

CFR 47 FCC Part 15.231

TEST REPORT

Product : **TPMS-TX**

Trade Name : N/A

Model Number : TX-P002, TX-P004, TX-P006, TX-P008,
TX-P010, TX-P012, TX-P014, TX-P016,
TX-P018, TX-P020, TX018

FCC ID : ULZ-TXP002

Prepared for

MOBILETRON ELECTRONICS CO., LTD.

39,Sec.3,Chung-Ching Rd.,Ta-Ya,Taichung Hsien,Taiwan

TEL. : +886 4 2568 3366

FAX. : +886 4 2567 3069

Prepared by

Interocean EMC Technology Corp.

No. 5-2, Lin 1, Tin-Fu, Lin-Kou Dist., New Taipei City,

Taiwan 244, R.O.C.

TEL.: +886 2 2600 6861

FAX.: +886 2 2600 6859

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Statement of Compliance

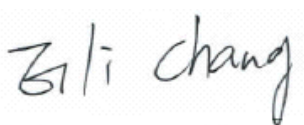
Applicant: MOBILETRON ELECTRONICS CO., LTD.
Manufacturer: MOBILETRON ELECTRONICS CO., LTD.
Product: TPMS-TX
Model No.: TX-P002, TX-P004, TX-P006, TX-P008, TX-P010, TX-P012,
TX-P014, TX-P016, TX-P018, TX-P020, TX018
Tested Power Supply: 3Vdc Battery
Date of Final Test: Oct. 21, 2015

Configuration of Measurements and Standards Used :

FCC Rules and Regulations Part 15 Subpart C

1. The result of the testing report relate only to the item tested.
2. The testing report shall not be reproduced expect in full, without the written approval of IETC.

Report Issued: 2015/11/03

Project Engineer: 

Elli Chang

Approved: 

Jerry Liu

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1 Summary of Measurement

Report Clause	Test Parameter	Reference Document CFR47 Part15	Results
4	Timing requirement	§15.231(e)	Pass
4	Radiated Emission	§15.231(e), 15.209	Pass
5	Emission Bandwidth	§15.231(c)	Pass

2 General Information

2.1 Description of Equipment Under Test

Product	: TPMS-TX
Model Number	: TX-P002, TX-P004, TX-P006, TX-P008, TX-P010, TX-P012, TX-P014, TX-P016, TX-P018, TX-P020, TX018
Applicant	: MOBILETRON ELECTRONICS CO., LTD. 39,Sec.3,Chung-Ching Rd.,Ta-Ya,Taichung Hsien,Taiwan
Manufacturer	: MOBILETRON ELECTRONICS CO., LTD. 39,Sec.3,Chung-Ching Rd.,Ta-Ya,Taichung Hsien,Taiwan
Power Supply	: 3Vdc Battery
Operating Frequency	: 433.92MHz
Type of Modulation	: ASK & FSK
Antenna Description	: This device uses Monopole antenna. The antenna is integral to the device, thereby meeting the requirement of FCC 15.203.
Antenna Gain	: 0 dBi
Date of Test	: Oct. 01 ~ 21, 2015
Additional Description	: 1) The Model Number " TX-P002 " is representative selected in the test and included in this report. 2) Programming software is slightly modified for different receivers fitted in car makes and models. 3) Such modifications are not sufficient to affect the test results provided herein. 4) For more detail specification about EUT, please refer to the user's manual.

2.2 Details of Tested Peripheral Equipment

N/A

2.3 Test Facility

- Site Description** : ☑Chamber 3
- Name of Firm** : Interocean EMC Technology Corp.
- Company web** : <http://www.ietc.com.tw>
- Location** : No. 5-2, Lin 1, Tin-Fu, Lin-Kou Dist., New Taipei City, Taiwan 244, R.O.C.
- Site Filing** :
- Federal Communication Commissions – USA
Registration No.: 96399 (OATS 1, 2, 3 & Chamber 3)
Designation No.: TW1020
 - Industry Canada (IC)
OUR FILE: 46405-4437
Registration No. (OATS 1): Site# 4437A-1
Registration No. (OATS 3): Site# 4437A-3
Registration No. (Chamber 3): Site# 4437A-5
Registration No. (OATS 5): Site# 4437A-6
 - Voluntary Control Council for Interference by Information Technology Equipment (VCCI) – Japan
Member No.: 1349
Registration No. (Conducted Room): C-1094
Registration No. (Conducted Room): T-1562
Registration No. (OATS 1): R-1040; G-274
- Site Accreditation** :
- Bureau of Standards and Metrology and Inspection (BSMI) – Taiwan, R.O.C.
Accreditation No.:
SL2-IN-E-0026 for CNS13438 / CISPR 22
SL2-IN-E-0026 for CNS14757-2 / IEC 62040-2
SL2-R1-E-0026 for CNS13439 / CISPR 13
SL2-R2-E-0026 for CNS13439 / CISPR 13
SL2-A1-E-0026 for CNS13783-1 / CISPR 14-1
SL2-L1-E-0026 for CNS 14115 / CISPR 15
 - Taiwan Accreditation Foundation (TAF)
Accreditation No.: 1113
 - Vehicle Safety Certification Center (VSCC)
Approval No.: TW16-11-0
 - TÜV NORD
Certificate No: TNTW0801R-04

3 Test Specifications

3.1 Test Standard

The EUT was performed according to FCC Part 15 Subpart C Section 15.231 procedure and setup followed by ANSI C63.10, 2013 requirements.

3.2 Operation Mode

By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that “Z axis” position was the worst, then the final test was executed the worst condition and test data were recorded in this report

The EUT was operated in continuous transmission mode during all of the tests.



X axis mode



Y axis mode



Z axis mode

3.3 Test Step of EUT

- 3.3.1 Setup the fixture to EUT for power supplying.
- 3.3.2 Turn on the power of all equipment.
- 3.3.3 Let the EUT continuous transmission. Executed the test.

3.4 Test Equipment

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSP40	100478	2016/06/03
EMI Test Spectrum Analyzer & Receiver	Rohde & Schwarz	ESI7	830154/002	2016/09/24
Preamplifier	Burgeon	BPA-530	100216	2016/06/30
Preamplifier	Schaffner	CAP9231A	3351	2016/08/25
Preamplifier	Mini-Circuits	ZVA-213-S+	491801136	2016/08/25
Bilog Antenna	Schwarzbeck	VULB 9163	113	2016/07/26
Horn Antenna	Schwarzbeck	BBHA 9120	9120D-583	2016/09/29
Horn Antenna	Schwarzbeck	BBHA 9170	213	2016/07/19
Cable	HARBOUR	27478LL142	CBL22	2016/03/23
Cable	Jye Bao	N30N30-5006	CBL53	2016/03/30
Cable	HARBOUR	27478LL142	CBL65	2016/03/23

Note: The above equipments are within the valid calibration period.

4 Radiated Emission Test

4.1 Limits

According to FCC 15.231(e) requirement:

In addition to the provisions of §15.205, the field strength of emissions from intentional radiator operated under this section shall not exceed the following:

Fundamental and Harmonics Emission Limits

Frequency (MHz)	Field Strength of Fundamental		Field Strength of Harmonics	
	(μ V/m@3m)	(dB μ V/m@3m)	(μ V/m@3m)	(dB μ V/m@3m)
433.92	4399	72.8	439.9	52.8

General Radiated Emission Limit

Spurious Emission tested through until 10th harmonic. Radiated emissions, which fall in the restricted bands, as defined in §15.205 (a), comply with the radiated emission limits specified in §15.209 (a).

Frequency (MHz)	15.209 Limits	
	(μ V/m@3m)	(dB μ V/m@3m)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

Remark :

1. The table above tighter limit applies at the band edges.
2. The measurement distance in meters, which that between form closest point of EUT to instrument antenna.

4.2 Calculation of Average Factor

The output field strengths of specification in accordance with the FCC rules specify measurements with an average detector. During the test, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

The duty cycle is measured in 100 ms or the repetition cycle period, whichever is a shorter time frame. The duty cycle is measured by placing the spectrum analyzer to set zero span at 100kHz resolution bandwidth.

