

FCC 47 CFR PART 15 SUBPART C
CERTIFICATION TEST REPORT

OF

Shake sensor

MODEL No.: DC510B

Trademark: N/A

FCC ID: 2AIDK-DC510B

REPORT NO: ES160503012E

ISSUE DATE: June 13, 2016

Prepared for

Dometic Corporation

509 S. Poplar Street, LaGrange, IN 46706

Prepared by

EMTEK (SHENZHEN) CO., LTD

Bldg 69, Majialong Industry Zone, Nanshan District,
Shenzhen, Guangdong, China

TEL: 86-755-26954280

FAX: 86-755-26954282

VERIFICATION OF COMPLIANCE

Applicant	:	Dometic Corporation 509 S. Poplar Street, LaGrange, IN 46706
Manufacturer	:	Dometic Corporation 509 S. Poplar Street, LaGrange, IN 46706
Product Description	:	Shake sensor
Model Number	:	DC510B
Serial Number	:	N/A
File Number	:	ES160503012E
Date of Test	:	May 03, 2016 to June 13, 2016

We hereby certify that:

The above equipment was tested by EMTEK (SHENZHEN) CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with radiated emission limits of FCC Rules Part 15.231.

The test results of this report relate only to the tested sample identified in this report.

Date of Test : May 03, 2016 to June 13, 2016

Prepared by :



Joe Xia/Editor

Reviewer :



Yaping Shen /Supervisor

Approve & Authorized Signer :



Lisa Wang/Manager

TABLE OF CONTENTS

1.	GENERAL INFORMATION	4
1.1.	PRODUCT DESCRIPTION.....	4
1.2.	RELATED SUBMITTAL(S) / GRANT (S)	4
1.3.	TEST METHODOLOGY	4
1.4.	SPECIAL ACCESSORIES.....	4
1.5.	EQUIPMENT MODIFICATIONS.....	4
1.6.	MEASUREMENT UNCERTAINTY	5
1.7.	TEST FACILITY	5
2.	SYSTEM TEST CONFIGURATION.....	6
2.1.	EUT CONFIGURATION	6
2.2.	EUT EXERCISE	6
2.3.	TEST PROCEDURE	6
2.4.	DESCRIPTION OF TEST MODES.....	6
2.5.	SUMMARY OF TEST RESULTS	6
2.6.	DESCRIPTION OF SUPPORT UNITS	6
3.	RADIATED EMISSION TEST.....	7
3.1.	MEASUREMENT PROCEDURE.....	7
3.2.	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	7
3.3.	MEASUREMENT EQUIPMENT USED:.....	8
3.4.	RADIATED EMISSION LIMIT	9
3.5.	CALCULATION OF AVERAGE FACTOR.....	10
3.6.	MEASUREMENT RESULT.....	14
4.	TRANSMISSION REQUIREMENT	16
4.1.	REQUIREMENT	16
4.2.	TEST SET-UP.....	16
4.3.	MEASUREMENT EQUIPMENT USED:.....	16
4.4.	TEST PROCEDURE	16
4.5.	TEST DATA	17
5.	BANDWIDTH TEST	19
5.1.	MEASUREMENT PROCEDURE.....	19
5.2.	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	19
5.3.	MEASUREMENT EQUIPMENT USED:.....	19
5.4.	MEASUREMENT RESULTS:	19
6.	ANTENNA APPLICATION.....	21
6.1.	ANTENNA REQUIREMENT	21
6.2.	RESULT	21

1. GENERAL INFORMATION

1.1. Product Description

Emitter (referred to as the EUT in this report), it is designed by way of utilizing the ASK modulation achieves the system operating.

A major technical descriptions of EUT is described as following:

- A). Operation Frequency: 433.88MHz
- B). Modulation: ASK
- C). Antenna Type: PCB antenna
- D). Antenna Gain: -2dBi
- E). Power Supply: DC 3V

1.2. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: 2AIDK-DC510B filing to comply with Section 15.231 of the FCC Part 15, Subpart C Rules.

1.3. Test Methodology

The radiated testing was performed according to the procedures in ANSI C63.10 (2013). Radiated testing was performed at an antenna to EUT distance 3 meters.

1.4. Special Accessories

Not available for this EUT intended for grant.

1.5. Equipment Modifications

Not available for this EUT intended for grant.

