Korea Standard Testlab
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FCC TEST REPORT

Applicant Name	: OA Information&Communication
Brand Name	: N/A
Applicant Address	: 2-2-28,393-7,Gyeongin-ro,Guro-gu,Seoul Republic of Korea
FCC ID	: 2AVQT-RF-OPEN01KM
Products Name	: Remote control
Model No.	: RF-OPEN01KM
Variant Model No.	: N/A
Products Manufacturer	: ZHEJIANG HUMAN PHOTOELECTRICY CO.,LTD
Test Standard	: FCC 15.231
Test Method	: ANSI C63.10:2013
Test Result	: PASS
Dates of Test	: FEB 04, 2020 to FEB 06, 2020
Date of Issue	: FEB 20, 2020
Test Laboratory	: Korea Standard Testlab FCC Registration No. : 829397

Tested by

Seungho Baek
Test Engineer

Approved by

Dongin Youn
Technical Manager

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1. GENERAL INFORMATION

1.1. E.U.T. Information

Applicant	2-2-28,393-7,Gyeongin-ro,Guro-gu, Seoul,Republic of Korea
Manufacturer	ZHEJIANG HUMAN PHOTOELECTRICY CO.,LTD
Equipment	Remote control
Model Name	RF-OPEN01KM
Model Discrepancy	N/A
Received Date	DEC 26, 2019
Date of Test	FEB 04, 2020 to FEB 06, 2020
Periodic operation	☒ (1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.
	☐ (2) A transmitter activated automatically shall cease transmission within 5 seconds after activation
	☐ (3) Periodic transmissions at regular predetermined intervals are not permitted.
	☐ (4) Periodic transmissions (lower field strength): each transmission is not greater than 1 sec and the silent period between transmissions is at least 30 times the duration of the transmission but in no case less than 10 sec.
Power Operation	Power from battery: DC 12V
Operation Frequency	TX: 315 MHz
S/W Version	Version 1
H/W Version	Version 1

1.2. E.U.T. Channel Information

Frequency Range	315 MHz
Modulation Type	ASK
Bandwidth	101.63 KHz
Number of Channels	1 Channel

Remark:

Refer as ANSI 63.10:2013 clause 5.6.1 Table 4 for test channels

Number of frequencies to be tested		
Frequency range in which device operates	**Number of frequencies**	**Location in frequency range of operation**
☒1 MHz or less	1	Middle
☐1 MHz to 10 MHz	2	1 near top and 1 near bottom
☐More than 10 MHz	3	1 near top, 1 near middle, and 1 near bottom

1.3. Antenna Information

Antenna Type	PCB antenna
Antenna Gain	N/A
Antenna Connector	N/A

1.4. Facilities And Test Location

All measurement facilities used to collect the measurement data are located at
107-27, Jangdeokdong-gil, Namyang-eup, Hwaseong-si, Gyeonggi-do, Korea.

Test site	Test Engineer	Remark
AC Conduction Room	-	Not applicable, because EUT doesn't connect to AC Main Source direct.
Radiation	Seungho Baek	-
RF Conducted	Seungho Baek	-

Remark: *The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.*

1.5. Instrument Calibration

No.	Test Equipment	Manufacturer	Model No.	Serial No.	Next Cal. Data	Used equipment
1	Spectrum Analyzer	Agilent	E4440A	MY45304715	20.10.01	■
2	Frequency Counter	HP	5350B	3049A05530	20.05.30	□
3	DC Power Supply	KEYSIGHT	U8002A	MY5813082	20.02.25	□
4	Signal Generator	Leader Electronics	3220	137231	20.05.28	□
5	Synthesized CW Generator	HP	83711B	US34490158	20.05.28	■
6	SYNTHESIZED SWEEPER	HP	8340B	2804A00830	20.05.28	□
7	Function Generator	IWATSU	SG-4105	62372780	20.05.27	□
8	Modulation Analyzer	Agilent	8901B	3438A05099	20.05.28	□
9	Audio Analyaer	Agilent	8903B	3279A18576	20.05.27	□
10	Power Meter	Agilent	E4418B	GB43312894	20.05.27	□
11	Power Sensor	HP	8485A	3316A14708	20.05.27	□
12	Power Sensor	Agilent	8482B	2703703543	20.05.27	□
13	Pre Amplifier	GTC	GA-1825A	GT0929/003	20.02.22	□
14	Pre Amplifier	8449B	HP	3008A00224	20.06.18	□

