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PAN AIR ELECTRIC CO.,LTD

TEST REPORT

REPORT NUMBER
190500319TWN-001

ISSUE DATE

Jun. 12, 2019

PAGES
20

DOCUMENT CONTROL NUMBER

Radio Spectrum
TEST REPORT

Applicant:	**PAN AIR ELECTRIC CO.,LTD** **No.198, Sec. 5, Fengyuan Blvd., Fengyuan Dist., Taichung City 420, Taiwan**
Product:	**Ceiling Fan Remote Control**
Model No.:	**TR90C**
Brand Name:	**NIL**
FCC ID:	**2ATAOTR90C**
Test Method/ Standard:	**47 CFR FCC Part 15.231**
Test By:	**Intertek Testing Services Taiwan Ltd.,** **Hsinchu Laboratory** **No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li,** **Shiang-Shan District, Hsinchu City, Taiwan**

Testing Laboratory
0597

Prepared and Checked by:

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Engineer

Revision History

Report No.	Issue Date	Revision Summary
190500319TWN-001	Jun. 12, 2019	Original report

Table of Contents

Summary of Test Data

Test Requirement	Applicable Rule (Section 15.225)	Result
Radiated Emission test	15.231(b), 15.209	Pass
Measured bandwidth	15.231(c)	Pass
Timing requirement of manually operated transmitter	15.231(a)(1)	Pass
Conducted Emission test	15.207	N/A
Antenna Requirement	15.203	Pass

1. General Information

1.1 Identification of the EUT

Product:	Ceiling Fan Remote Control
Model No.:	TR90C
Operating Frequency:	433.92MHz.
Rated Power:	DC 3V
Power Cord:	N/A
Sample receiving date:	Apr. 23, 2019
Sample condition:	Workable
Test Date(s):	May 30, 2019 ~ Jun. 04, 2019

1.2 Antenna description

Antenna Type : Printed Antenna
Connector Type : Fixed

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 2.1053 and the requirement in FCC Part 15 Subpart C Section 15.231.

2.2 Operation mode

Put the battery into the EUT, then the EUT will do the continuous Tx modulation emission.

The signal is maximized through rotation and placement in the three orthogonal axes.

X axis

Y axis

Z axis

After verifying three axes, we found the maximum electromagnetic field was occurred at Y axis. The final test data was executed under this configuration.

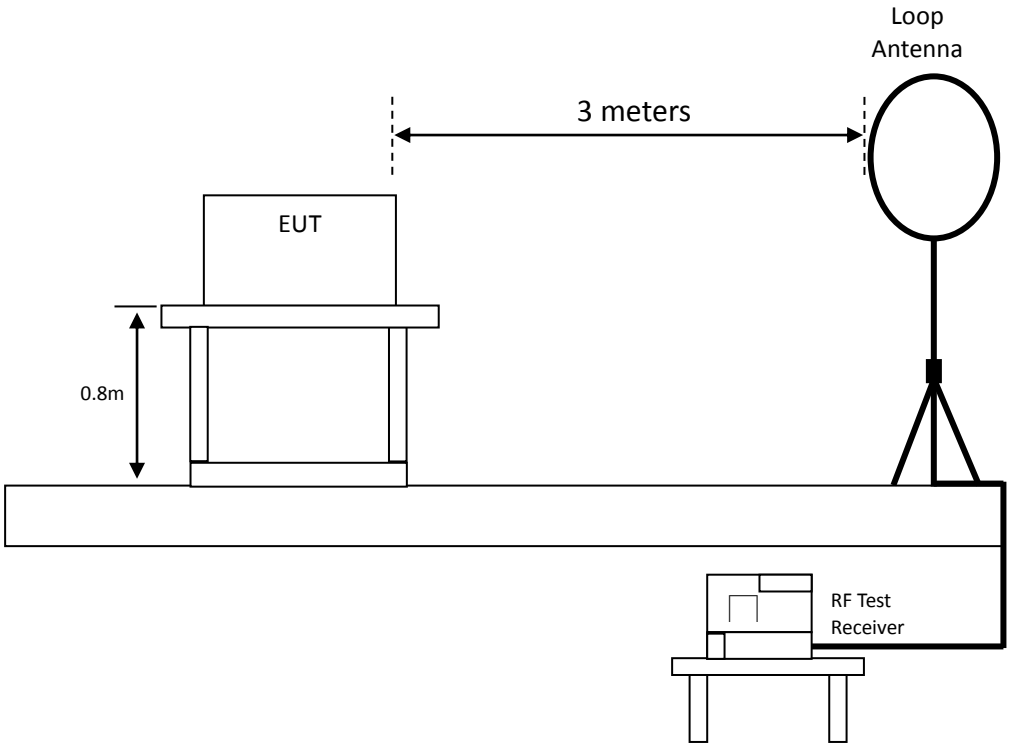
3. Radiated emission test FCC 15.231 (b)