(For ASK)

Averaging factor in dB = $20 \log (\text{duty cycle})$

The duration of one cycle = 113.4ms

The duty cycle is simply the on-time divided by 100ms

Duty Cycle = $(0.488\text{ms} \times 2 + 0.252\text{ms} \times 6 + 0.132\text{ms} \times 38) =$
7.504 ms / 100ms

Therefore, the averaging factor is found by $20 \log 0.07504 =$
-22.49 dB

(For FSK)

Averaging factor in dB = $20 \log (\text{duty cycle})$

The duration of one cycle = 117.6ms

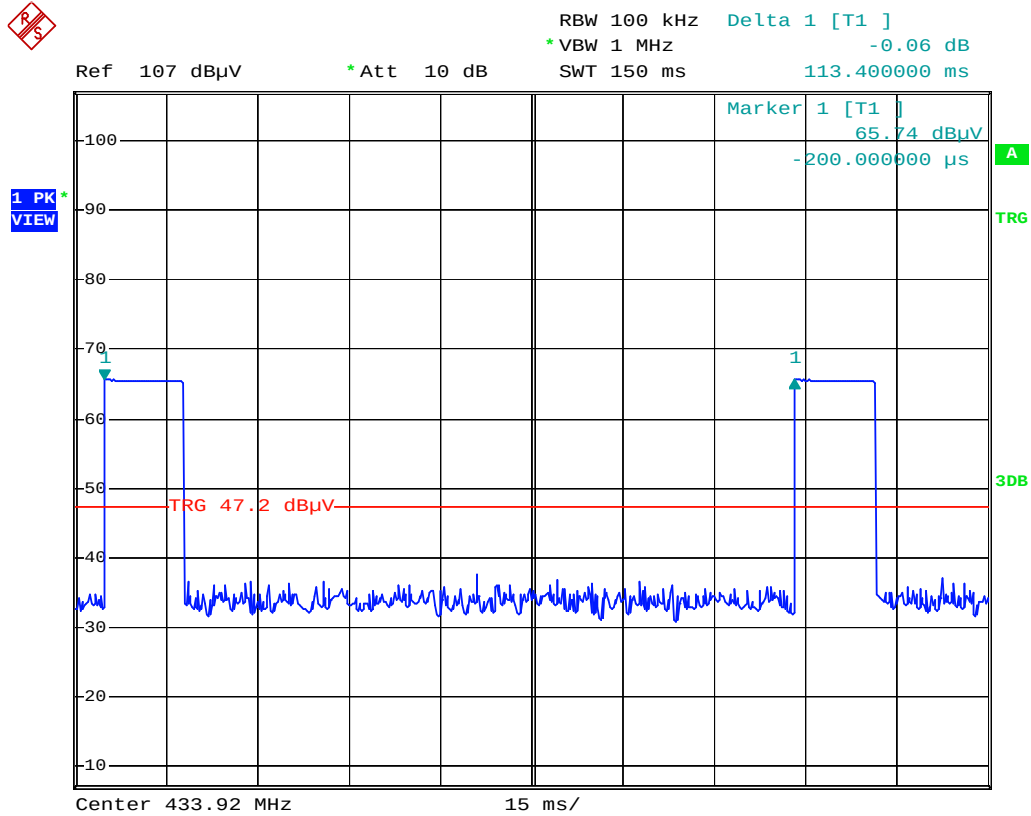
The duty cycle is simply the on-time divided by 100ms

Duty Cycle = $(0.5\text{ms} \times 2 + 0.26\text{ms} \times 6 + 0.13\text{ms} \times 38)$
= 7.50 ms / 100ms

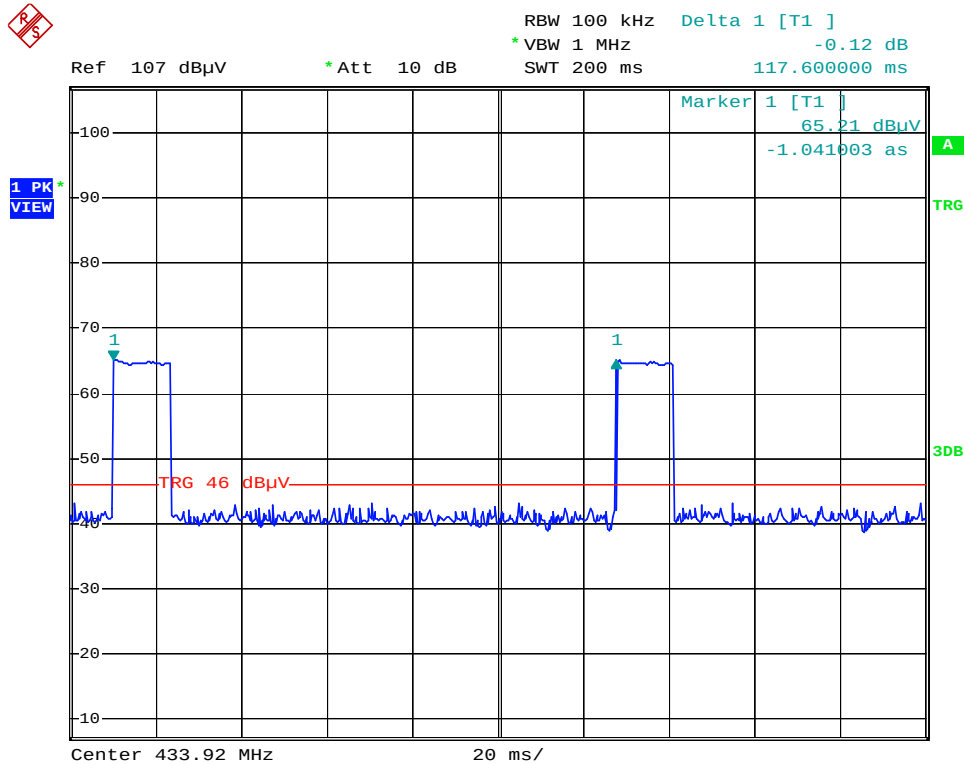
Therefore, the averaging factor is found by $20 \log 0.075 =$
-22.50 dB

Please see the diagrams below.

Duty Cycle

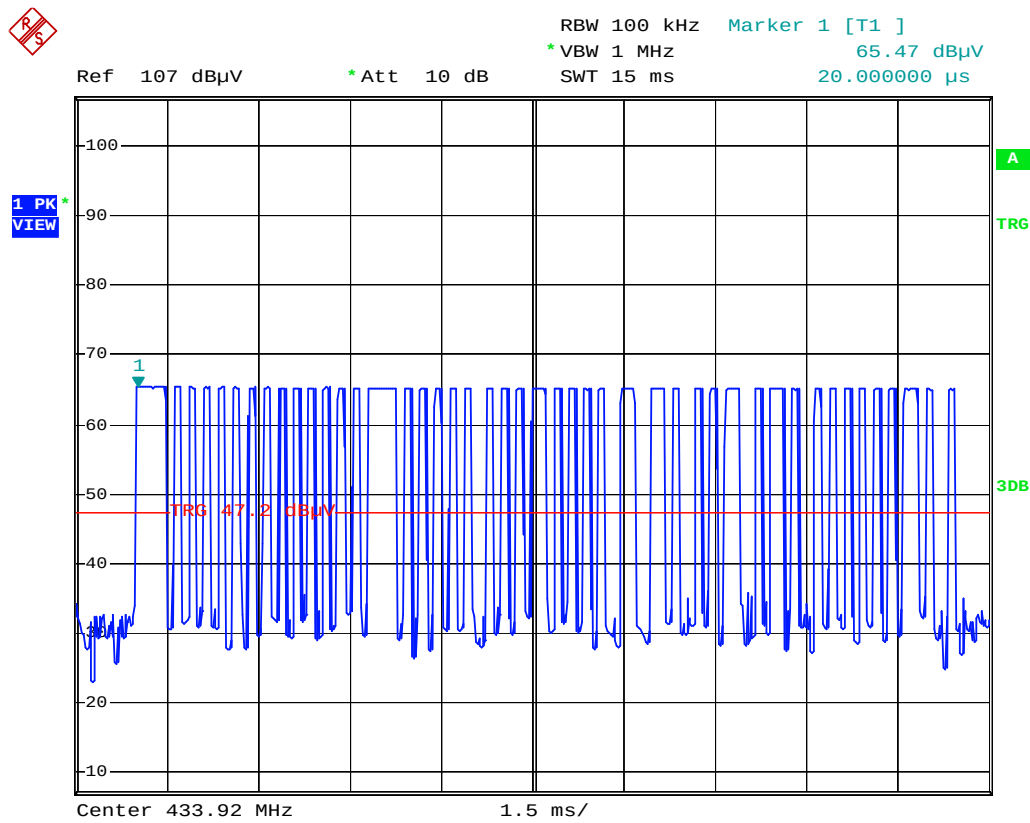


Duty Cycle (ASK)

