FCC Test Report

Report No.:	OKA-ESH-P21052103B-2
FCC ID:	2AYF8-KEYEA10A
Product:	KEY
Test Model:	KEYEA10A
Received Date:	Jul.16, 2021
Test Date:	Jul.16 to Aug.12.2021
Issued Date:	Aug.18, 2021
Applicant:	Zhejiang Okai Vehicle Co., Ltd.
Address:	No. 9, Xinxing Road, Xinbi Town, Jinyun County, Zhejiang, China
Manufacturer:	Zhejiang Okai Vehicle Co., Ltd.
Address:	No. 9, Xinxing Road, Xinbi Town, Jinyun County, Zhejiang, China
Issued By:	BUREAU VERITAS ADT (Shanghai) Corporation
Lab Address:	No. 829, Xinzhuan Road, Shanghai, P.R.China (201612)

ACCREDITED
Test Lab
Cert 2343.01

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Release Control Record

Issue No.	Description	Date Issued
OKA-ESH-P21052102B-2	Original release	Aug.18, 2021

1 Certificate of Conformity

Product: KEY

Brand: OKAI

Test Model: KEYEA10A

Applicant: Zhejiang Okai Vehicle Co., Ltd.

Test Date: Jul.16 to Aug.12.2021

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.231)
ANSI C63.10:2013

The above equipment has been tested by **BUREAU VERITAS ADT (Shanghai) Corporation**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Yuan Zhang , **Date:** Aug.18, 2021

Yuan ZHANG

Project Engineer

Approved by : , **Date:** Aug.18, 2021

Daniel SUN

EMC Lab Manager

2 Summary of Test Results

The EUT has been tested according to the following specifications:

47 CFR FCC Part 15, Subpart C			
FCC Clause	Test Item	Result	Remarks
15.203	Antenna Requirement	PASS	No antenna connector is used.
15.207	AC Power Conducted Emission	NA	The EUT is powered by battery.
15.231(c)	20dB Spectrum Bandwidth	PASS	Meet the requirement of limit.
15.231(a)	Dwell Time	PASS	Meet the requirement of limit.
15.231(e)	Field Strength of Fundamental Emissions	PASS	Meet the requirement of limit.
15.225 / 15.209 /	Radiated Emissions Measurement	PASS	Meet the requirement of limit.

2.1 Test Instruments

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Hybrid Antenna(25MHz-1.5GHz)	Schwarzbeck	VULB9168	E1A1012	Jul.29, 20	Jul.28, 22
Horn Antenna(1GHz -18GHz)	Schwarzbeck	BBHA9120D	E1A1017	Aug.25, 20	Aug.24, 22
Double Ridge Horn Antenna(18G-40G)	COM-POWER	AH-840	E1A1040	Jul.15, 20	Jul.14, 22
Pre-Amplifier(100kHz-1.3GHz)	Agilent	8447D	E1A2001	Apr.19, 21	Apr.18, 22
Pre-Amplifier(0.5GHz-18GHz)	EMCI	EMC184045SE	E1A2009	Jul.05, 21	Jul.04, 22
Pre-Amplifier(18GHz-40GHz)	EMCI	EMC051845SE	E1A2008	Jul.05, 21	Jul.04, 22
EMI test recerver	R&S	ESR7	E1R1005	Apr.19, 21	Apr.18, 22
Spectrum Analyzer	Keysight	N9030B	E1S1003	Jul.22, 21	Jul.21, 22
Spectrum Analyzer	Keysight	N9020A	E1S1004	Mar.02, 21	Mar.01, 22
EMI test recerver	R&S	ESCS30	E1R1001	May.11, 21	May.10, 22
LISN	R&S	ENV216	E1L1011	May.11, 21	May.10, 22
Humidity&Temp Tester	Baolima	WS508	E1H1011	Apr. 02, 21	Apr. 01, 22
RF Control Unit	Toscend	JS0806-2	E1C5003	N/A	N/A
Test Software	ADT	ADT_COND_V7.3.1	N/A	N/A	N/A
Test Software	Toscend	JS32-RE	N/A	N/A	N/A
Test Software	Toscend	JS1120	N/A	N/A	N/A
Test Software	Toscend	JS1120-3	N/A	N/A	N/A

2.2 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.83 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.36 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	3.47 dB
	6GHz ~ 18GHz	3.75 dB
	18GHz ~ 40GHz	3.30 dB