3.1 Operating environment

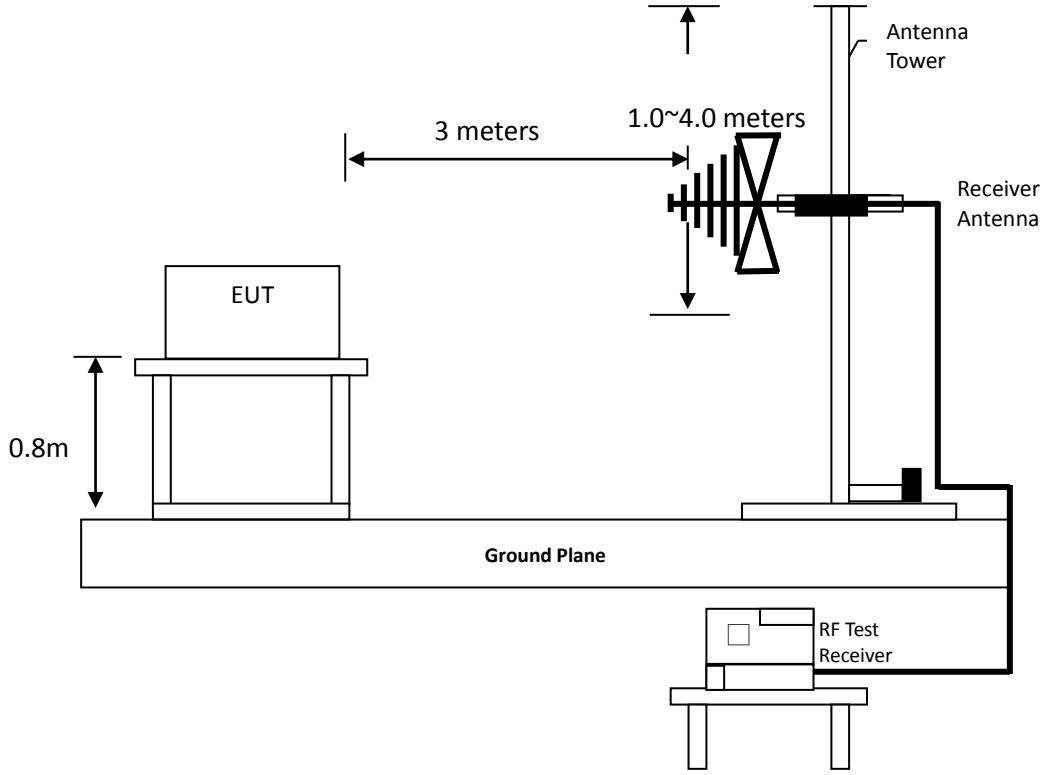
Temperature:	27	℃
Relative Humidity:	64	%