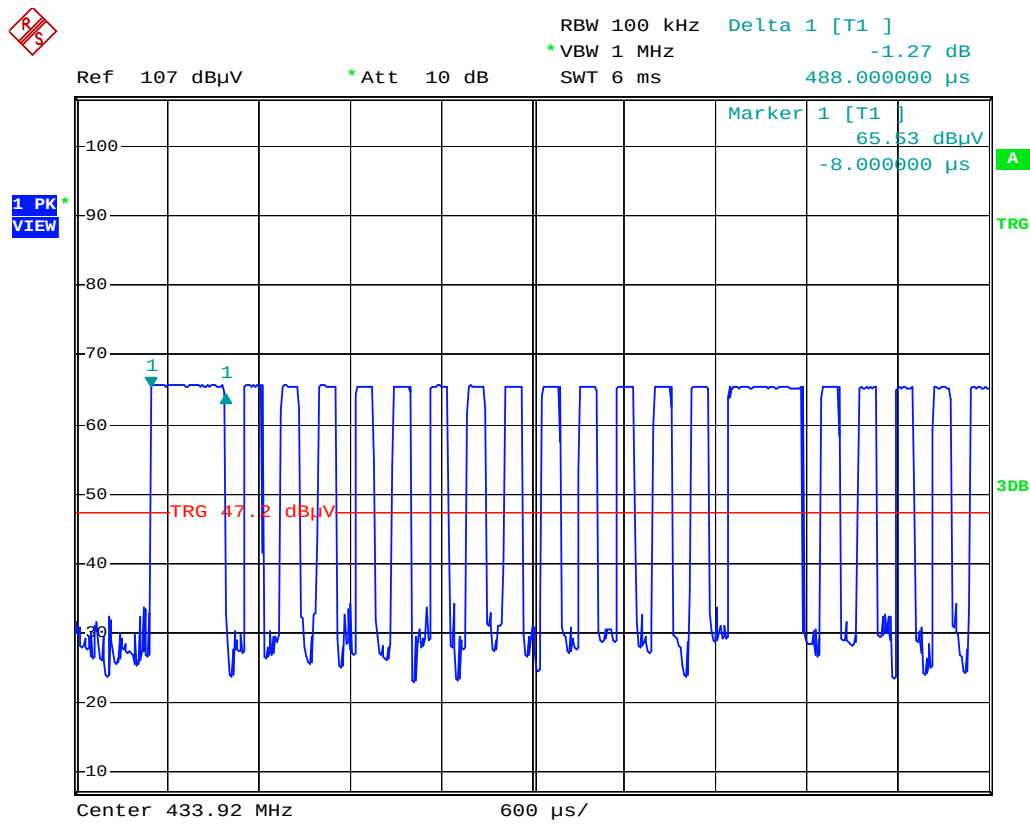


Duty Cycle (FSK)

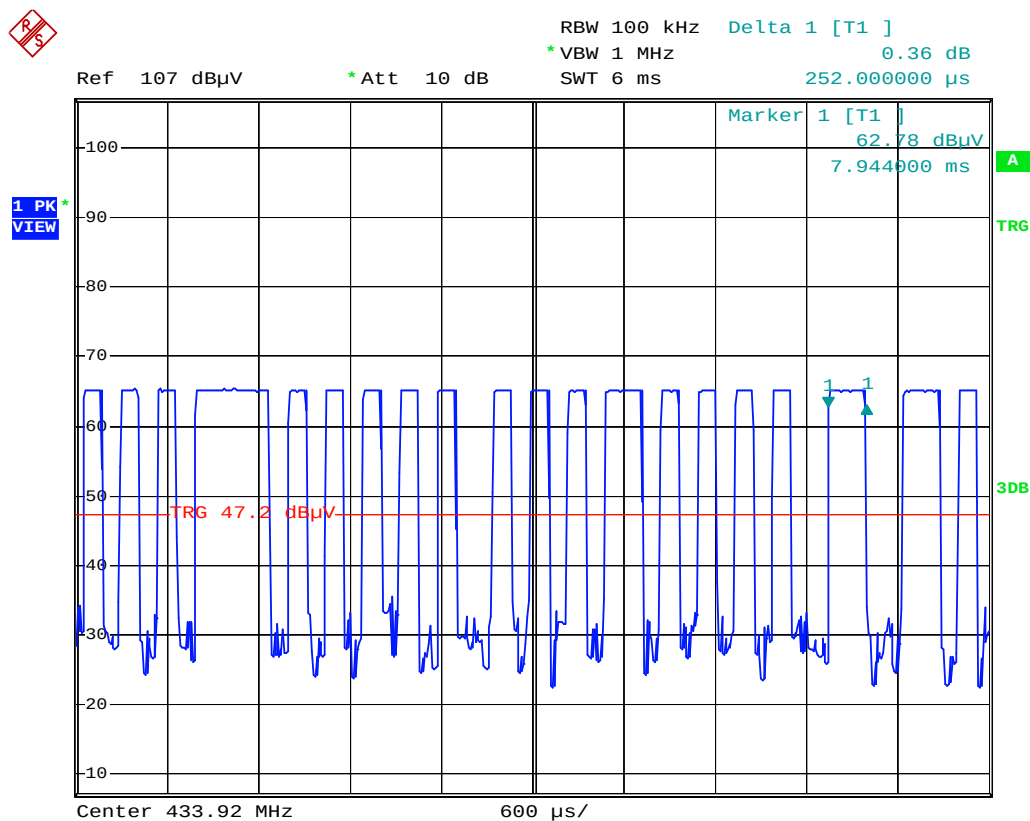
Time Slot (ASK)