2.3 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	KEY
Brand	OKAI
Test Model	KEYEA10A
Power Rating	Powered by battery
Modulation Type	ASK
Operating Frequency	433.92MHz
Number of Channel	1
Antenna Type	PCB Antenna
Antenna Connector	--

Note:

1. For more details, please refer to the User's manual of the EUT.

3.2 Description of Test Modes

CHANNEL	FREQUENCY	MODULATION TYPE
1	433.92 MHz	ASK

3.2.1 Test Mode Applicability:

EUT Configure Mode	Applicable to					Description
	RE (9 kHz~30MHz)	RE (30MHz~1GHz)	PLC	BW	DW	
-	√	√	-	√	√	-

Where **RE≥1G:** Radiated Emission above 1GHz **RE< 1G:** Radiated Emission below 1GHz

PLC: Power Line Conducted Emission **BW: 20dB Spectrum Bandwidth**

DW: Dwell Time

NOTE:
Pre-scanned tests, X, Y, Z in three orthogonal panels to determine the final configuration (Z plane as worst plane) from all possible combinations.

Radiated Emission Test RE (9 kHz~30MHz):

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
-	TX	433.92 MHz	433.92 MHz	ASK

Radiated Emission Test RE (30MHz~1GHz):

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
-	TX	433.92 MHz	433.92 MHz	ASK

Power Line Conducted Emission Test:

☐ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
-	TX	433.92 MHz	433.92 MHz	ASK

20dB Spectrum Bandwidth

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
-	TX	433.92 MHz	433.92 MHz	ASK

Dwell Time

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
-	TX	433.92 MHz	433.92 MHz	ASK

3.2.2 Test Condition:

Applicable to	Normal Environmental Conditions	Normal Input Power
RE (9 kHz~30MHz)	23deg. C, 58%RH	Battery
RE (30MHz~1GHz)	23deg. C, 58%RH	Battery
PLC	--	Battery
BW	25deg. C, 60%RH	Battery
DW	25deg. C, 60%RH	Battery

3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units.

3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standard:

FCC Part 15, Subpart C (15.231)

ANSI C63.10:2013

All relaxed test items have been performed and recorded as per the above standard.

4 Test Procedure and Results

4.1 AC Power Conducted Emission

4.1.1 Limits

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.1.2 Test Procedures

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

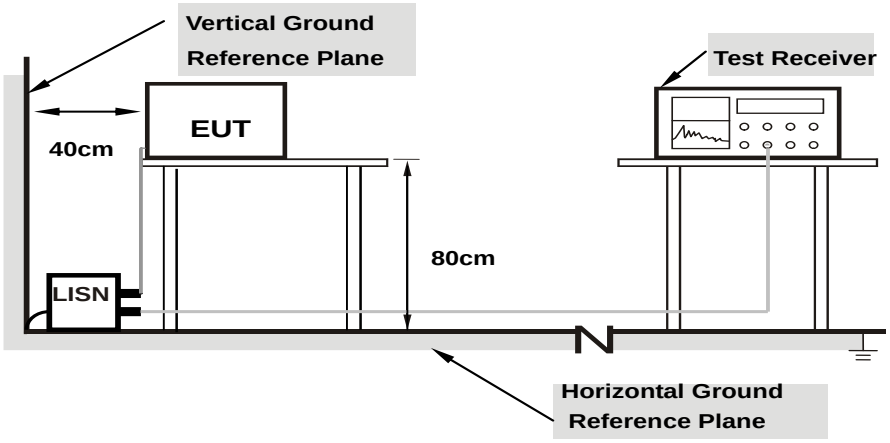
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.1.3 Deviation from Test Standard

No deviation.

4.1.4 Test Setup



Note: 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.5 EUT Operating Conditions

Same as 4.1.6.

4.1.6 Test Results

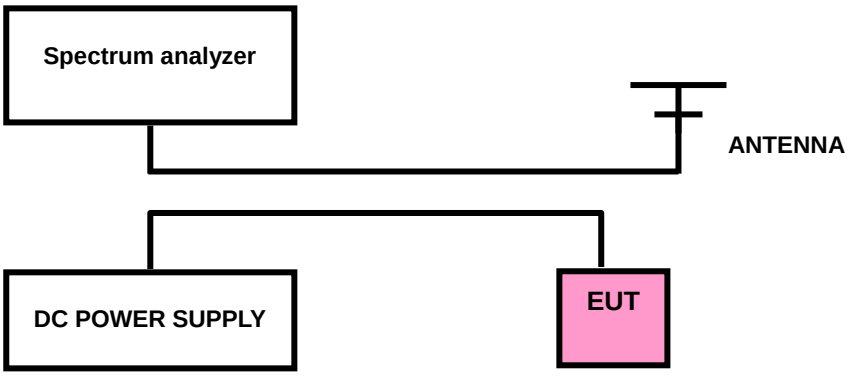
Not applicable. The EUT is powered by battery.