15	Attenuator	Weinsche	53-30-33	MG906	20.05.27	☐
16	Step Attenuator	Agilent	8494B	MY41110204	20.05.27	☐
17	Step Attenuator	Agilent	8495B	3308A17660	20.05.27	☐
18	Step Attenuator	Agilent	8496B	US40152183	20.05.27	☐
19	Attenuator	HP	30dB	N/A	20.05.27	☐
20	Attenuator	TAE SUNG	SMA-1	N/A	20.05.27	☐
21	Attenuator	TAE SUNG	SMA-2	N/A	20.05.27	☐
22	Termination	KWANG YEOK	KYTE-NJ-150W	2040004	20.05.27	☐
23	Bluetooth Tester	TESCOM	TC-3000A	3000A590236	20.05.27	☐
24	Loop ANT.	Com-Power	AL-130	121010	21.06.10	☐
25	Horn ANT.	SCHWARZBECK	BBHA 9120D	831	20.07.23	■
26	Temp & Humidity Chamber	Seoksan Tech	SE-CT-02	S7400JD5340618	20.05.27	☐
27	Test Receiver	LIG Nex1	LSA-265	L07098033	20.10.01	☐
28	Test Receiver	ROHDE&SCHWARZ	ESPI	101014	20.05.27	■
29	Bi-log Antenna	SCHWARZBECK	VULB9163	760	21.04.09	■
30	EMI TEST Receiver	ESI	ROHD & SCHWARZ	838786	20.02.20	☐

1.6. Support And E.U.T. Accessories Equipment

There are no accessories and support equipment be used during the test.

1.7. Test Methodology And Applied Standards

The test methodology, setups and results comply with all requirements in accordance with ANSI C63.10:2013, FCC 15.231 Rules.

2. TEST SUMMERY

FCC Standard Sec.	Chapter	Test Item	Result
15.203	1.3	Antenna Information	Pass
15.207	4.1	AC Power-line Conducted Emission	Not applicable
15.231(c)	4.2	Emission Bandwidth	Pass
15.231(b)	4.3	Field Strength Of Fundamenta	Pass
15.209(b)	4.4	Radiation Unwanted Emission	Pass
15.231(a)(1)	4.5	Operation Restriction	Pass

3. DESCRIPTION OF TEST MODES

3.1. The Worst Mode Of Operating Condition

Operation mode	315 MHz
RF Filed strength	**ASK** Peak: 93.28 dBuv/m Average : 68.72 dBuv/m

Remark: Field strength performed Average level at 3m.

3.2. The Worst Mode Of Measurement

Radiated Emission Measurement Above 1G	
Test Condition	Band edge, Emission for Unwanted and Fundamental
Power supply Mode	Mode 1:EUT power by battery(DC 12V)
Worst Mode	☒ Mode1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4
Worst Position	☒ Placed in fixed position. ☐ Placed in fixed position at X-Plane (E2-Plane) ☐ Placed in fixed position at Y-Plane (E1-Plane) ☐ Placed in fixed position at Z-Plane (H-Plane)
Worst Polarity	☒ Horizontal ☒ Vertical

Radiated Emission Measurement Below 1G	
Test Condition	Radiated Emission Below 1G
Power supply Mode	Mode 1:EUT power by battery(DC 12V)
Worst Mode	☒ Mode1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Remark:

The worst mode was record in this test report.

3.3. FCC PART 15.205 Restricted Bands OF Operation

According to FCC 15.231(b), 15.231(e),

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

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	11,250 to 3,750	1125 to 375
174-260	3,750	375
260-470	13,750 to 12,500	1375 to 1,250
Above 470	12,500	1,250

Linear interpolations.