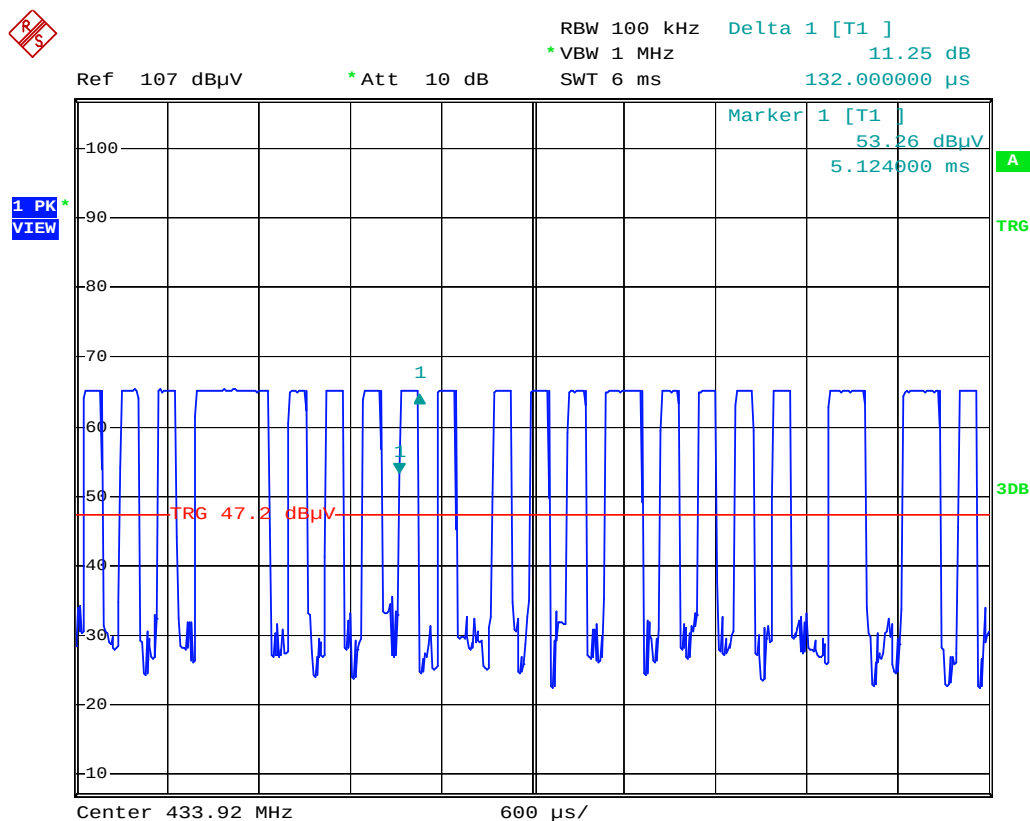
Time Slot



Time Slot -1

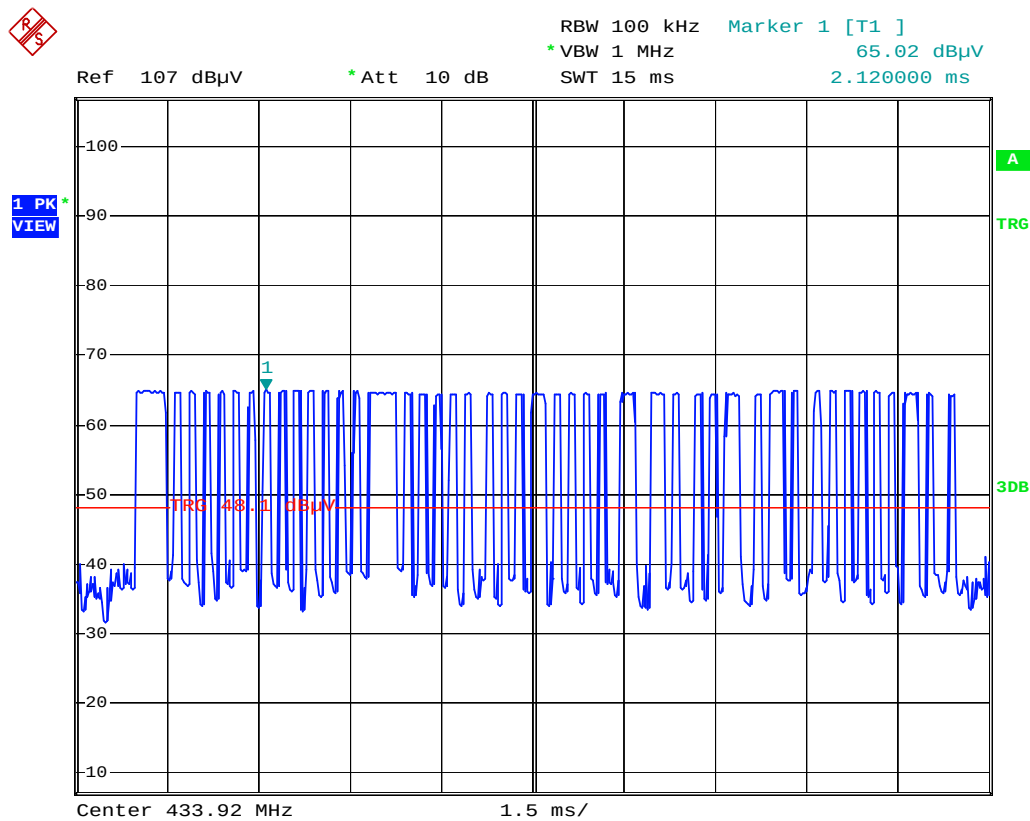


Time Slot -2

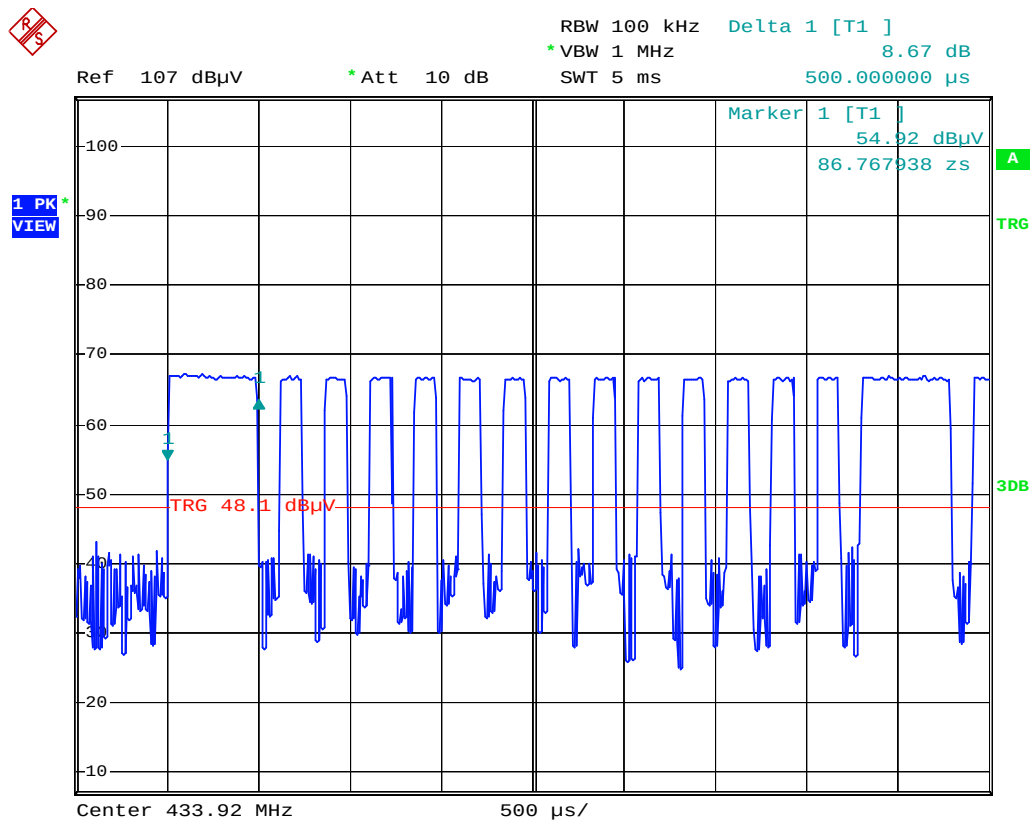


Time Slot -3

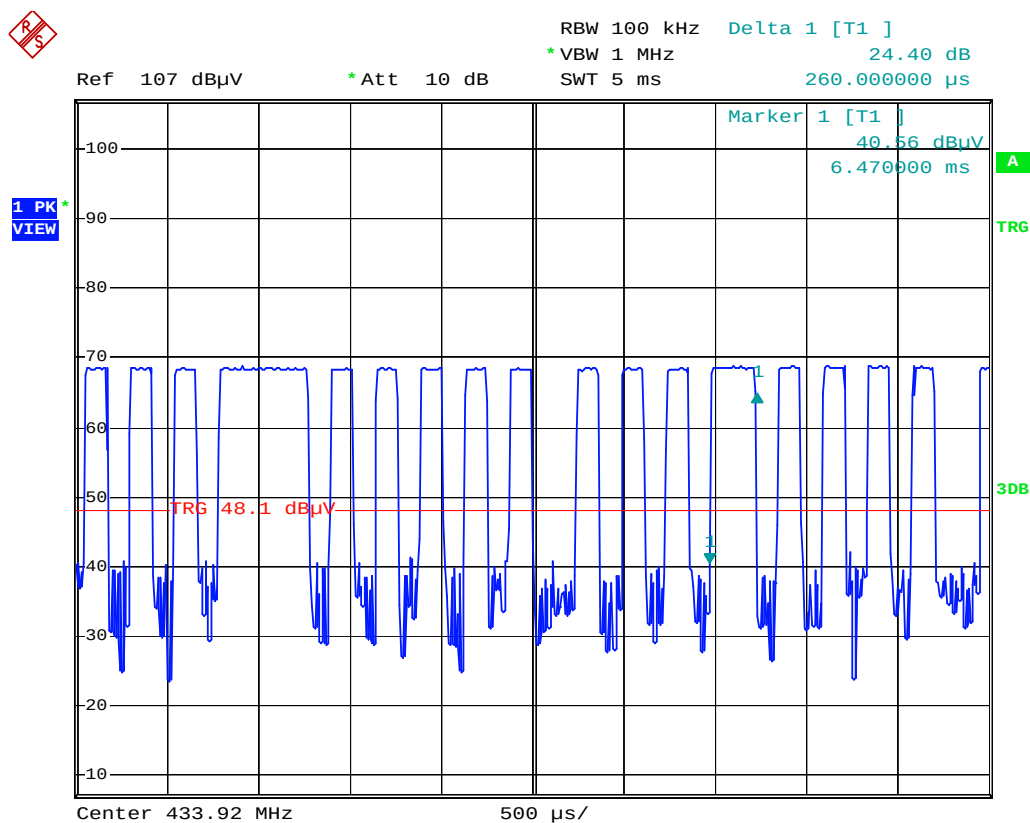
Time Slot (FSK)