4.2 20dB Spectrum Bandwidth Measurement

4.2.1 Limit

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

4.2.2 Test Setup



4.2.3 Test Procedures

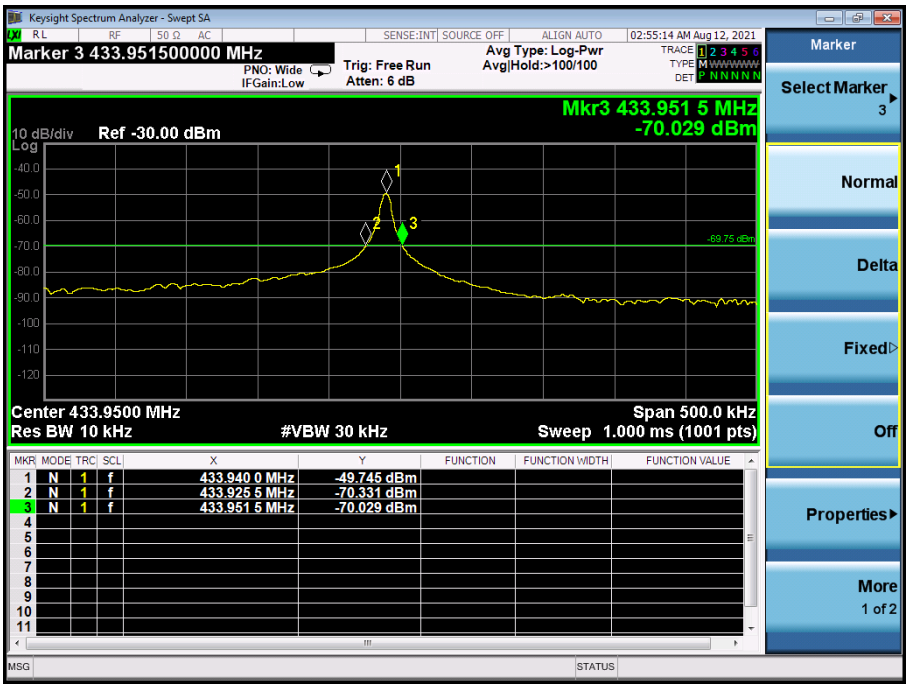
1. The resolution bandwidth of 10 kHz and the video bandwidth of 30 kHz were used.
2. EUT in peak Max hold mode.
3. Measured the spectrum width with power higher than 20dB below carrier.

4.2.4 Deviation of Test Standard

No deviation.

4.2.5 Test Results

20dB bandwidth (kHz)	F_L (MHz)	F_H (MHz)	Limit(MHz)	Result
26.0	433.9255	433.9515	1084.80	Pass

