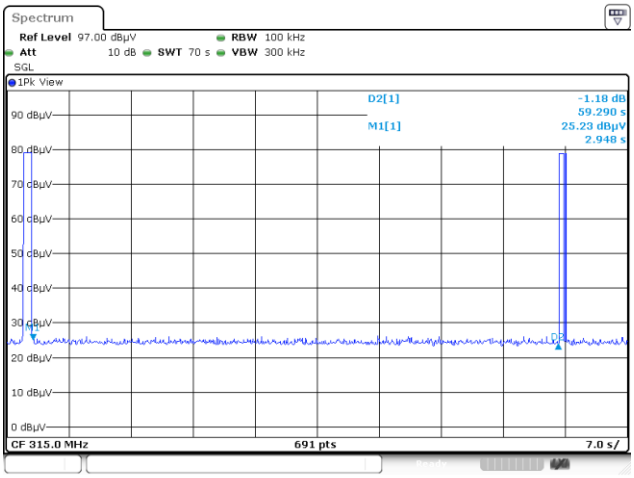
Rotating mode-1	Rotating mode-2
	

3.2.5 Test Result of Stationary mode

ASK mode_315MHz

Stationary mode			
Frequency(MHz)	**Transmission time (S)**	**Limit (s)**	**Pass/Fail**
315.00	0.905800	1.00	PASS
Frequency(MHz)	**Deactivation Time (S)**	**Limit (s)**	**Pass/Fail**
315.00	59.290000	27.17	PASS

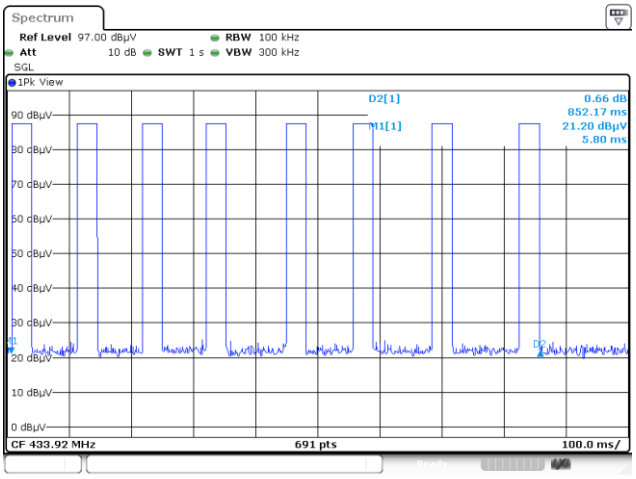
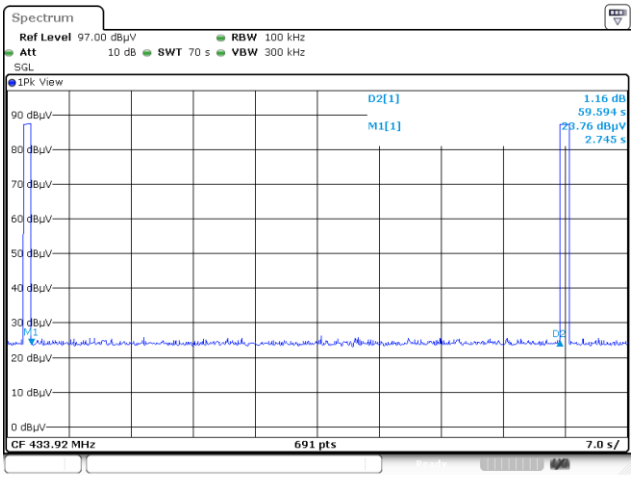
Note: The limit is longer than 10 seconds and is not shorter than transmission time multiplied by 30 (0.905800 s * 30 = 27.17 s)

Stationary mode-1	Stationary mode-2
	

ASK mode_433.92MHz

Stationary mode			
Frequency(MHz)	**Transmission time (S)**	**Limit (s)**	**Pass/Fail**
433.92	0.852170	1.00	PASS
Frequency(MHz)	**Deactivation Time (S)**	**Limit (s)**	**Pass/Fail**
433.92	59.594000	25.57	PASS