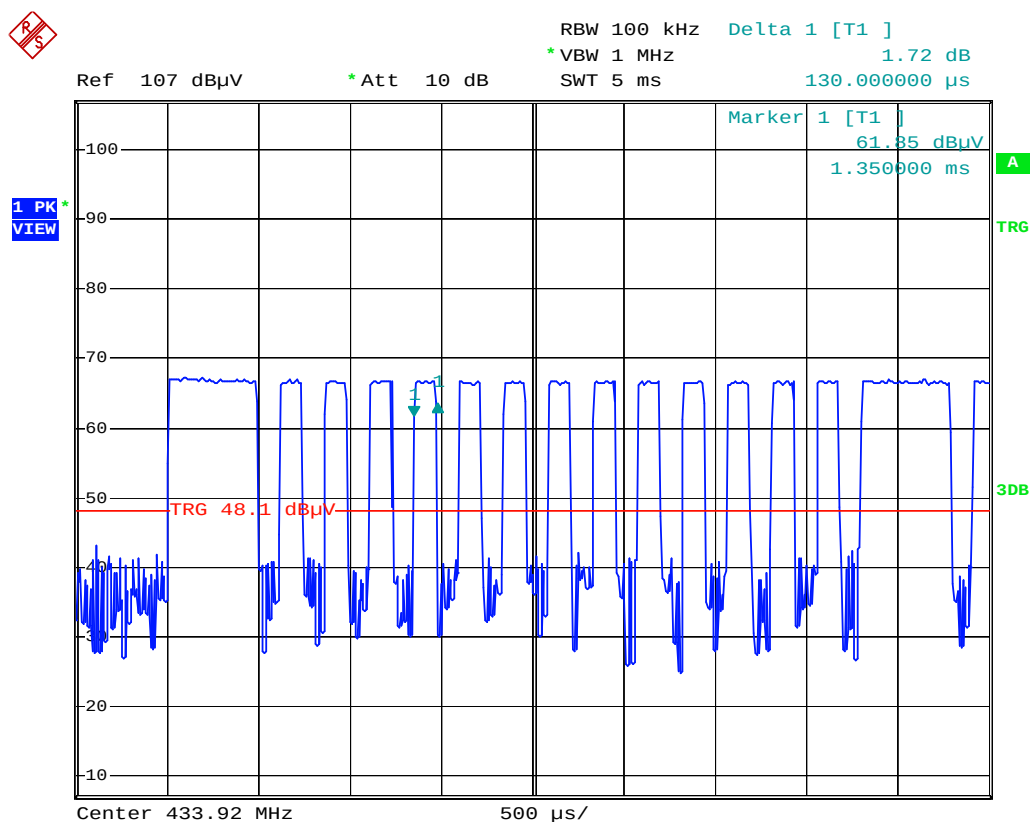
Time Slot



Time Slot -1



Time Slot -2



Time Slot -3

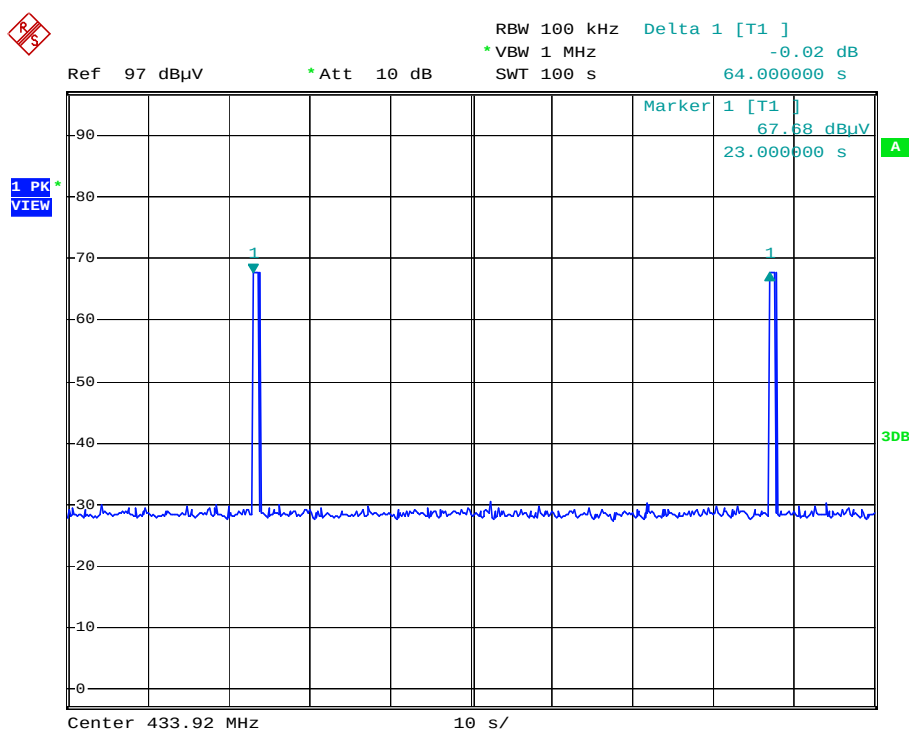
The EUT (ASK & FSK) was complied with the requirement of FCC 15.231 (e)

Result: 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

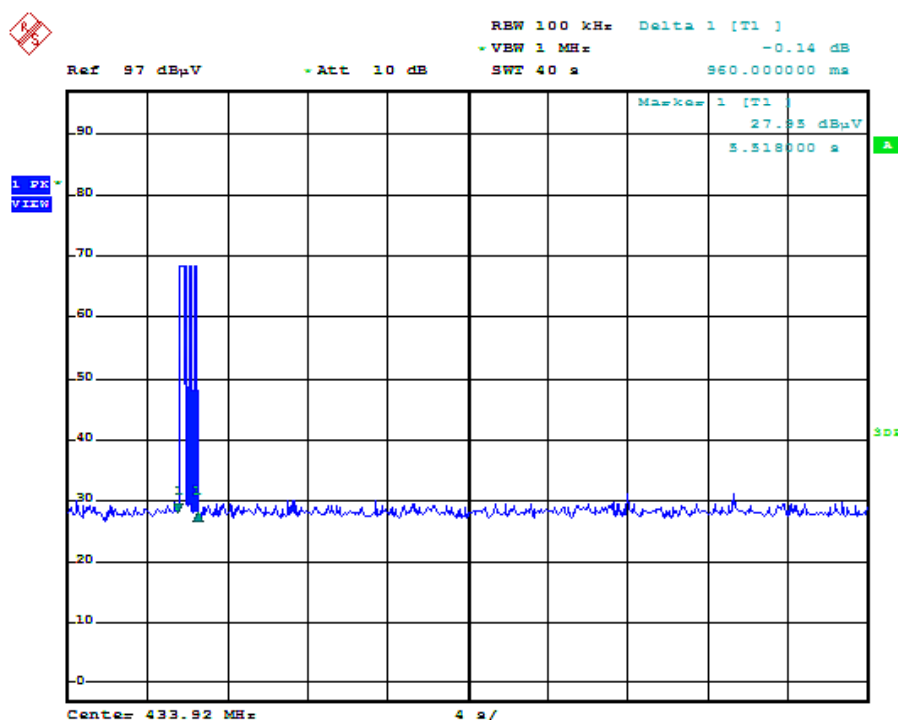
(For ASK)

Silent Period = Transmission Period – Transmission Time

	Time	Limit
Transmission Time	960ms	<1s
Transmission Period	64s	---
Silent Period	63.04s	>10s & > Transmission Time *30



Transmission Period (ASK)