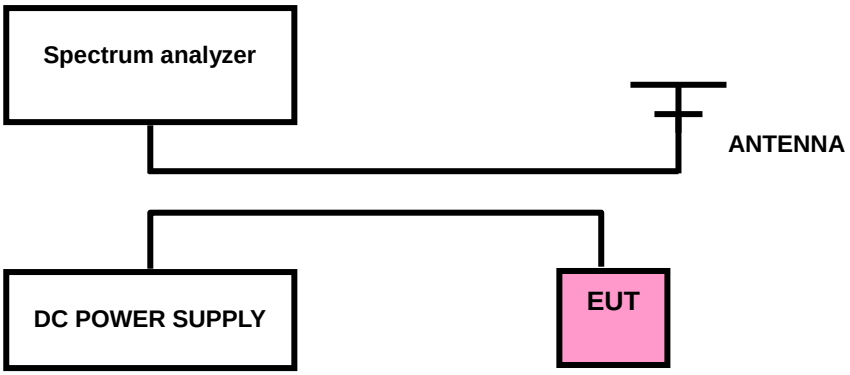


4.3 Dwell Time Measurement

4.3.1 Limit

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

4.3.2 Test Setup



4.3.3 Test Procedures

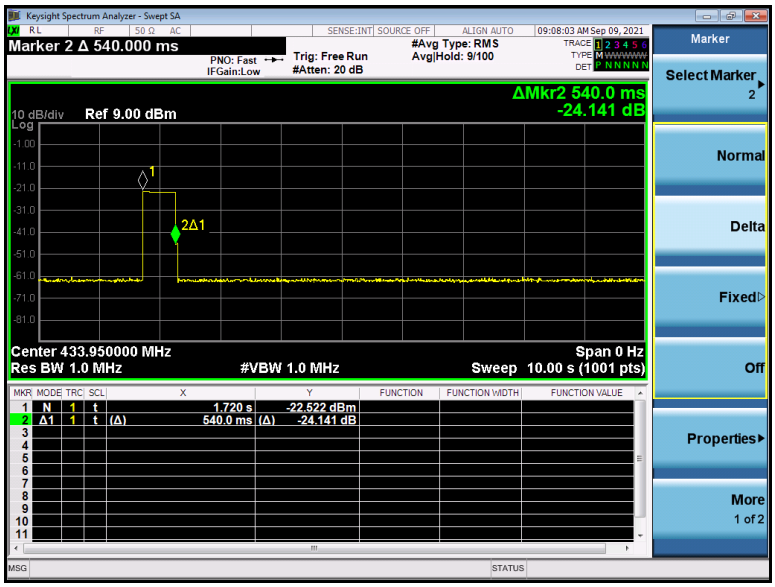
1. The resolution bandwidth of 1 MHz and the video bandwidth of 1 MHz were used.
2. EUT in peak Max hold mode.
3. Measured the spectrum width with power higher than 20dB below carrier.

4.3.4 Deviation of Test Standard

No deviation.

4.3.5 Test Results

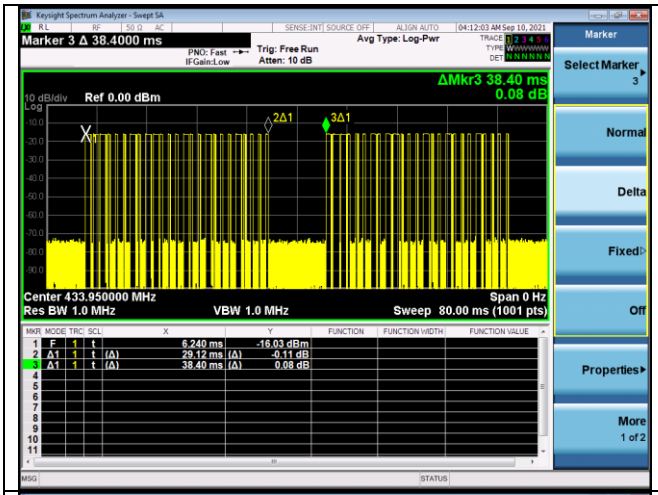
Frequency(MHz)	Transmission Time(s)	Limit(s)	Results
433.92	0.54	≤5	Pass

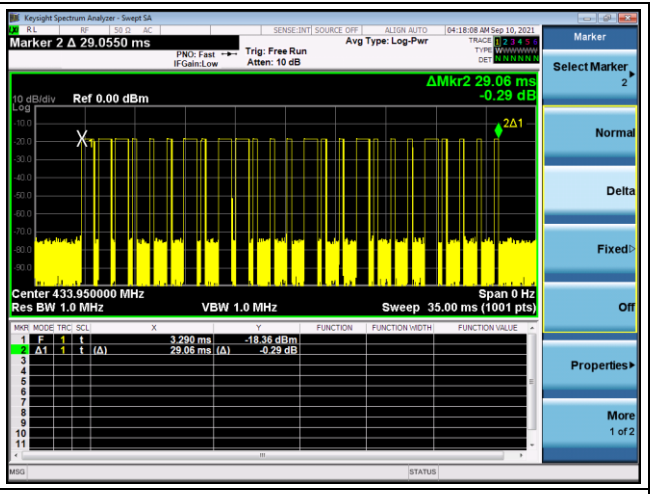


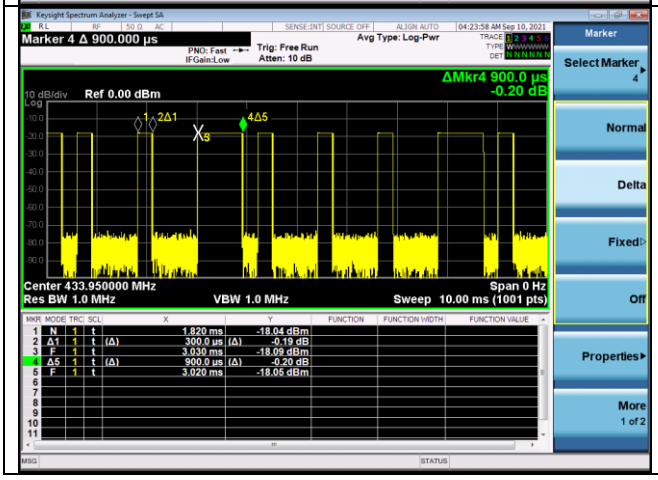
Type of Pulse	Width of Pulse (ms)	Quantity of Pulse	Transmission Time (ms)	Total Time (Ton) (ms)
Pulse 1	0.9	9	8.1	12.9
Pulse 2	0.3	16	4.8	