3.2 Test setup & procedure

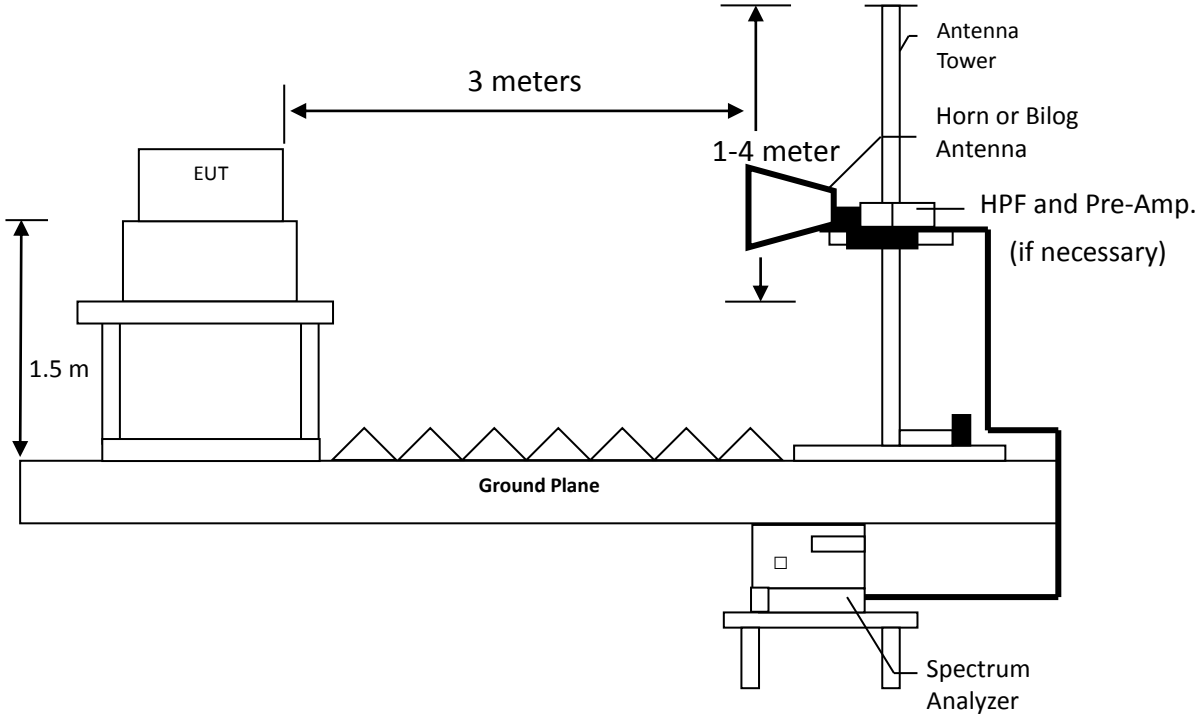
3.2.1 Radiated emission from 9kHz to 30MHz uses Loop Antenna:



3.2.2 Radiated emission below 1GHz using Bilog Antenna



3.2.3 Radiated emission above 1GHz using Horn Antenna



3.3 Radiated emission limit

3.3.1 Fundamental and harmonics emission limits

Frequency (MHz)	Field Strength of Fundamental		Field Strength of Harmonics	
	(uV/m@3 m)	(dBuV/m@3 m)	(uV/m@3 m)	(dBuV/m@3 m)
433.92	11002.7185	80.83	1100.2718	60.83

3.3.2 General radiated emission limit

The spurious Emission shall test through the 10th harmonic. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

Frequency MHz	15.209 Limits (dBµV/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