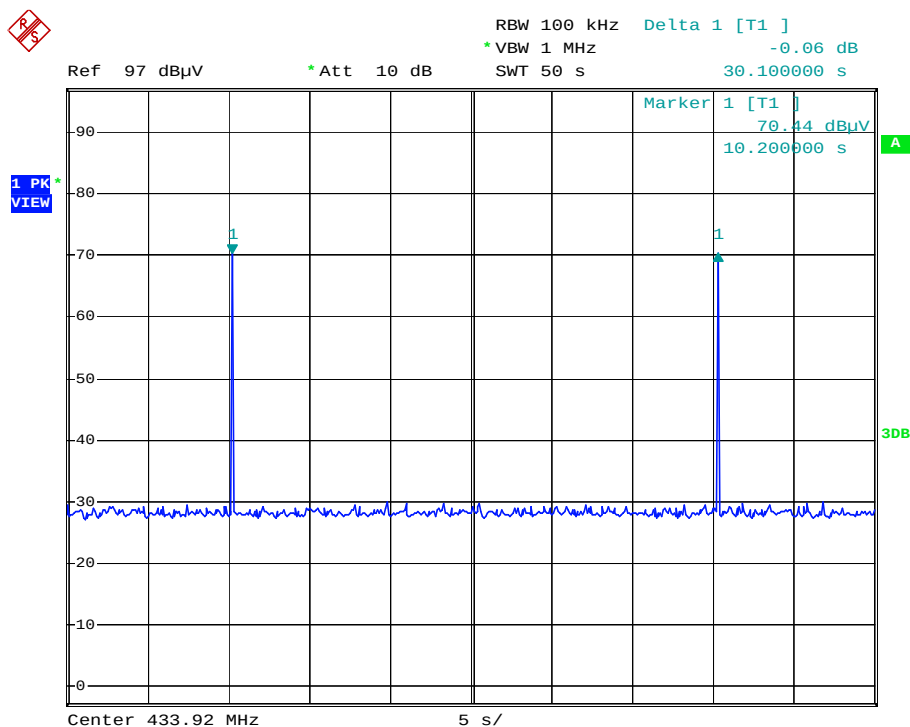


Transmission Time (ASK)

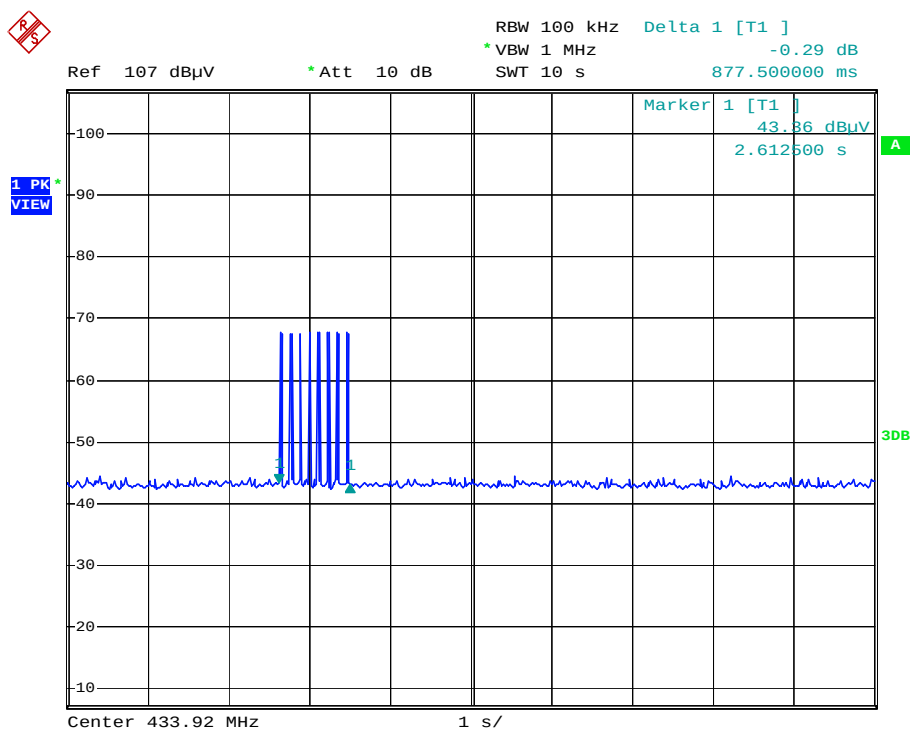
(For FSK)

Silent Period = Transmission Period – Transmission Time

	Time	Limit
Transmission Time	877.5ms	<1s
Transmission Period	30.1s	--
Silent Period	29.22s	>10s & > Transmission Time *30



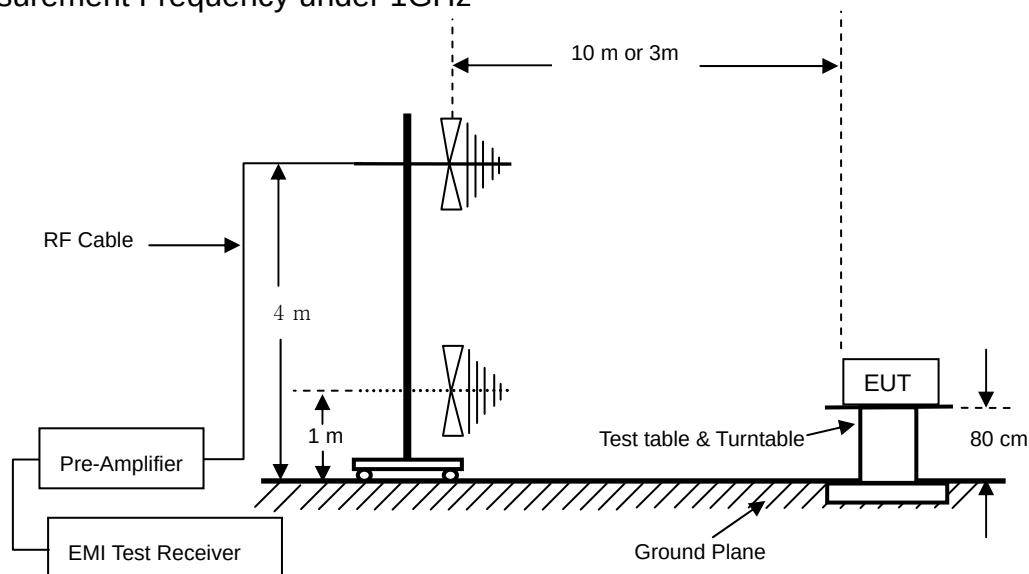
Transmission Period (FSK)



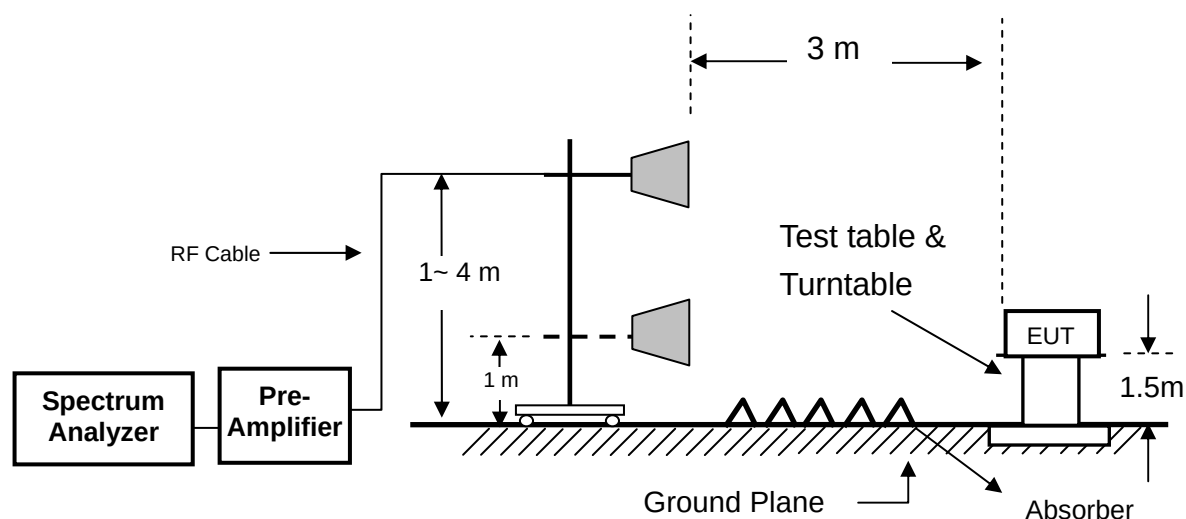
Transmission Time (FSK)

4.3 Configuration of Measurement

Measurement Frequency under 1GHz



Measurement Frequency above 1GHz



4.4 Test Procedure

Radiated emission measurements frequency range were performed from 30MHz to 5GHz. Spectrum Analyzer Resolution Bandwidth set to 100kHz or greater for frequencies from 30MHz to 1GHz, and set 1MHz Resolution Bandwidth for frequencies above 1GHz.