Transmission Time(ms)	Total Time(ms)	Duty Cycle(%)	Duty Cycle Factory(dB)
12.9	38.40	33.59	-9.48

Duty Cycle Factor=20*log(Duty Cycle)







None

Note:

The measured pulse width (PW) is 0.3 ms.

2/PW=2/0.3 ms=6.67 KHz

RBW used for duty cycle testing=1MHz=1000KHz > 6.67 Hz(2/PW)

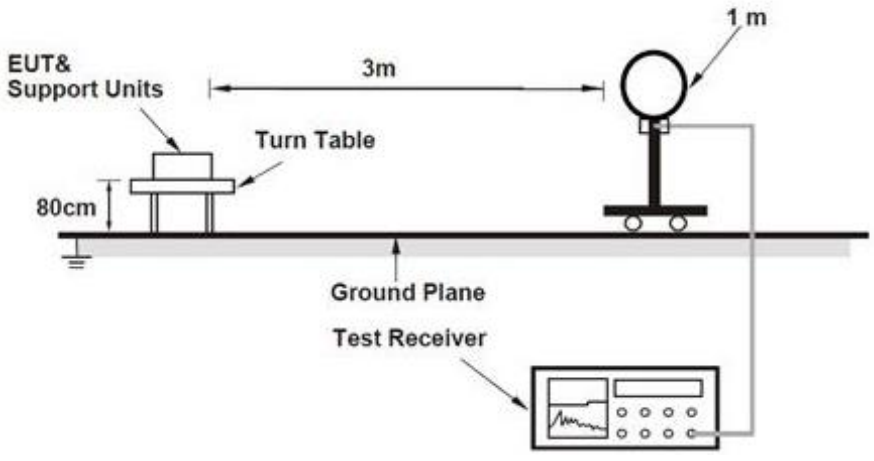
Therefore PDCF (pulse desensitization correction factor) is not required.

4.4 Field Strength of Fundamental Emissions and Mask Measurement

4.4.1 Test Limit

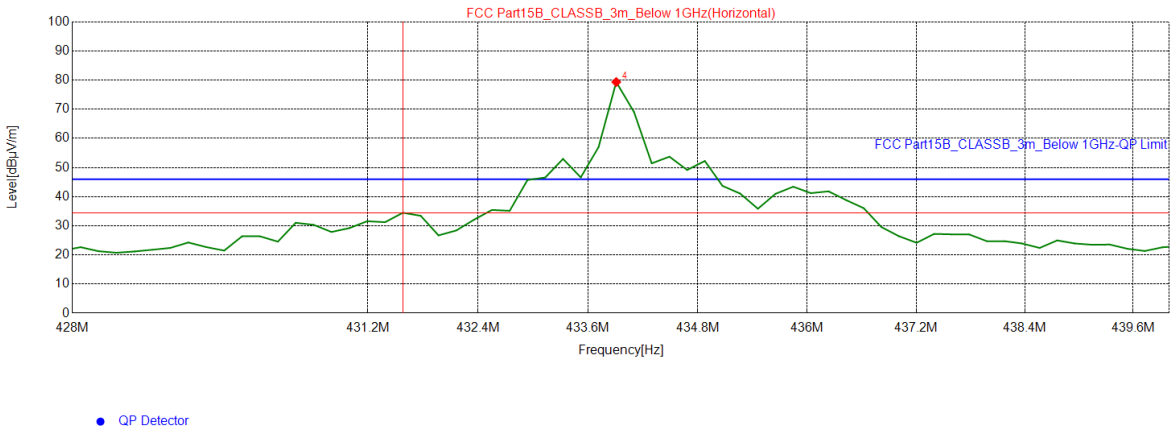
Rules and specifications	FCC CFR 47 Part 15 section 15.225			
Description	Compliance with the spectrum mask is tested with RBW set to 9kHz.			
Freq. of Emission (MHz)	Field Strength (μV/m) at 30m	Field Strength (dBμV/m) at 30m	Field Strength (dBμV/m) at 10m	Field Strength (dBμV/m) at 3m
1.705~13.110	30	29.5	48.58	69.5
13.110~13.410	106	40.5	59.58	80.5
13.410~13.553	334	50.5	69.58	90.5
13.553~13.567	15848	84.0	103.08	124.0
13.567~13.710	334	50.5	69.58	90.5
13.710~14.010	106	40.5	59.58	80.5
14.010~30.000	30	29.5	48.58	69.5