1.6. Measurement Uncertainty

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Fundamental Fieldstrength	Not Applicable	95%	±2.94dB
Transmitter 20 dB Bandwidth	Not Applicable	95%	±0.92PPm
Radiated Spurious Emissions	30 MHz to 40 GHz	95%	±3.00dB
Conducted Emission	0.15MHz to 0.50MHz	95%	±2.0dB

1.7. Test Facility

Site Description

EMC Lab.

: Accredited by CNAS, 2013.10.29
The certificate is valid until 2016.10.28
The Laboratory has been assessed and proved to be in compliance with
CNAS/CL01:2006(identical to ISO/IEC17025: 2005)
The Certificate Registration Number is L2291

Accredited by TUV Rheinland Shenzhen 2010.5.25
The Laboratory has been assessed according to the requirements ISO/IEC
17025

Accredited by FCC, April 17, 2014
The Certificate Registration Number is 406365.

Accredited by Industry Canada, March 5, 2010
The Certificate Registration Number is 4480A-2.

Name of Firm

: EMTEK (SHENZHEN) CO., LTD

Site Location

: Bldg 69, Majialong Industry Zone,
Nanshan District, Shenzhen, Guangdong, China

2. SYSTEM TEST CONFIGURATION

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

2.3. Test Procedure

2.3.1 Radiated Emissions

The EUT is placed on a turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. Emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 6.3 to 6.6 of ANSI C63.10-2013.

2.4. Description of test modes

The EUT (Shake sensor) has been tested under normal operating condition. Let EUT transmit during test, and the result was reported.

2.5. Summary of Test Results

FCC Part15, Subpart C		
Standard Section	Test Item	Result
FCC		
15.231(a)(1)	Transmission Requirement	Pass
15.231(b)	Radiated Emission	Pass
15.231(c)	20dB Bandwidth	Pass
15.207(a)	Conducted Emission	N/A

Note: (1)"N/A" denotes test is not applicable in this test report.

2.6. Description of Support Units

Equipment	Mfr/Brand	Model/Type No.	FCC ID / IC	Series No.	Note
Shake sensor	N/A	DC510B	2AIDK-DC510B	N/A	EUT

3. RADIATED EMISSION TEST

3.1. Measurement Procedure

a. 9 kHz to 30 MHz emissions

For testing performed with the loop antenna. The centre of the loop was positioned 1 m above the ground and positioned with its plane vertical at the special distance from the EUT. During testing the loop was rotated about its vertical axis for maximum response at each azimuth and also investigated with the loop positioned in the horizontal plane.

b. 30 MHz to 1 GHz emissions:

For testing performed with the bi-log type antenna. The measurement is performed with the EUT rotated 360°, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

c. Above 1 GHz emissions:

For testing performed with the horn antenna. The measurement is performed with the EUT rotated 360°, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

Detector: For Peak:

RBW = 1 MHz for $f \geq 1$ GHz,

200 Hz for 9 kHz to 150 kHz

9 kHz for 150 kHz to 30 MHz

100 kHz for 30 MHz to 1GHz

VBW \geq RBW

Sweep = auto

Detector function = peak for $f \geq 1$ GHz, QP for $f < 1$ GHz

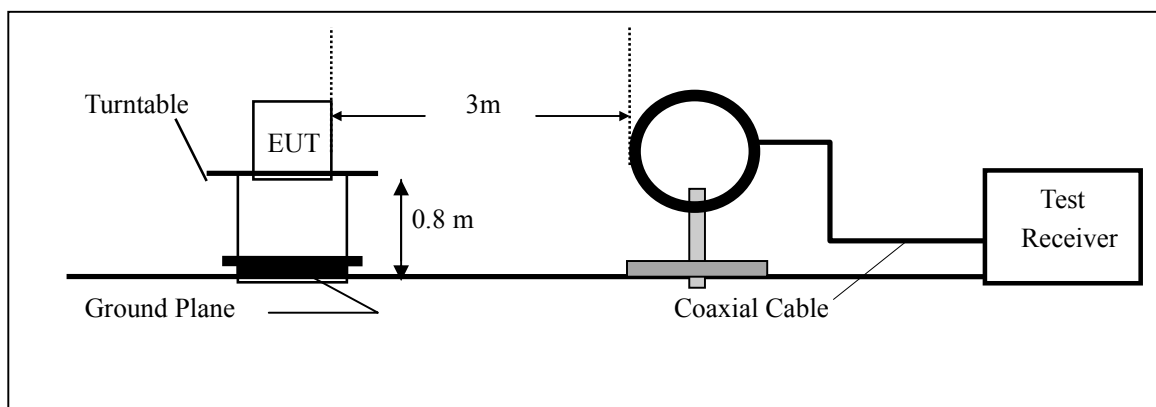
Trace = max hold

For AV value:

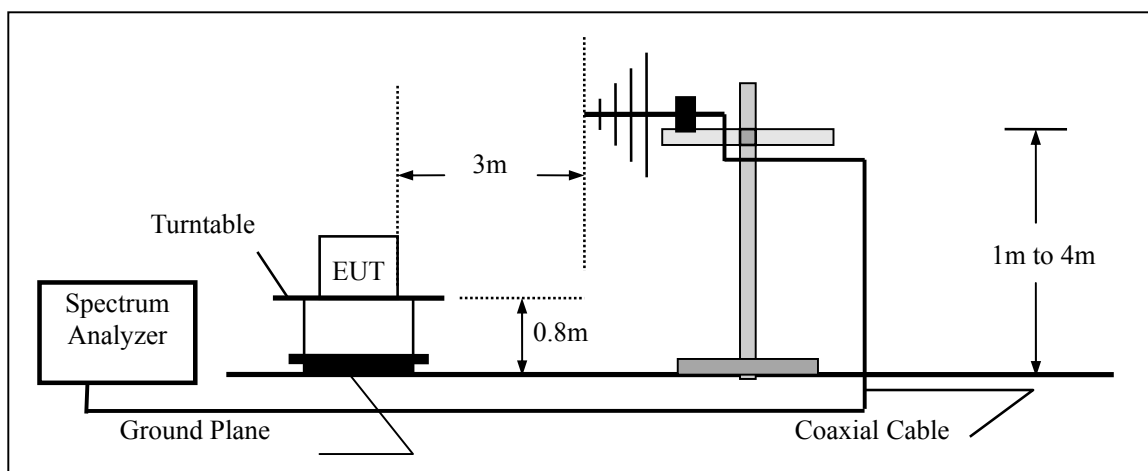
Average = Peak value + 20log (Duty cycle)

3.2. Test SET-UP (Block Diagram of Configuration)

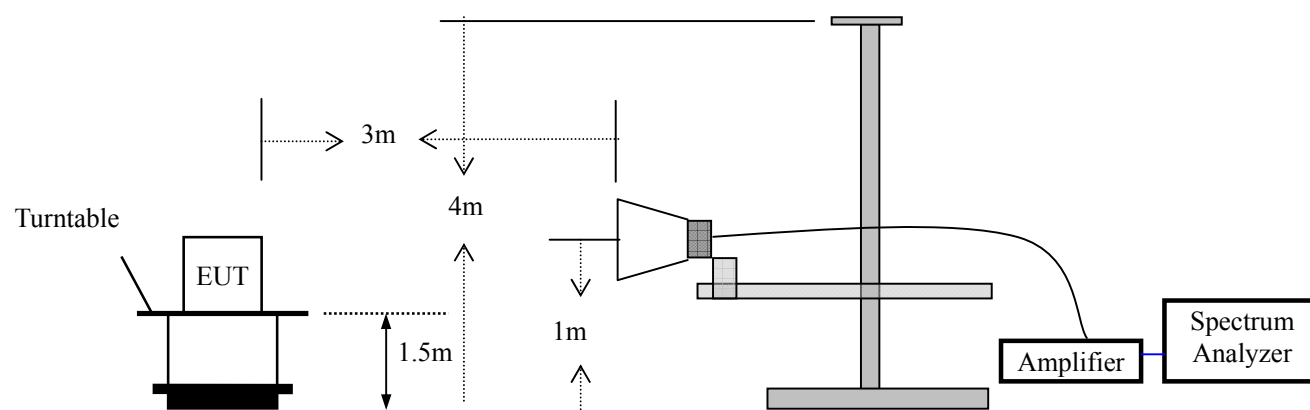
a. Radiated Emission Test Set-Up, Frequency Below 30MHz



b. Radiated Emission Test Set-Up, Frequency Below 1000MHz



c. Radiated Emission Test Set-Up, Frequency above 1000MHz



3.3. Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	ESCI	101414	05/15/2016	05/14/2017
Spectrum Analyzer	Rohde & Schwarz	FSP7	839511/010	05/15/2016	05/14/2017
Spectrum Analyzer	HP	E4407B	839840481	05/15/2016	05/14/2017
EMI Test Receiver	Rohde & Schwarz	ESCS30	828985/018	05/15/2016	05/14/2017
Pre-Amplifier	HP	8447D	2944A07999	05/15/2016	05/14/2017
Bilog Antenna	Schwarzbeck	VULB9163	142	05/15/2016	05/14/2017
Loop Antenna	ARA	PLA-1030/B	1029	05/15/2016	05/14/2017
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170399	05/15/2016	05/14/2017
Horn Antenna	Schwarzbeck	BBHA 9120	D143	05/15/2016	05/14/2017