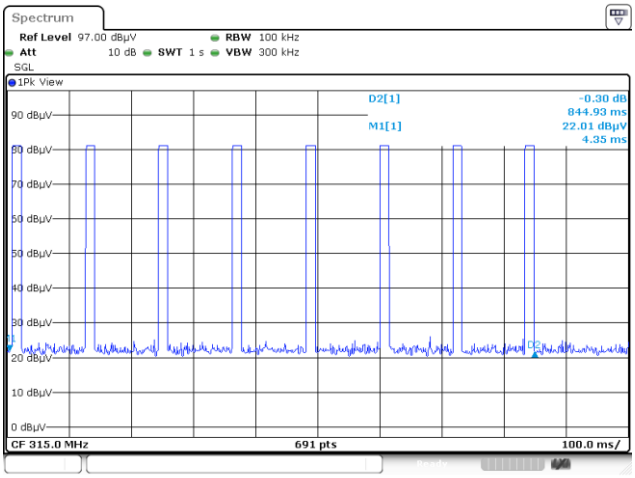
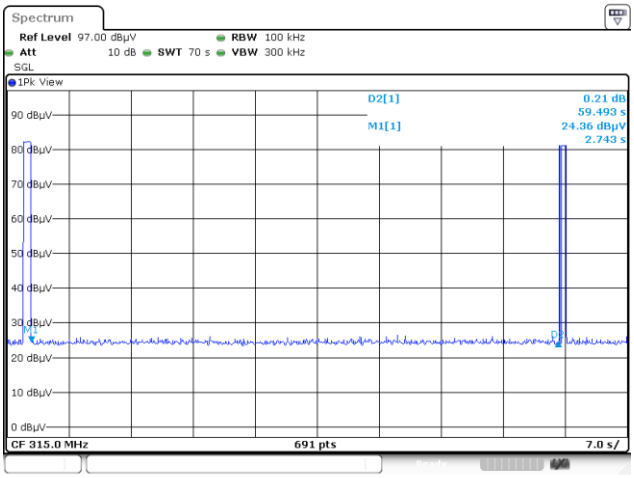
Note: The limit is longer than 10 seconds and is not shorter than transmission time multiplied by 30 (0.85217s * 30 = 25.57 s)

Stationary mode-1	Stationary mode-2
	

FSK mode_315MHz

Stationary mode			
Frequency(MHz)	**Transmission time (S)**	**Limit (s)**	**Pass/Fail**
315.00	0.844930	1.00	PASS
Frequency(MHz)	**Deactivation Time (S)**	**Limit (s)**	**Pass/Fail**
315.00	59.493000	25.35	PASS

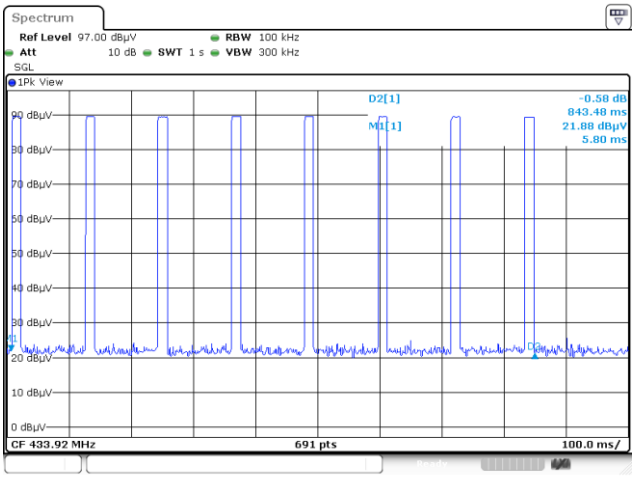
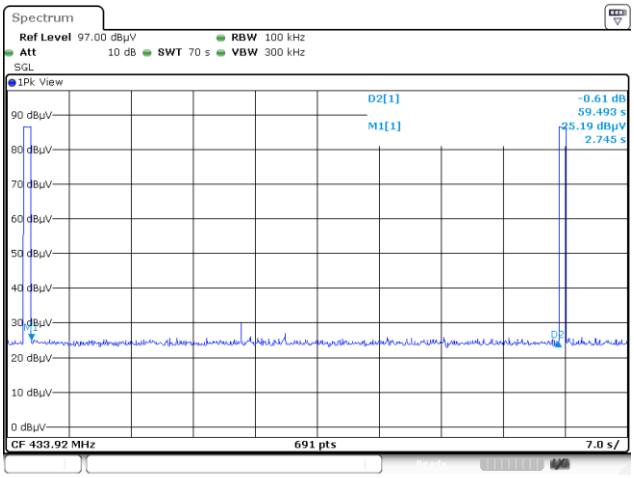
Note: The limit is longer than 10 seconds and is not shorter than transmission time multiplied by 30 (0.844930 s * 30 = 25.35 s)