4.4.2 Test Setup

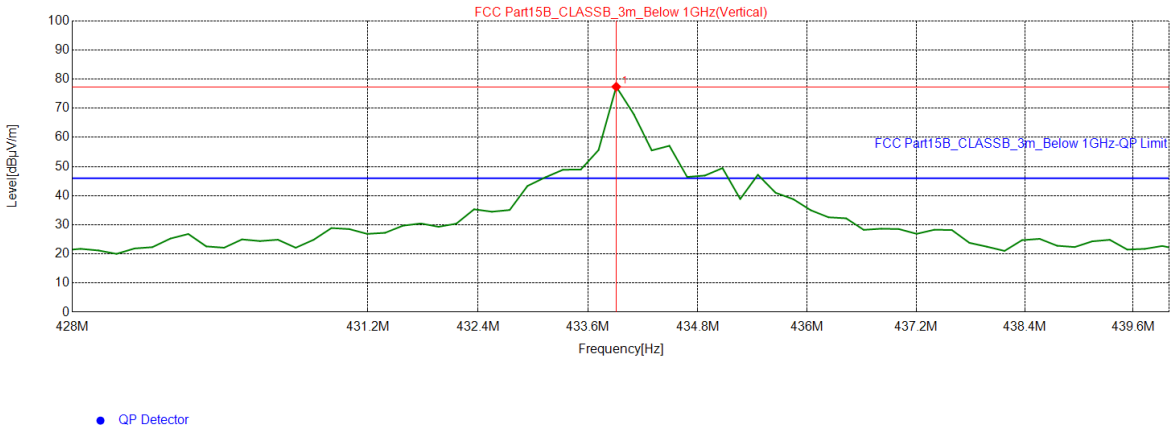


4.4.3 Test Results

Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Duty Cycle Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Detector
433.92	84.85	-5.51	-	79.34	100.82	21.48	H	PK
433.92	-	-	-9.48	69.86	80.82	10.96	H	AV



Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Duty Cycle Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Detector
433.92	82.89	-5.51	-	77.38	100.82	23.44	V	PK
433.92	-	-	-9.48	67.90	80.82	12.92	V	AV



Margin [dB] =Limit [dBµV/m] – Level [dBµV/m]

4.5 Radiated Emissions Measurement

For 15.205 requirement:

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) of FCC part15, must also comply with the radiated emission limits specified in Section 15.209(a).

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (GHz)
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
1 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(2)
13.36 - 13.41	--	--	--

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47CFR must not exceed the limits shown in Table per Section 15.209.

FCC Part 15 Subpart C Paragraph 15.209		
Frequency [MHz]	Field Strength [uV/m]	Measured Distance [Meters]
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

4.5.1 Test Procedure Reference

ANSI C63.10 Section 6.3 (General Requirements)

4.5.2 Test Procedures

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector.

Receiver Parameter	Setting
Frequency Range: 9kHz~150kHz	RBW 200Hz for QP
Frequency Range: 150kHz~30MHz	RBW 9kHz for QP
Frequency Range: 30MHz~1000MHz	RBW 120kHz for Peak

For Radiated emission below 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degree to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. Both X and Y axes of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and the rotate table was turned from 0 degree to 360 degree to find the maximum reading.

e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

For Radiated emission above 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1 GHz) / 1.5 meters (for above 1 GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

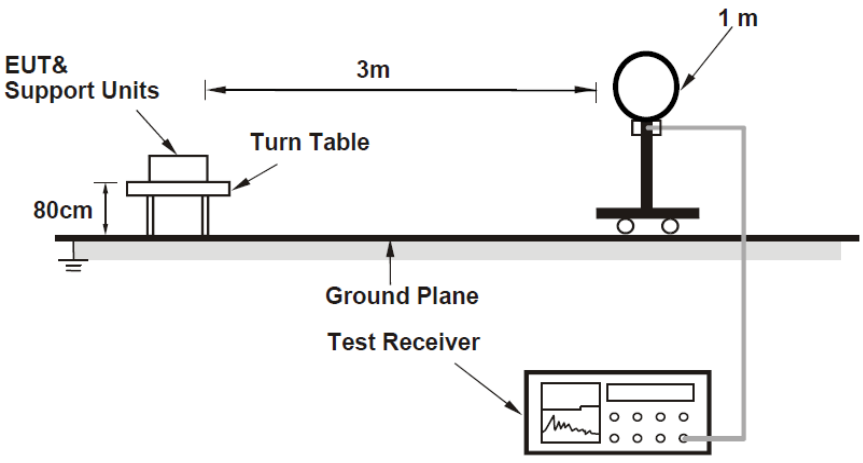
e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