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) 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.

(e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	1,000	100
70-130	500	50
130-174	500 to 1,500	50 to 150
174-260	1,500	150
260-470	1,500 to 5,000	150 to 500
Above 470	5,000	500

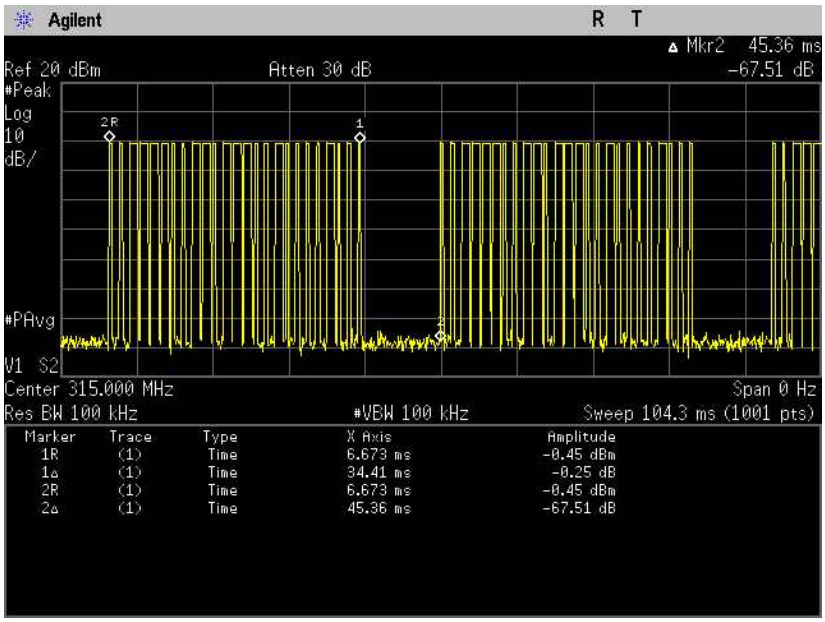
Linear interpolations.

In addition, 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.

3.4. E.U.T. Duty Cycle

315 MHz

Duty Cycle			
TX ON (ms)	**TX All(ms)**	**Duty Cycle**	**Duty Factor(dB)**
34.41	45.36	75.86%	-9.27



Notes:

1. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by 20 log (Time(on) / [Period or 100 ms whichever is the lesser])

2. The EUT transmits for a Time(on) of 34.41 milliseconds.
   20 log (Time(on) / [Period or 100 ms whichever is the lesser]).
   20 log (34.41/100) = -9.27dB

4. TEST RESULT

4.1. AC Power Line Conducted Emission

4.1.1. Test Limit

According to §15.207(a)

Frequency Range (MHz)	Limits(dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

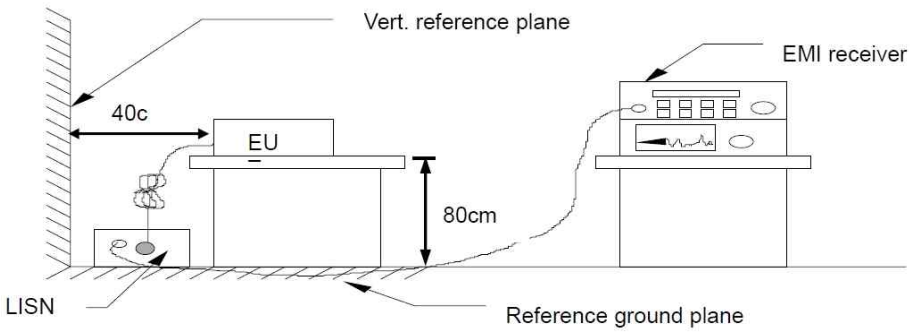
* Decreases with the logarithm of the frequency.