Stationary mode-1	Stationary mode-2
	

FSK mode_433.92MHz

Stationary mode			
Frequency(MHz)	**Transmission time (S)**	**Limit (s)**	**Pass/Fail**
433.92	0.843480	1.00	PASS
Frequency(MHz)	**Deactivation Time (S)**	**Limit (s)**	**Pass/Fail**
433.92	59.493000	25.30	PASS

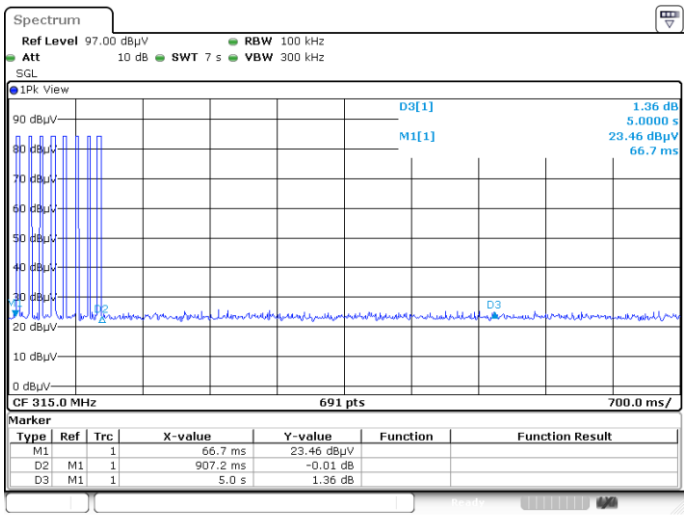
Note: The limit is longer than 10 seconds and is not shorter than transmission time multiplied by 30 (0.843480 s * 30 = 25.30 s)

Stationary mode-1	Stationary mode-2
	

3.2.6 Test Result of Alert mode

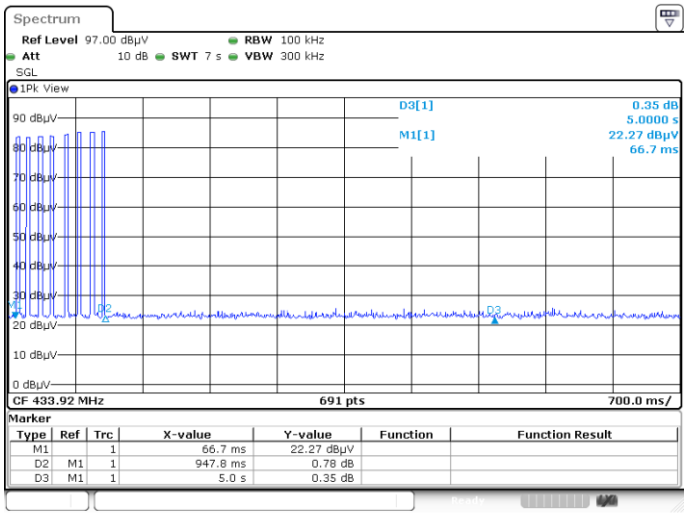
ASK mode_315MHz

Transmission Time Alert mode			
Frequency(MHz)	**Transmission time (S)**	**Limit (s)**	**Pass/Fail**
315.00	0.907200	5.00	PASS