The EUT is place on non-conductive turntable for the test. If peripheral devices apply to the EUT, the peripheral devices will be connected to EUT and whole system. During the emission test, the signal is maximized through rotation and all cables were present worst-case emissions. The height of antenna and polarization is constantly changed for exploring maximum signal reading. The height of antenna can be up form reference ground to 4 meter and down to 1 meter.

4.5 Test Result

PASS.

The final test emission data is shown as following tables.

Radiated Emission Below 1GHz

Worse case: ASK Modulation (Z Axis)

Frequency	Antenna	Reading	Preamp	Correction Factor	Corrected Level	Limits	Margin	Det
(MHz)	Polarization	(dBuV)	(dB)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	Mode
73.49	H	45.38	30.62	7.61	22.37	40.00	-17.63	PK
133.97	H	41.06	30.07	16.13	27.12	43.52	-16.40	PK
203.88	H	38.50	29.82	19.76	28.44	43.52	-15.08	PK
356.89	H	39.72	29.45	19.44	29.71	46.02	-16.31	PK
314.20	H	41.20	29.53	18.59	30.26	46.02	-15.76	PK
453.18	H	37.26	29.25	21.98	29.99	46.02	-16.03	PK
117.30	V	41.09	30.13	14.87	25.83	43.52	-17.69	PK
180.40	V	37.94	29.90	19.43	27.47	43.52	-16.05	PK
226.79	V	40.00	29.76	20.64	30.88	46.02	-15.14	PK
311.65	V	39.78	29.54	18.56	28.80	46.02	-17.22	PK
430.20	V	38.61	29.30	21.62	30.93	46.02	-15.09	PK
493.67	V	37.80	29.17	22.69	31.32	46.02	-14.70	PK

Remark : Corrected Level = Reading + Correction Factor – Preamp
Correction Factor = Antenna Factor + Cable Loss

Fundamental and Harmonics Emissions

ASK

Fundamental and Harmonics emission (Worse: Z axis)

Freq.	Antenna	Reading	Preamp	Correction Factor	Average Factor	Corrected Level	Limits	Margin	Det
(MHz)	Polarization	(dBuV)	(dB)	(dB/m)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Mode
433.92 (X Axis)	H	48.75	0.00	21.68	--	70.43	92.87	-22.44	PK
433.92 (X Axis)	H	48.75	0.00	21.68	-22.49	47.94	72.87	-24.93	AV
433.92 (Y Axis)	H	54.23	0.00	21.68	--	75.91	92.87	-16.96	PK
433.92 (Y Axis)	H	54.23	0.00	21.68	-22.49	53.42	72.87	-19.45	AV
433.92 (Z Axis)	H	58.94	0.00	21.68	--	80.62	92.87	-12.25	PK
433.92 (Z Axis)	H	58.94	0.00	21.68	-22.49	58.13	72.87	-14.74	AV
867.84	H	54.53	29.48	29.68	--	54.73	72.87	-18.14	PK
867.84	H	54.53	29.48	29.68	-22.49	32.24	52.87	-20.63	AV
1301.76	H	61.42	27.38	28.27	--	62.31	74.00	-11.69	PK
1301.76	H	61.42	27.38	28.27	-22.49	39.82	54.00	-14.18	AV
1735.68	H	58.33	27.71	29.58	--	60.20	74.00	-13.80	PK
1735.68	H	58.33	27.71	29.58	-22.49	37.71	54.00	-16.29	AV
2169.60	H	59.97	27.86	31.04	--	63.15	74.00	-10.85	PK
2169.60	H	59.97	27.86	31.04	-22.49	40.66	54.00	-13.34	AV
2603.52	H	59.62	27.91	32.68	--	64.39	74.00	-9.61	PK
2603.52	H	59.62	27.91	32.68	-22.49	41.90	54.00	-12.10	AV
3037.44	H	50.38	27.91	33.89	--	56.36	74.00	-17.64	PK
3037.44	H	50.38	27.91	33.89	-22.49	33.87	54.00	-20.13	AV
3471.36	H	43.97	27.72	34.50	--	50.75	74.00	-23.25	PK
3471.36	H	43.97	27.72	34.50	-22.49	28.26	54.00	-25.74	AV
3905.28	H	41.10	27.82	36.14	--	49.42	74.00	-24.58	PK
3905.28	H	41.10	27.82	36.14	-22.49	26.93	54.00	-27.07	AV
4339.20	H	39.63	27.80	37.29	--	49.12	74.00	-24.88	PK
4339.20	H	39.63	27.80	37.29	-22.49	26.63	54.00	-27.37	AV
433.92 (X Axis)	V	54.94	0.00	21.68	--	76.62	92.87	-16.25	PK
433.92 (X Axis)	V	54.94	0.00	21.68	-22.49	54.13	72.87	-18.74	AV

433.92 (Y Axis)	V	50.35	0.00	21.68	--	72.03	92.87	-20.84	PK
433.92 (Y Axis)	V	50.35	0.00	21.68	-22.49	49.54	72.87	-23.33	AV
433.92 (Z Axis)	V	46.97	0.00	21.68	--	68.65	92.87	-24.22	PK
433.92 (Z Axis)	V	46.97	0.00	21.68	-22.49	46.16	72.87	-26.71	AV
867.84	V	49.35	29.48	29.68	--	49.55	72.87	-23.32	PK
867.84	V	49.35	29.48	29.68	-22.49	27.06	52.87	-25.81	AV
1301.76	V	60.17	27.38	28.27	--	61.06	74.00	-12.94	PK
1301.76	V	60.17	27.38	28.27	-22.49	38.57	54.00	-15.43	AV
1735.68	V	52.00	27.71	29.58	--	53.87	74.00	-20.13	PK
1735.68	V	52.00	27.71	29.58	-22.49	31.38	54.00	-22.62	AV
2169.60	V	62.88	27.86	31.04	--	66.06	74.00	-7.94	PK
2169.60	V	62.88	27.86	31.04	-22.49	43.57	54.00	-10.43	AV
2603.52	V	57.58	27.91	32.68	--	62.35	74.00	-11.65	PK
2603.52	V	57.58	27.91	32.68	-22.49	39.86	54.00	-14.14	AV
3037.44	V	53.05	27.91	33.89	--	59.03	74.00	-14.97	PK
3037.44	V	53.05	27.91	33.89	-22.49	36.54	54.00	-17.46	AV
3471.36	V	46.35	27.72	34.50	--	53.13	74.00	-20.87	PK
3471.36	V	46.35	27.72	34.50	-22.49	30.64	54.00	-23.36	AV
3905.28	V	42.57	27.82	36.14	--	50.89	74.00	-23.11	PK
3905.28	V	42.57	27.82	36.14	-22.49	28.40	54.00	-25.60	AV
4339.20	V	41.98	27.80	37.29	--	51.47	74.00	-22.53	PK
4339.20	V	41.98	27.80	37.29	-22.49	28.98	54.00	-25.02	AV

FSK

Fundamental and Harmonics emission (Worse: Z axis)