Remark:
1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

3.4 Radiated emission test data FCC 15.231

3.4.1 Measurement results: Fundamental emission

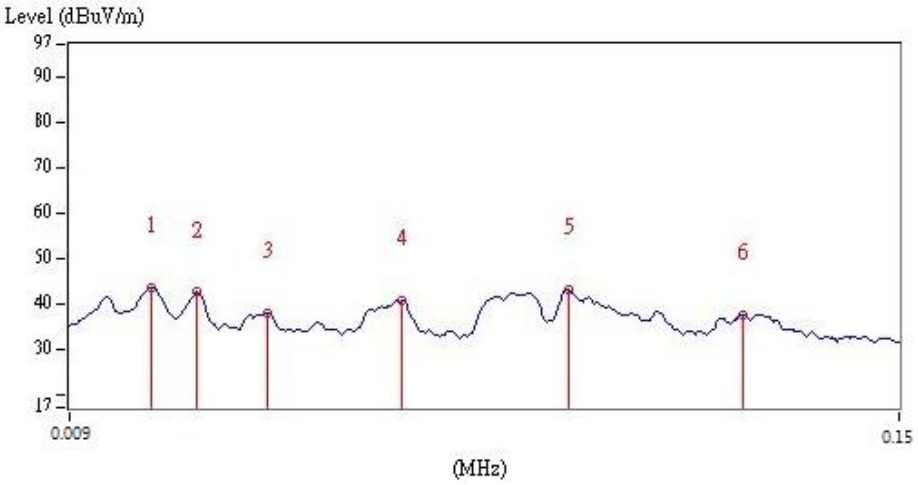
Frequency (MHz)	Detector	Polarization (H/V)	Corr. Factor (dB/m)	Readin (dBµV)	Calculated (dBµV/m)	Limit @ 3 m (dBµV/m)	Margin (dB)
433.92	PK	V	25.36	44.80	70.16	100.82	-30.66
433.92	PK	H	25.36	52.62	77.98	100.82	-22.84

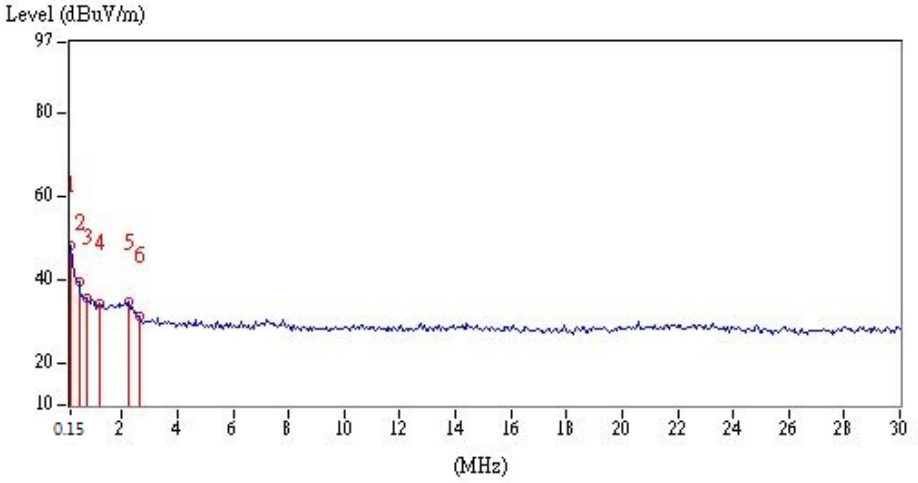
Remark:
1. Calculated = Reading + Corr. Factor
2. Margin= Calculated – Limit

3.4.2 Measurement results: frequencies 9kHz to 30MHz

Frequency (MHz)	Detector	Corr. Factor (dB/m)	Reading (dBµV)	Calculated (dBµV/m)	Limit @ 3 m (dBµV/m)	Margin (dB)
0.02	PK	18.84	24.61	43.45	121.58	-78.13
0.03	PK	19.05	23.37	42.42	118.06	-75.64
0.04	PK	18.81	19.18	37.99	115.56	-77.57
0.07	PK	18.54	22.07	40.61	110.70	-70.09
0.09	PK	18.31	24.75	43.06	108.52	-65.46
0.12	PK	18.27	19.26	37.53	106.02	-68.49
0.15	PK	18.27	30.11	48.38	104.08	-55.70
0.45	PK	18.37	21.04	39.41	94.54	-55.13
0.75	QP	18.54	17.19	35.73	70.10	-34.37
1.22	QP	18.72	15.69	34.41	65.88	-31.47
2.24	QP	18.85	15.91	34.76	69.54	-34.78
2.66	QP	18.91	12.45	31.36	69.54	-38.18

Remark:
1. Calculated = Reading + Corr. Factor – Average Factor
2. Correction Factor = Antenna Factor + Cable Loss
3. Margin= Calculated – Limit