alert mode


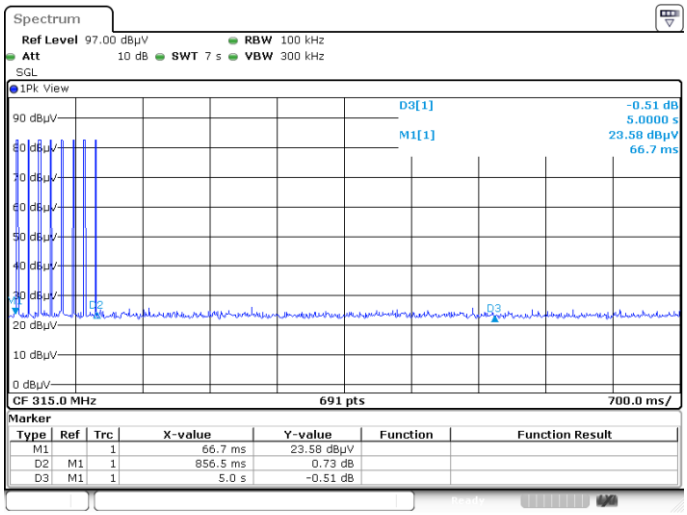
ASK mode_433.92MHz

Transmission Time Alert mode			
Frequency(MHz)	**Transmission time (S)**	**Limit (s)**	**Pass/Fail**
433.92	0.947800	5.00	PASS

alert mode


FSK mode_315MHz

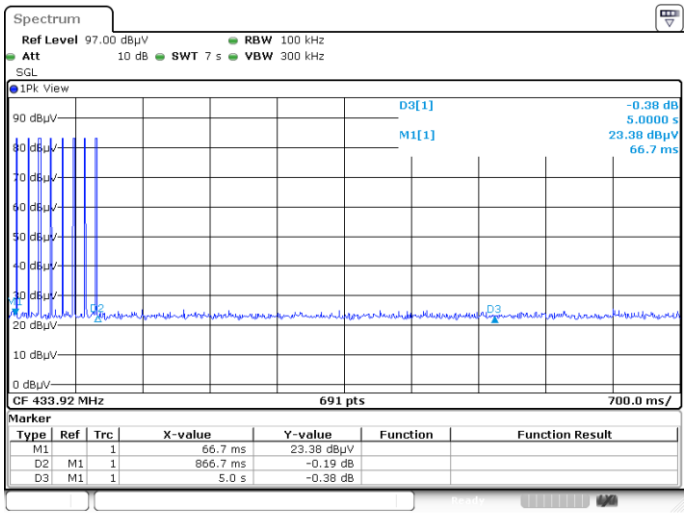
Transmission Time Alert mode			
Frequency(MHz)	**Transmission time (S)**	**Limit (s)**	**Pass/Fail**
315.00	0.856500	5.00	PASS

alert mode


FSK mode_433.92MHz

Transmission Time Alert mode			
Frequency(MHz)	**Transmission time (S)**	**Limit (s)**	**Pass/Fail**
433.92	0.866700	5.00	PASS

alert mode



3.3 20dB and Occupied Bandwidth

3.3.1 Limit of 20 dB Bandwidth

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz.