4.1.2. Test Procedure

Test method Refer as ANSI 63.10:2013 clause 6.2,

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete

4.1.3. Test Setup



4.1.4. Test Result

Not applicable

4.2. Emission Bandwidth

4.2.1. Test Limit

According to §15.231(c)

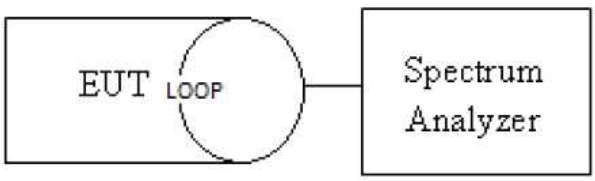
Limit	☒ 70 MHz – 900 MHz : Fc * 0.25 % ☐ Above 900 MHz : Fc * 0. 5 %

4.2.2. Test Procedure

Test method Refer as ANSI 63.10:2013 clause 6.9.2,

The Loop antenna connected to the spectrum analyzer, was touching to the transmitter antenna. Set the RBW=20KHz, VBW=30KHz, Detector = Peak, Trace mode = Max hold, Sweep = Auto. Measure the maximum width of the emission that is constrained by the frequencies associated with the 20dB Bandwidth. The Loop antenna connected to the spectrum analyzer, was touching to the transmitter antenna. SA set RBW = 1% ~ 5% OBW, VBW = three times the RBW and Detector = Peak, Trace mode = Max hold, Sweep = Auto. Measure the maximum width of the emission that is constrained by the frequencies associated with the Occupied Bandwidth (99%).