3.4. Radiated Emission Limit

FCC 15.205 Restricted frequency band

MHz	MHz	MHz	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 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)

FCC 15.209 Limited

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
960~1000	500	3
Above 1GHz	74 dBuV/m (PEAK) 54 dBuV/m (AVERAGE)	

15.231 Limited

Frequencies (MHz)	Field strength of fundamental @3m		Effective limit for 433.88MHz	
	(uV/m)	dB(uV/m)	(uV/m)	dB(uV/m)
40.66-40.70	1000	60		
70-130	500	54		
130-174	500 to 1500*	54 to 63.5*		
174-260	1500	63.5		
260-470	1500 to 5000*	63.5 to 74*	43986.7	92.87
Above 470	5000	74		

* Linear interpolation

Frequencies (MHz)	Field strength of Spurious emissions @3m		Effective limit for 433.88MHz	
	(uV/m)	dB(uV/m)	(uV/m)	dB(uV/m)
40.66-40.70	100	40		
70-130	50	34		
130-174	50 to 150*	34 to 43.5*		
174-260	150	43.5		
260-470	150 to 500*	51.4 to 54*	4398.67	72.87
Above 470	500	54		

* Linear interpolation

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, $\mu\text{V/m}$ at 3 meters = $22.72727(F) - 2454.545$; for the band 260-470 MHz, $\mu\text{V/m}$ at 3 meters = $16.6667(F) - 2833.3333$. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

FCC Part15 (15.231) , Subpart C		
Fundamental Frequency	Field Strength Of Fundamental	Field Strength of Spurious Emissions
433.88 MHz	AV:72.87 dBuV/m at 3m distance	AV:52.87 dBuV/m at 3m distance
	PK:92.87dBuV/m at 3m distance	PK:72.87 dBuV/m at 3m distance

3.5. 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 100ms 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.

Averaging factor in dB=20log(duty cycle)

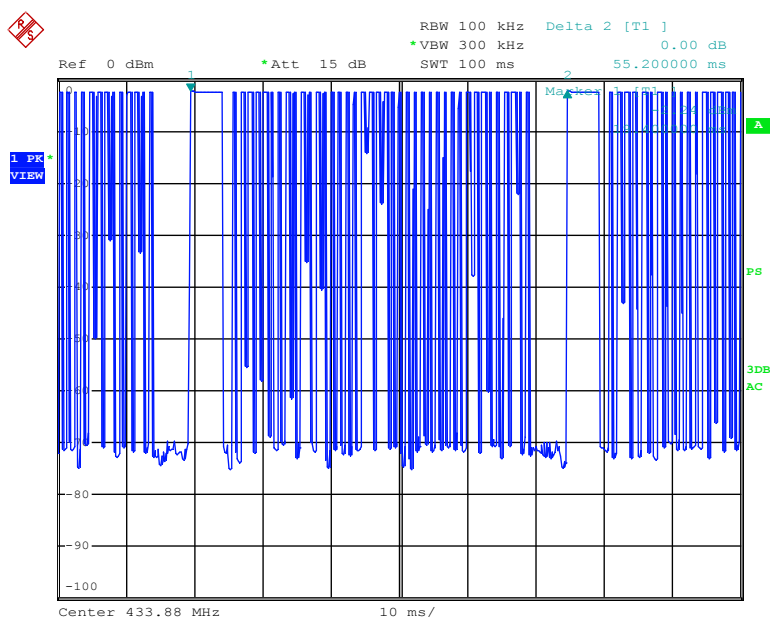
Where the duty factor is calculated from following formula:

$$20\log(\text{Duty cycle})=20\log((4.86+0.42*24+0.78*16)/55.2)=-6.08\text{dB}$$

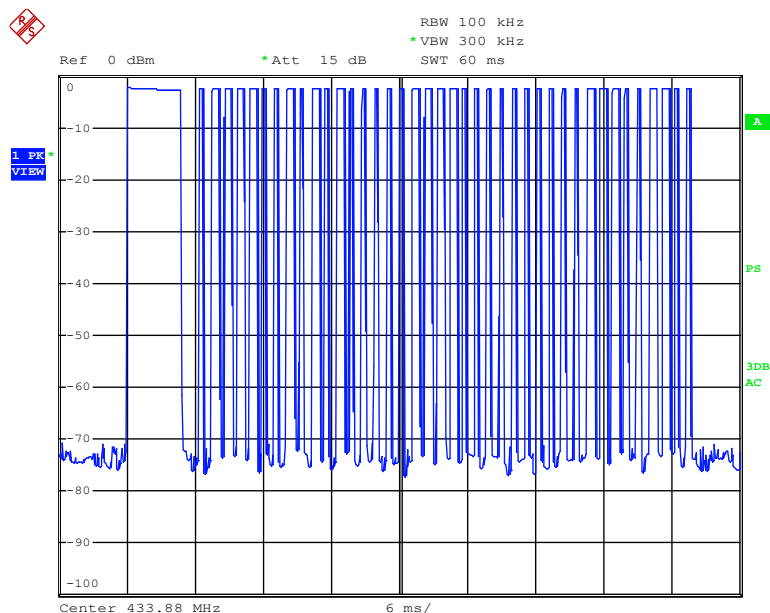
Therefore, the averaging factor is -6.08dB.

Pulse Width(PW)=0.42, $2/PW=2/0.42=4.76\text{KHz}$, $\text{RBW}=100\text{KHz}>4.76\text{KHz}$, Therefore PDCF is not needed.

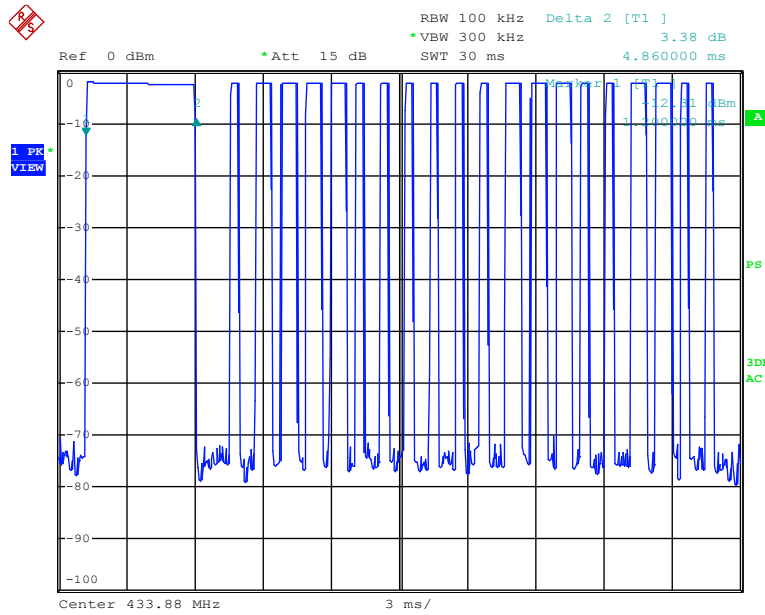
Please see the diagrams below:



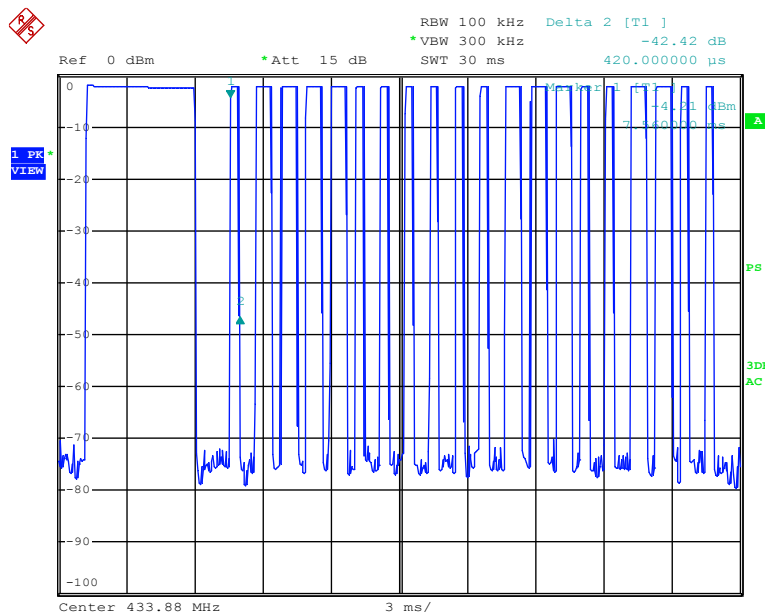
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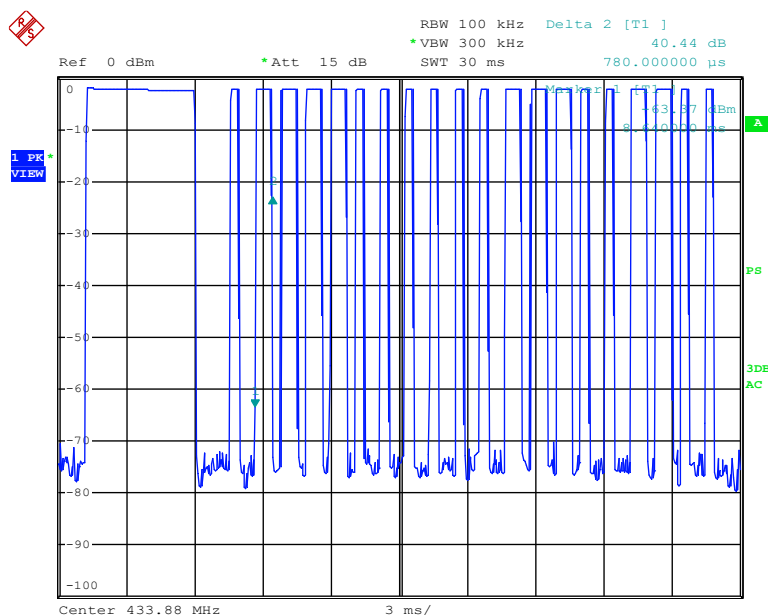
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3.6. Measurement Result

1. Fundamental emission:

Antenna polarization: Horizontal:

Freq. (MHz)	Reading Level(dBuV)	Correct Factor(dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin (dB)	Remark
433.88	91.53	-16.78	74.75	92.87	-18.12	Peak
433.88	74.75	-6.08	68.67	72.87	-4.20	Average

Antenna polarization: Vertical

Freq. (MHz)	Reading Level(dBuV)	Correct Factor(dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin (dB)	Remark
433.88	92.14	-16.78	75.36	92.87	-17.51	Peak
433.88	75.36	-6.08	69.28	72.87	-3.59	Average

2. Other emissions

The receiver was scanned from the lowest frequency generated within the EUT to 4.5 GHz. The field strength is calculated by adding the Antenna Factor, Cable Factor & Peramplifier. The basic equation with a sample calculation is as follows:

Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Peramplifier Factor.

All the x/y/z orientation has been investigated, and only worst case is presented in this report.

The following test results were performed on the EUT.

Horizontal:

Freq. (MHz)	Reading Level(dBuV)	Correct Factor(dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin (dB)	Remark
867.760	48.77	-1.97	46.80	72.87	-26.07	Peak
867.760	46.80	-6.08	40.72	52.87	-12.15	Average
1301.000	74.90	-23.44	51.46	74.00	-22.54	Peak
1301.000	51.46	-6.08	45.38	54.00	-8.62	Average
1735.000	77.17	-23.7	53.47	72.87	-19.40	Peak
1735.000	53.47	-6.08	47.39	52.87	-5.48	Average
2169.000	72.97	-22.64	50.33	72.87	-22.54	Peak
2169.000	50.33	-6.08	44.25	52.87	-8.62	Average
2603.000	76.15	-21.77	54.38	72.87	-18.49	Peak
2603.000	54.38	-6.08	48.30	52.87	-4.57	Average
3037.000	75.93	-21.55	54.38	72.87	-18.49	Peak
3037.000	54.38	-6.08	48.30	52.87	-4.57	Average
3908.500	74.12	-18.93	55.19	74.00	-18.81	Peak
3908.500	55.19	-6.08	49.11	54.00	-4.89	Average

Vertical:

Freq. (MHz)	Reading Level(dBuV)	Correct Factor(dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin (dB)	Remark
867.760	42.57	-1.97	40.60	72.87	-32.27	Peak
867.760	40.60	-6.08	34.52	52.87	-18.35	Average
1742.000	76.51	-23.7	52.81	72.87	-20.06	Peak
1742.000	52.81	-6.08	46.73	52.87	-6.14	Average
2169.000	71.41	-22.64	48.77	72.87	-24.10	Peak
2169.000	48.77	-6.08	42.69	52.87	-10.18	Average
2603.000	73.88	-21.77	52.11	72.87	-20.76	Peak
2603.000	52.11	-6.08	46.03	52.87	-6.84	Average
3037.000	72.88	-21.55	51.33	72.87	-21.54	Peak
3037.000	51.33	-6.08	45.25	52.87	-7.62	Average
3474.500	67.09	-20.61	46.48	72.87	-26.39	Peak
3474.500	46.48	-6.08	40.40	52.87	-12.47	Average
3908.500	75.54	-18.93	56.61	74.00	-17.39	Peak
3908.500	56.61	-6.08	50.53	54.00	-3.47	Average

Remark:

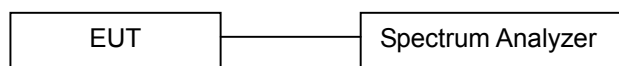
According to 15.35 (b) When average radiated emission measurements are specified in the regulations, including emission measurements below 1000 MHz, there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules, e.g., see Section 15.255.

4. TRANSMISSION REQUIREMENT

4.1. Requirement

Devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

4.2. Test SET-UP



4.3. Measurement Equipment Used:

Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	ESCI	101414	05/15/2016	05/14/2017

4.4. Test Procedure

The following table is the setting of spectrum analyzer.

Spectrum analyzer	Setting
Attenuation	Auto
Span Frequency	0Hz
RB	100KHz
VB	300KHz
Detector	Peak
Trace	Max hold
Sweep Time	30S

- The transmitter output (antenna port) was connected to the spectrum analyzer.
- Set RBW of spectrum analyzer to 100KHz and VBW to 300KHz, Set Detector to Peak, Trace to Max Hold.
- Set the span to 0Hz and the sweep time to 5s and record the value.

4.5. Test Data

Environmental Conditions

Temperature:	24°C
Relative Humidity:	55%
ATM Pressure:	1032mbar

Test Mode: Transmitting

TX on=0.15s

Tp=12.48s

Silent period no less than 10 seconds or $0.15 \times 30 = 4.5s$

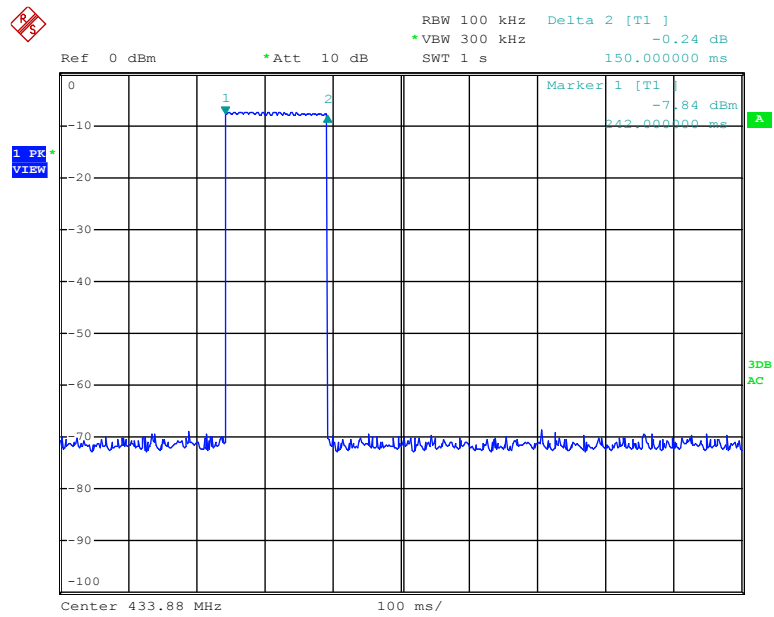
TX Silent period=12.48s

Frequency (MHz)	TX Silent period (Second)	Limit (Second)	Result
433.88	12.48	no less than 10 seconds	PASS