Freq.	Antenna	Reading	Preamp	Correction Factor	Average Factor	Corrected Level	Limits	Margin	Det
(MHz)	Polarization	(dBuV)	(dB)	(dB/m)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Mode
433.92 (X Axis)	H	39.09	0.00	21.68	--	60.77	92.87	-32.10	PK
433.92 (X Axis)	H	39.09	0.00	21.68	-22.50	38.27	72.87	-34.60	AV
433.92 (Y Axis)	H	46.70	0.00	21.68	--	68.38	92.87	-24.49	PK
433.92 (Y Axis)	H	46.70	0.00	21.68	-22.50	45.88	72.87	-26.99	AV
433.92 (Z Axis)	H	47.84	0.00	21.68	--	69.52	92.87	-23.35	PK
433.92 (Z Axis)	H	47.84	0.00	21.68	-22.50	47.02	72.87	-25.85	AV
867.84	H	54.86	29.48	29.68	--	55.06	72.87	-17.81	PK
867.84	H	54.86	29.48	29.68	-22.50	32.56	52.87	-20.31	AV
1301.76	H	59.98	27.38	28.27	--	60.87	74.00	-13.13	PK
1301.76	H	59.98	27.38	28.27	-22.50	38.37	54.00	-15.63	AV
1735.68	H	44.30	27.71	29.58	--	46.17	74.00	-27.83	PK
1735.68	H	44.30	27.71	29.58	-22.50	23.67	54.00	-30.33	AV
2169.60	H	41.27	27.86	31.04	--	44.45	74.00	-29.55	PK
2169.60	H	41.27	27.86	31.04	-22.50	21.95	54.00	-32.05	AV
2603.52	H	49.12	27.91	32.68	--	53.89	74.00	-20.11	PK
2603.52	H	49.12	27.91	32.68	-22.50	31.39	54.00	-22.61	AV
3037.44	H	44.66	27.91	33.89	--	50.64	74.00	-23.36	PK
3037.44	H	44.66	27.91	33.89	-22.50	28.14	54.00	-25.86	AV
3471.36	H	40.29	27.72	34.50	--	47.07	74.00	-26.93	PK
3471.36	H	40.29	27.72	34.50	-22.50	24.57	54.00	-29.43	AV
3905.28	H	38.24	27.82	36.14	--	46.56	74.00	-27.44	PK
3905.28	H	38.24	27.82	36.14	-22.50	24.06	54.00	-29.94	AV
4339.20	H	36.31	27.80	37.29	--	45.80	74.00	-28.20	PK
4339.20	H	36.31	27.80	37.29	-22.50	23.30	54.00	-30.70	AV
433.92 (X Axis)	V	43.47	0.00	21.68	--	65.15	92.87	-27.72	PK

433.92 (X Axis)	V	43.47	0.00	21.68	-22.50	42.65	72.87	-30.22	AV
433.92 (Y Axis)	V	40.85	0.00	21.68	--	62.53	92.87	-30.34	PK
433.92 (Y Axis)	V	40.85	0.00	21.68	-22.50	40.03	72.87	-32.84	AV
433.92 (Z Axis)	V	38.37	0.00	21.68	--	60.05	92.87	-32.82	PK
433.92 (Z Axis)	V	38.37	0.00	21.68	-22.50	37.55	72.87	-35.32	AV
867.84	V	50.89	29.48	29.68	--	51.09	72.87	-21.78	PK
867.84	V	50.89	29.48	29.68	-22.50	28.59	52.87	-24.28	AV
1301.76	V	52.45	27.38	28.27	--	53.34	74.00	-20.66	PK
1301.76	V	52.45	27.38	28.27	-22.50	30.84	54.00	-23.16	AV
1735.68	V	47.62	27.71	29.58	--	49.49	74.00	-24.51	PK
1735.68	V	47.62	27.71	29.58	-22.50	26.99	54.00	-27.01	AV
2169.60	V	41.62	27.86	31.04	--	44.80	74.00	-29.20	PK
2169.60	V	41.62	27.86	31.04	-22.50	22.30	54.00	-31.70	AV
2603.52	V	44.04	27.91	32.68	--	48.81	74.00	-25.19	PK
2603.52	V	44.04	27.91	32.68	-22.50	26.31	54.00	-27.69	AV
3037.44	V	41.00	27.91	33.89	--	46.98	74.00	-27.02	PK
3037.44	V	41.00	27.91	33.89	-22.50	24.48	54.00	-29.52	AV
3471.36	V	40.95	27.72	34.50	--	47.73	74.00	-26.27	PK
3471.36	V	40.95	27.72	34.50	-22.50	25.23	54.00	-28.77	AV
3905.28	V	38.43	27.82	36.14	--	46.75	74.00	-27.25	PK
3905.28	V	38.43	27.82	36.14	-22.50	24.25	54.00	-29.75	AV
4339.20	V	34.65	27.80	37.29	--	44.14	74.00	-29.86	PK
4339.20	V	34.65	27.80	37.29	-22.50	21.64	54.00	-32.36	AV

Remark :

1. Corrected Level = Reading + Correction Factor – Preamp
2. Correction Factor = Antenna Factor + Cable Loss
3. “ * ” Mark indicated Background Noise Level

5 Emission Bandwidth

5.1 Limits

According to FCC 15.231(c) requirement:

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating between 70 MHz to 900 MHz. Those devices operating above 900 MHz, the emission spurious shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

B.W (20dBc) Limit = $0.25\% * f(\text{MHz}) = 0.25\% * 433.92\text{MHz} = 1084.8\text{kHz}$

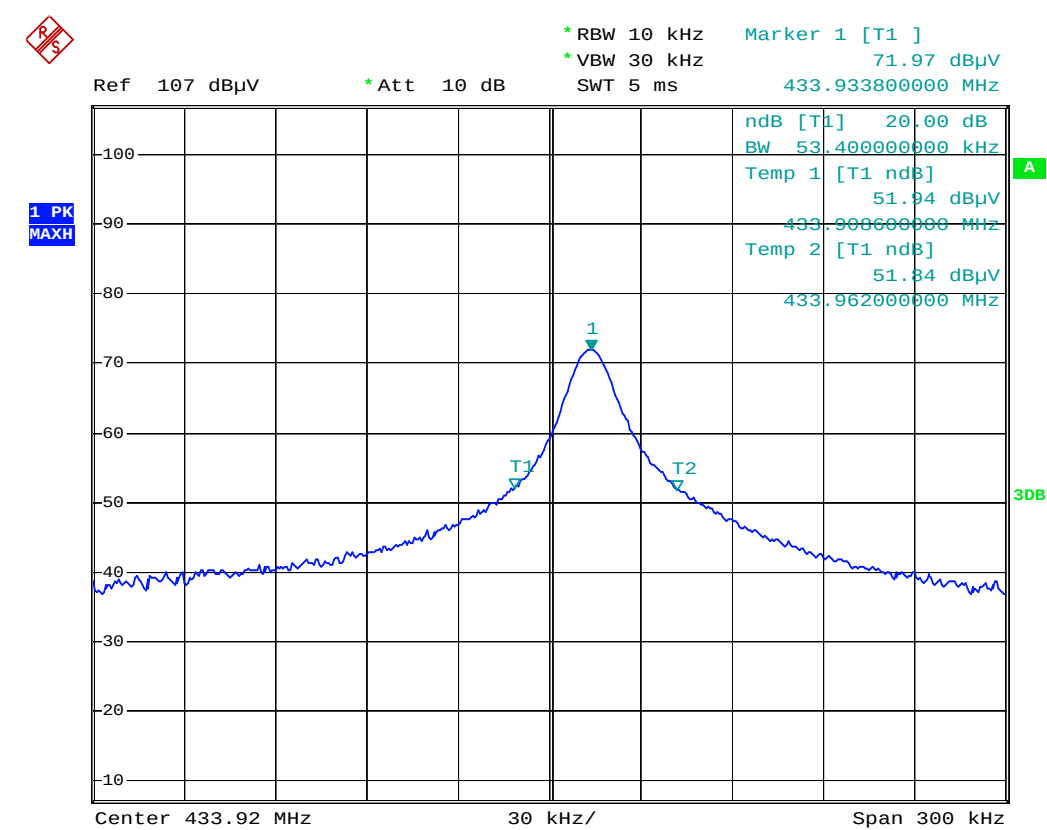
5.2 Test Result

PASS.

The final test data is shown as following.

20dB Bandwidth (ASK)

Channel Frequency (MHz)	Measured 20dB Bandwidth (kHz)	Limit (kHz)	Result
433.92	53.4	1084.8	PASS



20dB Bandwidth (FSK)

Channel Frequency (MHz)	Measured 20dB Bandwidth (kHz)	Limit (kHz)	Result
433.92	137.275	1084.8	PASS