4.2.3. Test Setup

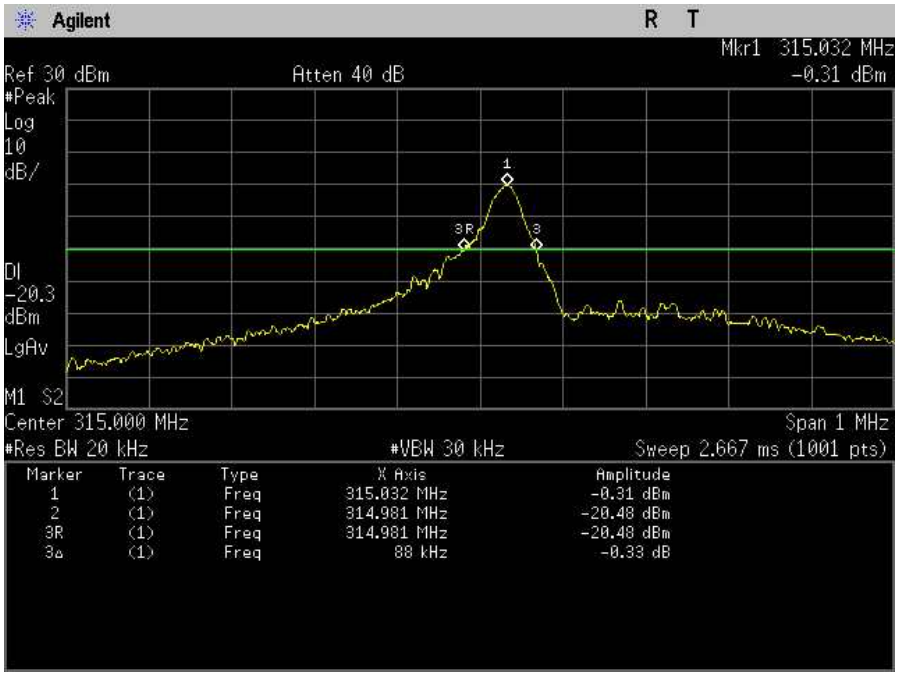


4.1.4. Test Result

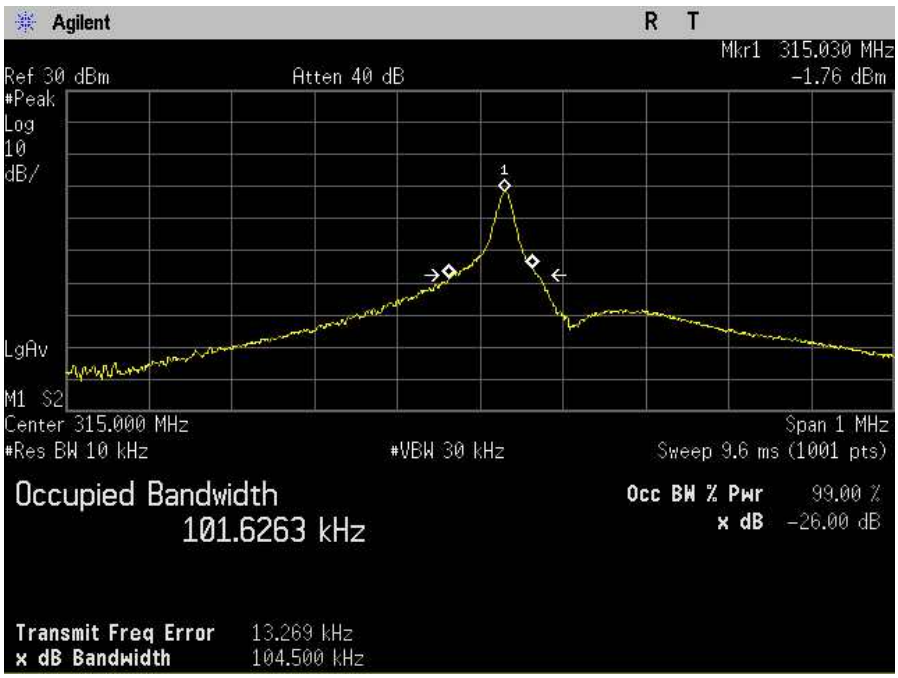
Spectrum Bandwidth				
Frequency (MHz)	**20dB Bandwidth (MHz)**	**20dB Bandwidth Limits (MHz)**	**99% Occupied BW (MHz)**	**99% Bandwidth Limits (MHz)**
315	0.0880	0.7875	0.1016	0.7875

Test Data

20dB Bandwidth



99% Occupied BW



4.3. Field Strength Of Fundamental

4.3.1. Test Limit

According to §15.231(b)

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of fundamental (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	1,250 to 3,750	125 to 375
174-260	3,750	375
260-470	3,750 to 12,500	375 to 1,250
Above 470	12,500	1,250

Freqency (MHz)	Class B(**dBuV/m @ 3m**)	
	Peak	Average
Above 1000	74	54

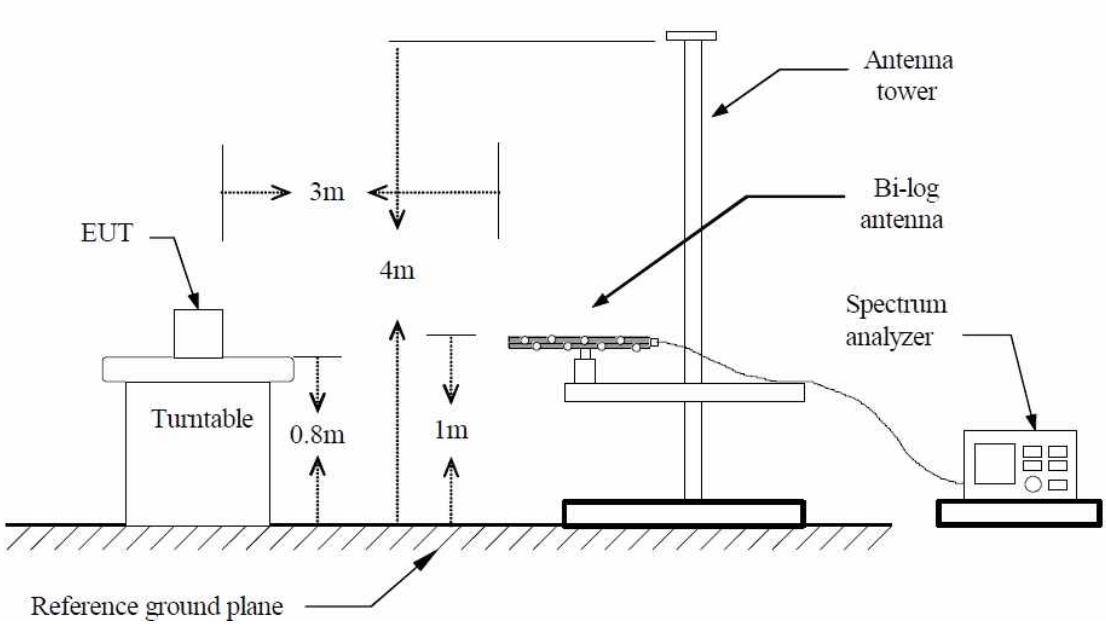
Or The maximuum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level whichever limit permits higher field strength.