3.3.2 Test Procedures

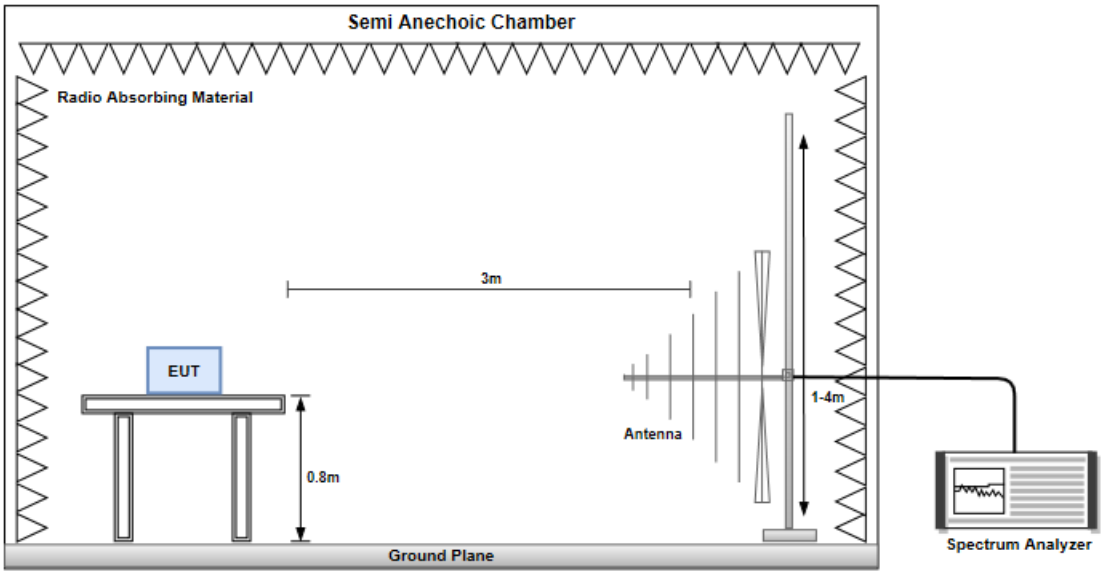
For 20dB bandwidth

1. Set resolution bandwidth (RBW) = 30 kHz, Video bandwidth = 100 kHz
2. Detector = Peak, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20dB relative to the maximum level measured in the fundamental emission.

For Occupied bandwidth

1. Set resolution bandwidth (RBW) = 30 kHz, Video bandwidth = 100 kHz
2. Detector = Peak, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. Use the occupied measurement function of specturm analyzer to measure 99% occupied bandwidth

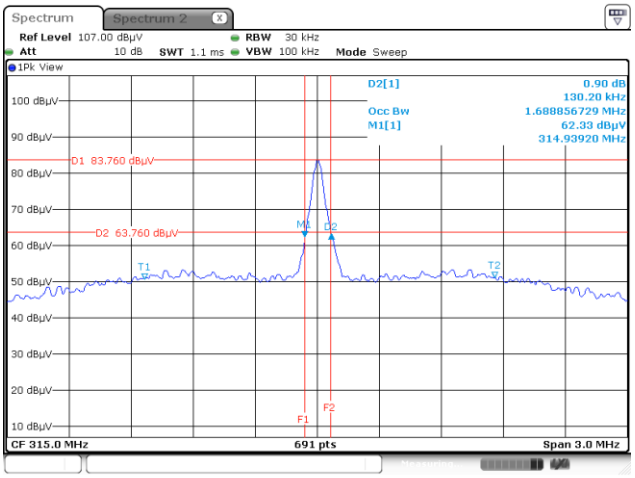
3.3.3 Test Setup



3.3.4 20dB and Occupied Bandwidth

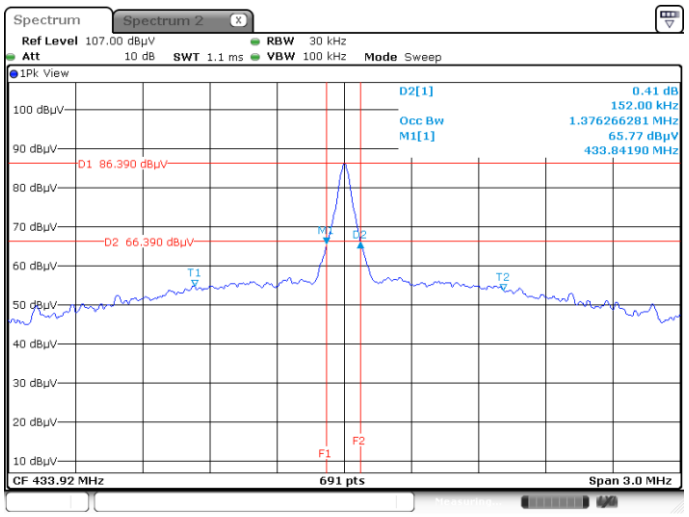
ASK mode_315MHz

20dB and Occupied Bandwidth				
Frequency(MHz)	**20dB Bandwidth (MHz)**	**20dB BW Limit (MHz)**	**99% BW (MHz)**	**Pass/Fail**
315.00	0.1302	0.7875	1.6889	PASS