Level (dBuV/m)
97
90
80
70
60
50
40
30
17
1
2
3
4
5
6
0.009
0.15
(MHz)

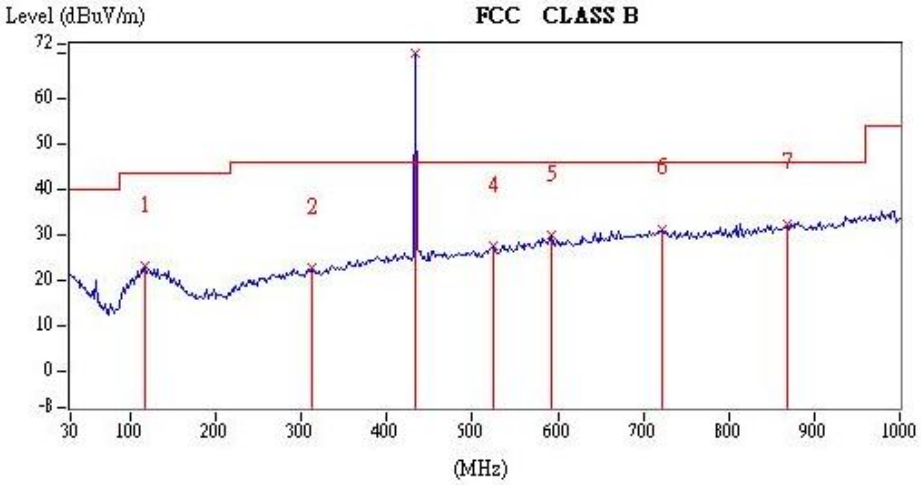

Level (dBuV/m)
97
80
60
40
20
10
1
2
3
4
5
6
0.15
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
(MHz)

3.4.3 Measurement results: frequencies below 1 GHz

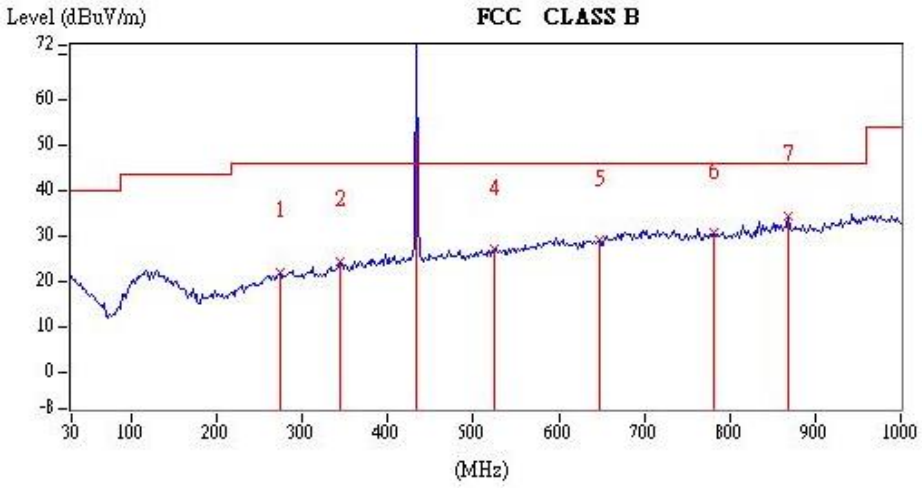
Polarization (circle)	Frequency (MHz)	Detector	Corr. Factor (dB/m)	Reading (dBuV)	Calculated (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Vertical	117.30	QP	22.59	0.42	23.01	80.82	-57.81
Vertical	313.24	QP	22.29	0.38	22.67	80.82	-58.15
Vertical	524.70	QP	26.67	0.83	27.50	80.82	-53.32
Vertical	592.60	QP	27.81	2.19	30.00	80.82	-50.82
Vertical	722.58	QP	29.74	1.63	31.37	80.82	-49.45
Vertical	867.84	QP	31.25	1.31	32.56	80.82	-48.26
Horizontal	274.44	QP	21.55	0.55	22.10	80.82	-58.72
Horizontal	344.28	QP	23.34	1.09	24.43	80.82	-56.39
Horizontal	524.70	QP	26.67	0.48	27.15	80.82	-53.67
Horizontal	646.92	QP	28.53	0.57	29.10	80.82	-51.72
Horizontal	780.78	QP	30.15	0.61	30.76	80.82	-50.06
Horizontal	867.84	QP	31.25	3.28	34.53	80.82	-46.29