4.3.2. Test Procedure

Test method Refer as ANSI 63.10:2013 clause 4.1.4 and clause 6.5

clause 4.1.4	☒ 4.1.4.2.2: Measurement Peak value. ☐ 4.1.4.2.3: Duty cycle ≥ 100%. ☒ 4.1.4.2.4: Measurement Average value.

4.3.3. Test Setup



4.3.4. Test Result

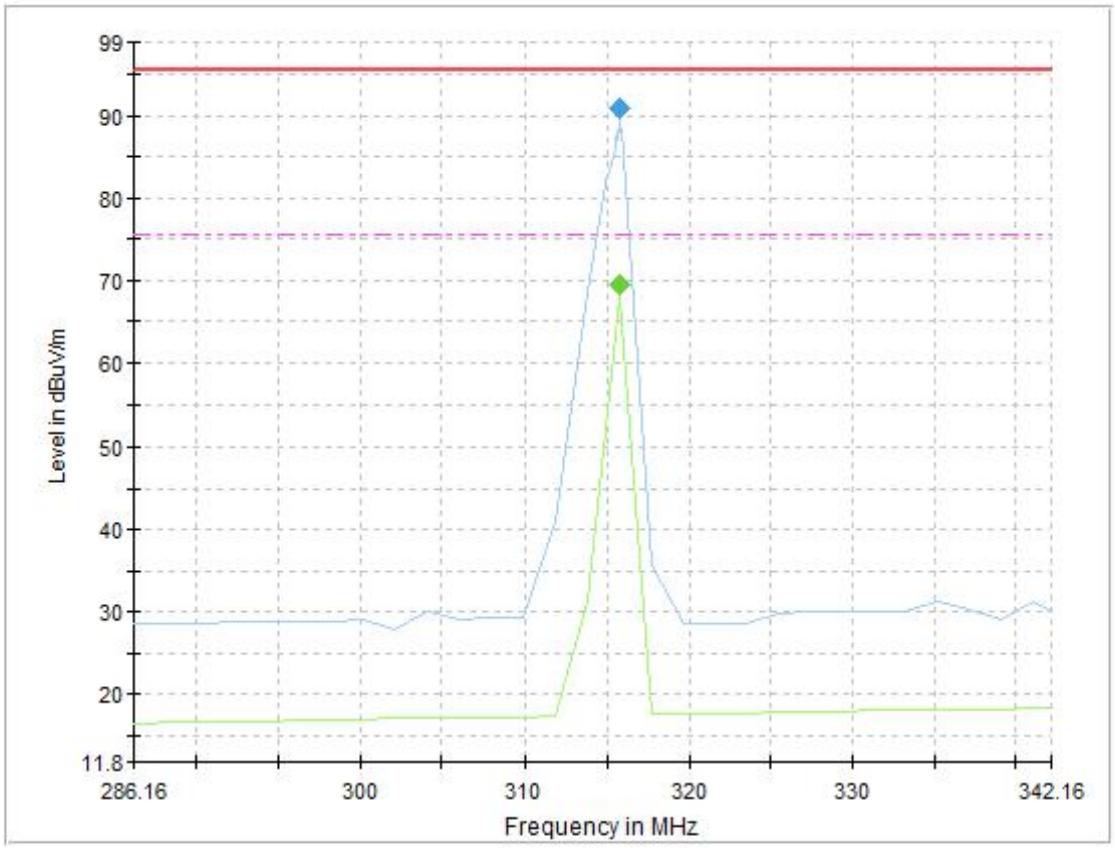
Field Strength					
Frequency (MHz)	**Fundamental (dBuV/m) at 3m**	**Limit (dBuV/m) at 3m**	**Margin (dB)**	**Pol**	**Remark**
315.03	89.95	95.62	-5.67	V	PEAK