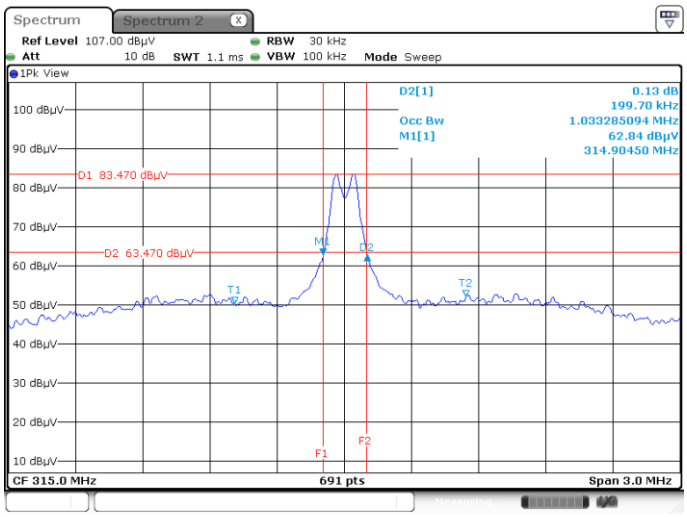
ASK mode_433.92MHz

20dB and Occupied Bandwidth				
Frequency(MHz)	**20dB Bandwidth (MHz)**	**20dB BW Limit (MHz)**	**99% BW (MHz)**	**Pass/Fail**
433.92	0.1520	1.0848	1.3763	PASS



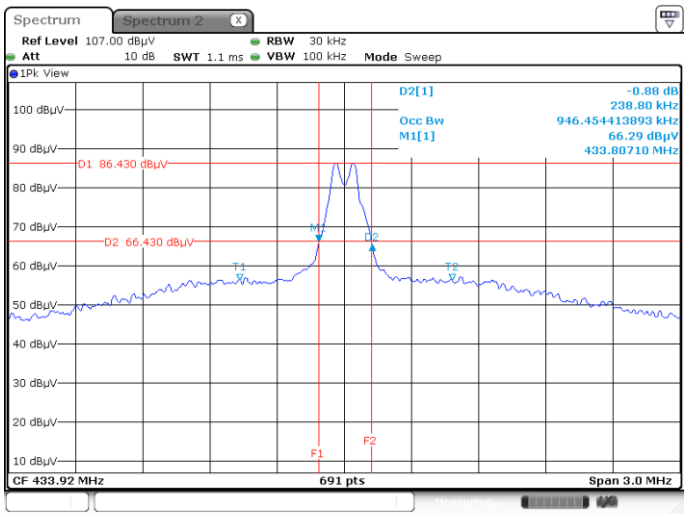
FSK mode_315MHz

20dB and Occupied Bandwidth				
Frequency(MHz)	**20dB Bandwidth (MHz)**	**20dB BW Limit (MHz)**	**99% BW (MHz)**	**Pass/Fail**
315.00	0.1997	0.7875	1.0333	PASS



FSK mode_433.92MHz

20dB and Occupied Bandwidth				
Frequency(MHz)	**20dB Bandwidth (MHz)**	**20dB BW Limit (MHz)**	**99% BW (MHz)**	**Pass/Fail**
433.92	0.2388	1.0848	0.9465	PASS



4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website http://www.icertifi.com.tw.

Linkou	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.	No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information.

Tel: 886-3-271-8666
Fax: 886-3-318-0155
Email: ICC_Service@icertifi.com.tw

==END==