Remark:
1. Calculated = Reading + Corr. Factor – Average Factor
2. Correction Factor = Antenna Factor + Cable Loss
3. Margin= Calculated – Limit

Vertical



Horizontal



3.4.4 Measurement results: frequency above 1GHz

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Reading (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
1301.76	PK	V	-7.62	49.40	41.78	80.82	-39.04
2169.60	PK	V	-3.01	47.03	44.02	80.82	-36.80
2603.52	PK	V	-1.68	44.04	42.36	80.82	-38.46
3037.44	PK	V	-0.11	52.36	52.25	80.82	-28.57
3471.36	PK	V	0.10	44.79	44.89	80.82	-35.93
3905.28	PK	V	2.07	40.00	42.07	80.82	-38.75
1301.76	PK	H	-7.62	49.56	41.94	80.82	-38.88
2169.60	PK	H	-3.01	55.38	52.37	80.82	-28.45
2603.52	PK	H	-1.68	48.68	47.00	80.82	-33.82
3037.44	PK	H	-0.11	52.98	52.87	80.82	-27.95
3471.36	PK	H	0.10	39.30	39.40	80.82	-41.42
3905.28	PK	H	2.07	39.83	41.90	80.82	-38.92
4339.20	PK	H	3.56	33.39	36.95	80.82	-43.87

Remark:

1. Correction Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Correction Factor – Preamp. Gain
3. The frequency measured ranges from 1 GHz to 25 GHz. The data value listed above which is higher than the system noise floor.

4. Measured bandwidth FCC 15.231(C)

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

B.W(20dBc) Limit = 0.25% × f(MHz) = 0.25% × 433.92 MHz = 1.0848 MHz

From the plot, the bandwidth is observed to be 115.7 kHz at 20dBc, where the bandwidth limit is 1.0848 MHz.

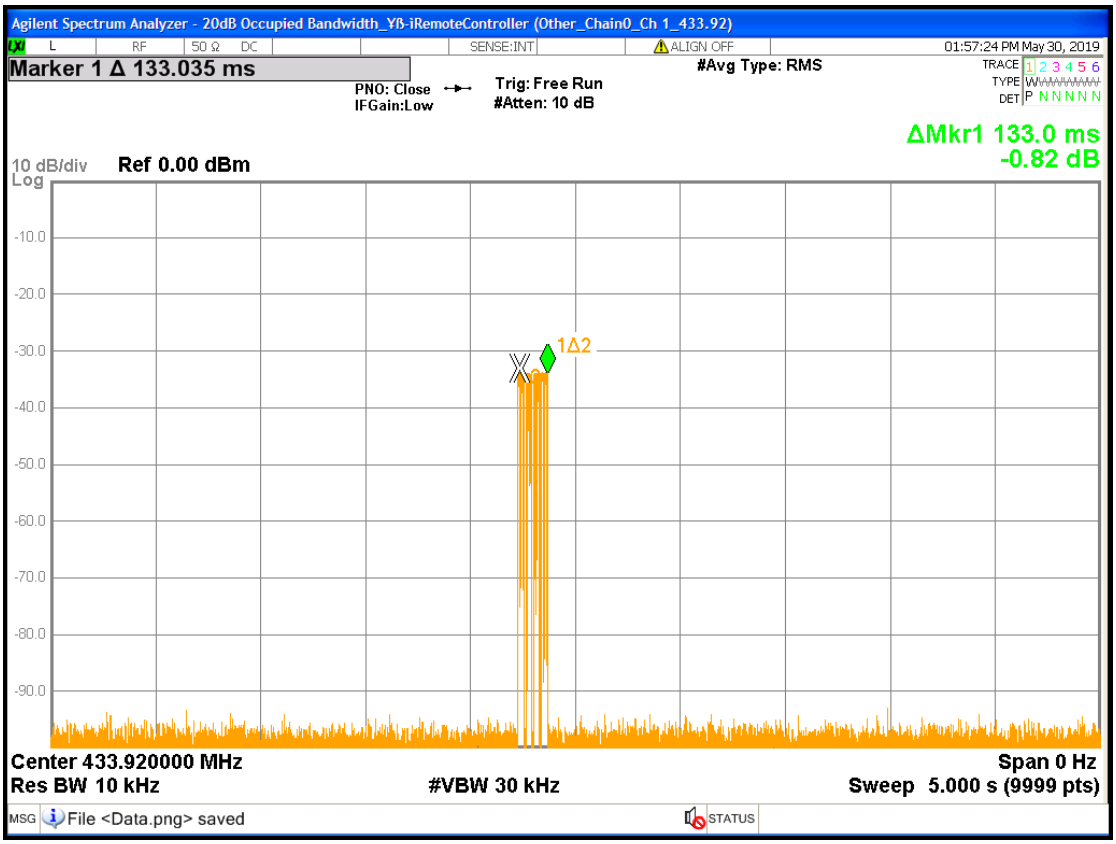
Please see the plot below.