4.5.3 Deviation from Test Standard

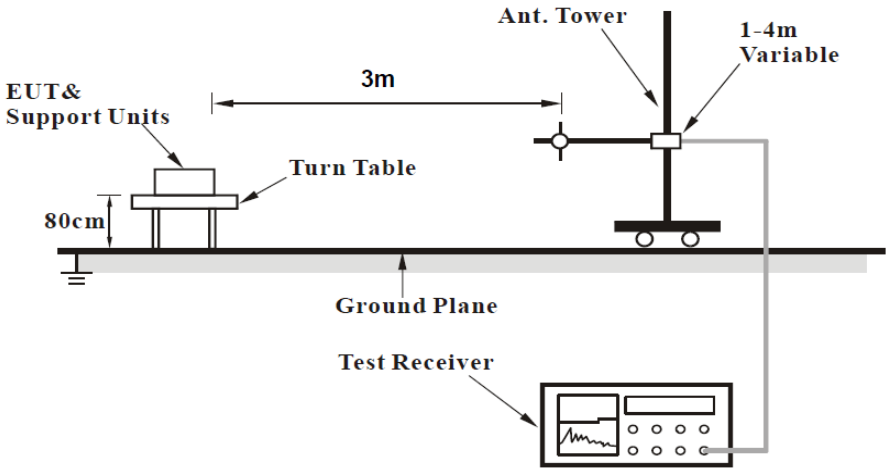
No deviation.

4.5.4 Test Setup

For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.5.5 Test Results

Radiated Emissions Range 9kHz~30MHz

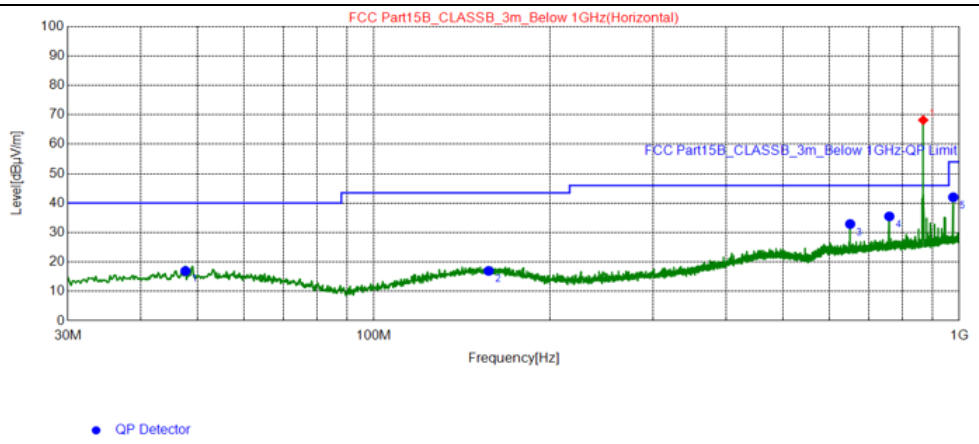
The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

Radiated Emissions Range 30MHz~1GHz

Below is the worst test data

Channel	433.92MHz	**Detector Function**	Quasi-Peak (QP)
Frequency Range	30MHz ~ 1GHz	**Antenna Polarity**	Horizontal

Test Plot:



NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Value [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	47.654	26.8	-9.87	16.93	40.00	23.07	100	353	Horizont	QP
2	157.07	26.81	-9.84	16.97	43.50	26.53	100	179	Horizont	QP
3	650.99	34.97	-2.07	32.90	46.00	13.10	100	313	Horizont	QP
4	759.44	36.06	-0.56	35.50	46.00	10.50	100	107	Horizont	QP
5	867.88	67.72	0.47	68.19	80.82	12.63	100	26	Horizont	PK
6	976.52	39.85	2.15	42.00	54.00	12.00	100	353	Horizont	QP

REMARKS:

1. Emission Level(dBuV/m) = Spectrum reading (dBuV) + Correction Factor(dB/m)

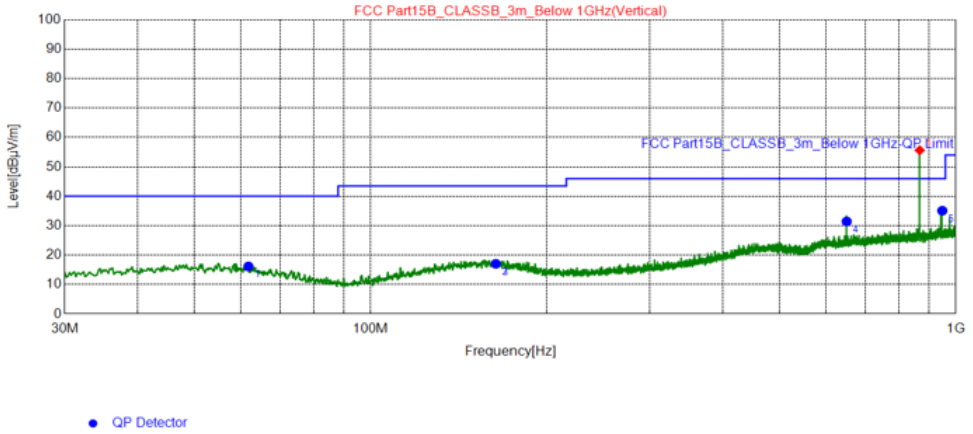
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Limit value – Emission Level

Channel	433.92MHz	**Detector Function**	Quasi-Peak (QP)
Frequency Range	30MHz ~ 1GHz	**Antenna Polarity**	Vertical

Test Plot:



NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Value [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	61.816	26.76	-10.60	16.16	40.00	23.84	200	206	Vertical	QP
2	163.66	27.01	-9.97	17.04	43.50	26.46	100	314	Vertical	QP
3	163.66	27.05	-9.97	17.08	43.50	26.42	100	314	Vertical	QP
4	650.99	33.5	-2.07	31.43	46.00	14.57	100	318	Vertical	QP
5	867.88	55.16	0.47	55.63	80.82	25.19	200	336	Vertical	PK
6	948.39	33.19	1.91	35.10	46.00	10.90	200	22	Vertical	QP

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Limit value – Emission Level

Radiated Emission Range 2th ~10th Harmonic

Below is the worst test data

Channel	433.92MHz	Detector Function	Peak (PK)
Frequency Range	0.8 ~ 6GHz		Average (AV)

Spurious Emission Level									
No.	Frequency (MHz)	Reading [dBµV/m]	Factor (dB)	Duty Cycle Factor [dB]	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Polarity	Detector
1	867.8800	67.72	0.47	-	68.19	80.82	12.63	H	PK
2	867.8800	-	-	-9.48	58.71	60.82	2.11	H	AV
3	1302.6000	77.63	-19.51	-	58.12	74.00	15.88	H	PK
4	1736.1000	-	-	-9.48	48.64	54.00	5.36	H	AV
5	1736.1000	70.58	-18.07	-	52.51	74.00	21.49	H	PK
6	1736.1000	-	-	-9.48	43.03	54.00	10.97	H	AV
7	2169.6000	49.88	-16.63	-	33.25	74.00	40.75	H	PK
8	2169.6000	-	-	-9.48	23.77	54.00	30.23	H	AV
9	2603.1000	47.25	-15.09	-	32.16	74.00	41.84	H	PK
10	2603.1000	-	-	-9.48	22.68	54.00	31.32	H	AV
11	867.8800	55.16	0.47	-	55.63	80.82	25.19	V	PK
12	867.8800	-	-	-9.48	46.15	60.82	14.67	V	AV
13	1302.6000	81.84	-19.51	-	62.33	74.00	11.67	V	PK
14	1302.6000	-	-	-9.48	52.85	54.00	1.15	V	AV
15	1736.1000	79.96	-18.07	-	61.89	74.00	12.11	V	PK
16	1736.1000	-	-	-9.48	52.41	54.00	1.59	V	AV
17	2169.6000	56.22	-16.63	-	39.59	74.00	34.41	V	PK
18	2169.6000	-	-	-9.48	30.11	54.00	23.89	V	AV
19	2603.1000	53.77	-15.09	-	38.68	74.00	35.32	V	PK
20	2603.1000	-	-	-9.48	29.20	54.00	24.80	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Factor(dB/m)

2. Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Limit value – Emission Level

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

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