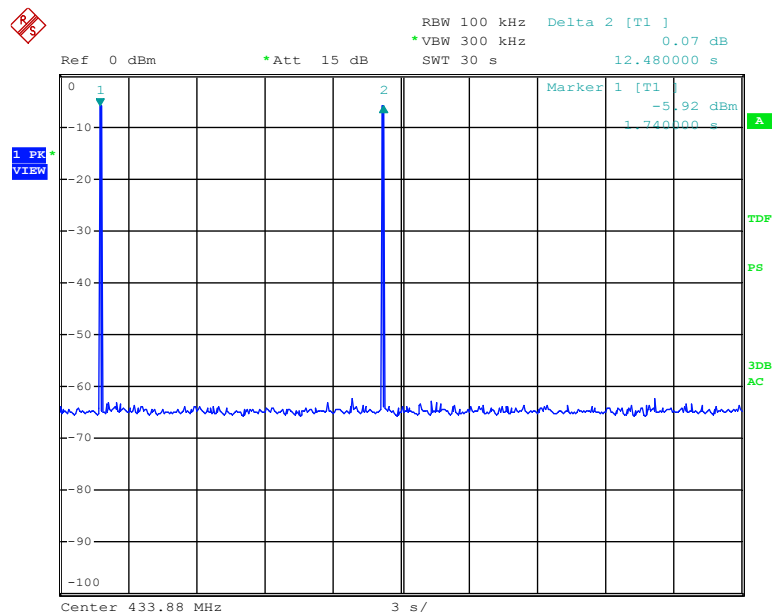
Frequency (MHz)	Max transmission (Second)	Limit (Second)	Result
433.88	0.15	not be greater than one second	PASS

Frequency (MHz)	TX Silent period (Second)	Limit (Second)	Result
433.88	12.48	Least 30 times the duration of the transmission (4.5S)	PASS

Refer to the attached plot



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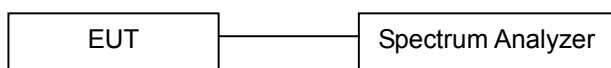
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5. BANDWIDTH TEST

5.1. Measurement Procedure

The useful radiated emission from the EUT was detected by the spectrum analyzer with peak detector. Record the 20 dB bandwidth of the carrier.

5.2. Test SET-UP (Block Diagram of Configuration)



15.231 (c) 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.

5.3. Measurement Equipment Used:

Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	ESCI	101414	05/15/2016	05/14/2017

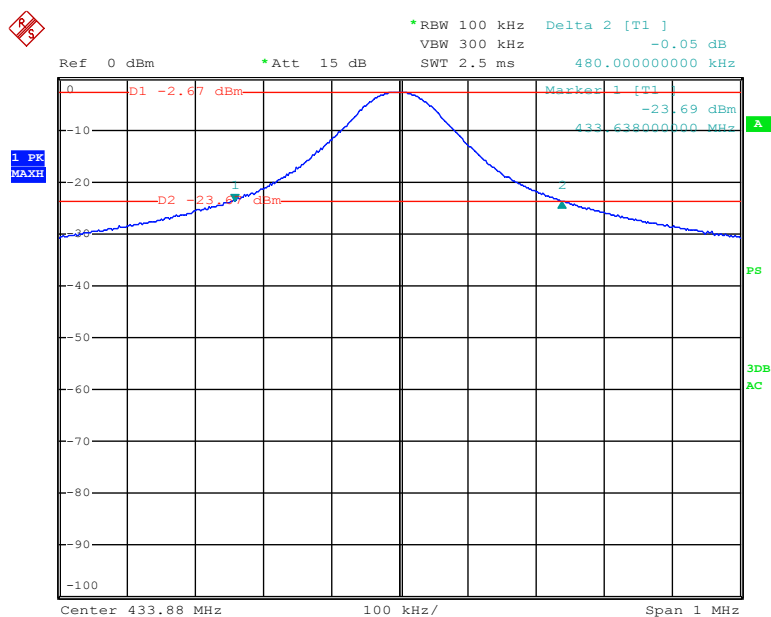
5.4. Measurement Results:

Spectrum Detector:	PK	Test Date:	May 03, 2016
Test By:	KK	Temperature:	24 °C
Test Result:	PASS	Humidity:	55 %

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)	Limit
CH1	433.88	480	≤1.0847MHz

Remark:

The bandwidth limit is $433.88\text{MHz} \times 0.0025 = 1084.7 \text{ kHz}$.



Date: 3.MAY.2016 19:55:15

6. ANTENNA APPLICATION

6.1. Antenna Requirement

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

6.2. Result

The EUT's antenna is PCB antenna, using a permanently attached antenna which is not replaceable. The antenna's gain is -2dBi and meets the requirement.

---END OF REPORT---