Remark:

1. Fundamental measured method setting on spectrum, RBW=100 kHz, VBW=100kHz and Detector=Peak.

2. The worst modulation was the ASK of field strength of fundamental, we selected worst modulation to performed the radiation unwanted emission test.

Test Data



Final_Result

Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol
315.03	---	68.72	75.62	-6.90	V
315.03	89.95	---	95.62	-5.67	V

4.4. Radiation Unwanted Emission

4.4.1. Test Limit

According to §15.231(b) and §15.209, §15.205

Unwanted emissions limit follow the table or the FCC Part 15.209, whichever limit permits higher field strength.

According to §15.231(b)

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of fundamental (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	1,250 to 3,750	125 to 375
174-260	3,750	375
260-470	3,750 to 12,500	375 to 1,250
Above 470	12,500	1,250

Linear interpolations.

Below 30MHz

Frequency (MHz)	Field Strength				
	(μV/m)	(dBμV/m)	Measurement Distance (meter)	(dBμV/m)	Measurement Distance (meter)
0.009 - 0.490	2400/F(kHz)	48.52 − 13.80	300	128.52−104.84	3
0.490 - 1.705	24000/F(kHz)	33.80 − 22.97	30	73.80− 62.97	3
1.705 − 30.0	30	29.54	30	69.54	3

Above 30MHz

Frequency (MHz)	Field Strength		Measurement Distance (meter)
	(μV/m)	(dBμV/m)	
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

4.4.2. Test Procedure

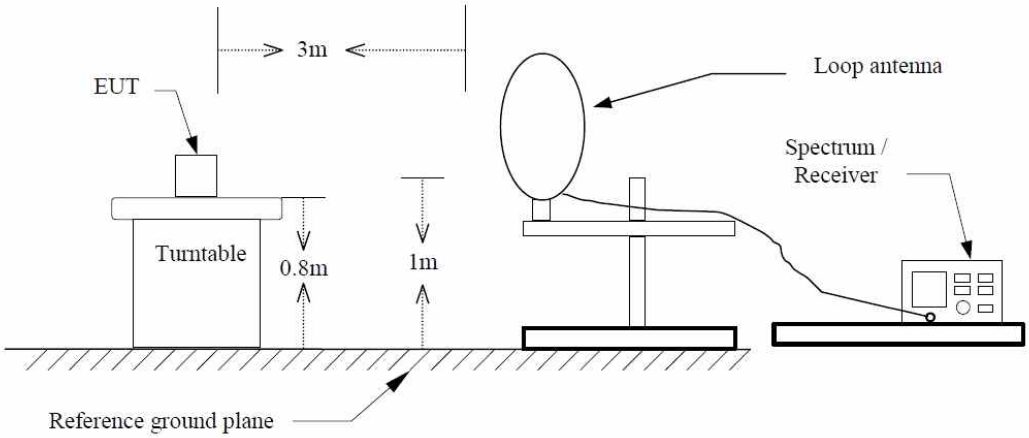
Test method Refer as ANSI 63.10:2013

☒ Unwanted Emission	☒ clause 4.1.4.2.2: Measurement Peak value. ☐ clause 4.1.4.2.3: Duty cycle ≥ 100%. ☒ clause 4.1.4.2.4: Measurement Average value.
☒ Radiated Emission	☒ clause 6.4: below 30 MHz and test distance is 3m. ☒ clause 6.5: below 30 MHz -1 GHz and test distance is 3m. ☒ clause 6.6: Above 30 MHz and test distance is 3m.