Bandwidth

5. Timing requirement of manual activation operated transmitter

A transmitter manual activation shall cease transmission within 5 seconds after activation

Release Time



6. Conducted emission FCC 15.207

Since the EUT is not connected to AC source, therefore, the test can be waived.

Appendix A: Test equipment list

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
ESCI EMI Test Receiver	Rohde & Schwarz	ESCI	100018	2018/11/14	2019/11/13
Spectrum Analyzer	Rohde & Schwarz	FSP30	100137	2018/09/03	2019/09/02
Horn Antenna (1-18G)	SHWARZBECK	BBHA 9120 D	9120D-456	2019/02/01	2020/01/31
Horn Antenna (14-42G)	SHWARZBECK	BBHA 9170	BBHA9170159	2017/09/04	2020/09/02
Broadband Antenna	SHWARZBECK	VULB 9168	9168-172	2018/04/23	2019/04/22
Pre-Amplifier	EMC Co.	EMC12635SE	980205	2018/12/10	2019/12/09
Pre-Amplifier	MITEQ	JS4-26004000--27-8A	828825	2018/08/28	2019/08/27
Signal Analyzer	Agilent	N9030A	MY51380492	2018/08/24	2019/08/23
966-2(A) Cable 9kHz~26.5GHz	SUHNER	SMA / EX 100	N/A	2018/08/07	2019/08/06
966-2(B) Cable 9kHz~26.5GHz	SUHNER	SUCOFLEX 104P	CB0005	2018/08/07	2019/08/06
RF Cable 9kHz~26.5GHz	SUHNER	SUCOFLEX 102	CB0006	2019/05/02	2020/04/30
966-2_3m Semi-Anechoic Chamber	966_2	CEM-966_2	N/A	2019/02/23	2020/02/22
Active Loop Antenna	SCHWARZBECK MESS-ELEKTRONIC	FMZB1519	1519-067	2019/04/19	2020/04/17

Note: No Calibration Required (NCR)

Appendix B: Measurement Uncertainty

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

Item	Uncertainty
Fundamental emission	4.29 dB
20dB Bandwidth	7.69 %
Frequency stability	0.01118 ppm
In band Radiated Emission	1.15 dB
Out of band Radiated Emissions (9kHz~30MHz)	2.99 dB
Out of band Radiated Emissions (Vertical, 30MHz~1GHz)	5.2 dB
Out of band Radiated Emissions (Horizontal, 30MHz~1GHz)	5.28 dB
AC Power Line Conducted Emission	2.59 dB

Note: The statement of conformity to this test service with decision rule not includes the measurement uncertainty. The identified critical influencing factors are based on the standard requirements and controlled.