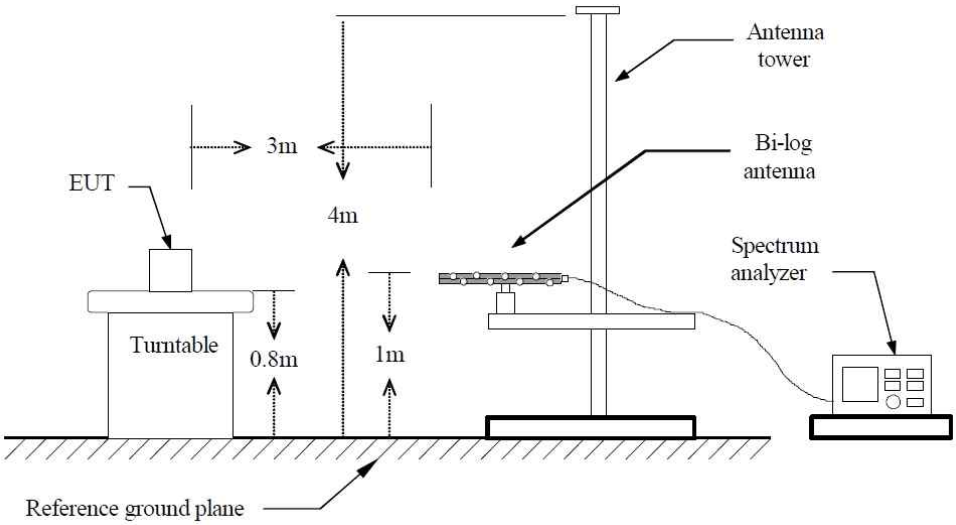
1. The EUT is placed on a turntable, which is 0.8m for test below 1GHz and 1.5m for test above 1GHz, above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:
   Below 1GHz:
   RBW=100kHz / VBW=300kHz / Sweep=AUTO
   Above 1GHz:
   (a)PEAK: RBW=1MHz / VBW=3MHz / Sweep=AUTO
   (b)AVERAGE: RBW=1MHz,
7. Repeat above procedures until the measurements for all frequencies are complete.

4.4.3. Test Setup

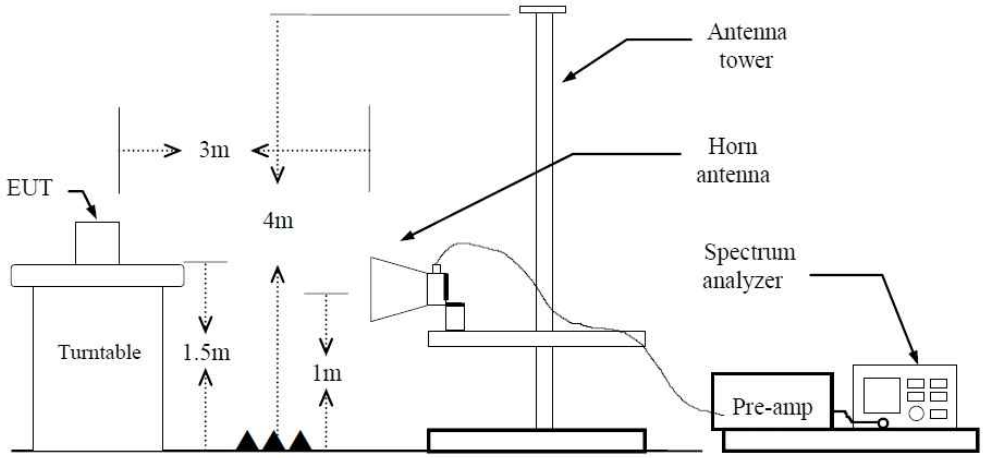
9 kHz ~ 30 MHz



30 MHz ~ 1 GHz



Above 1 GHz



4.4.4. Test Result

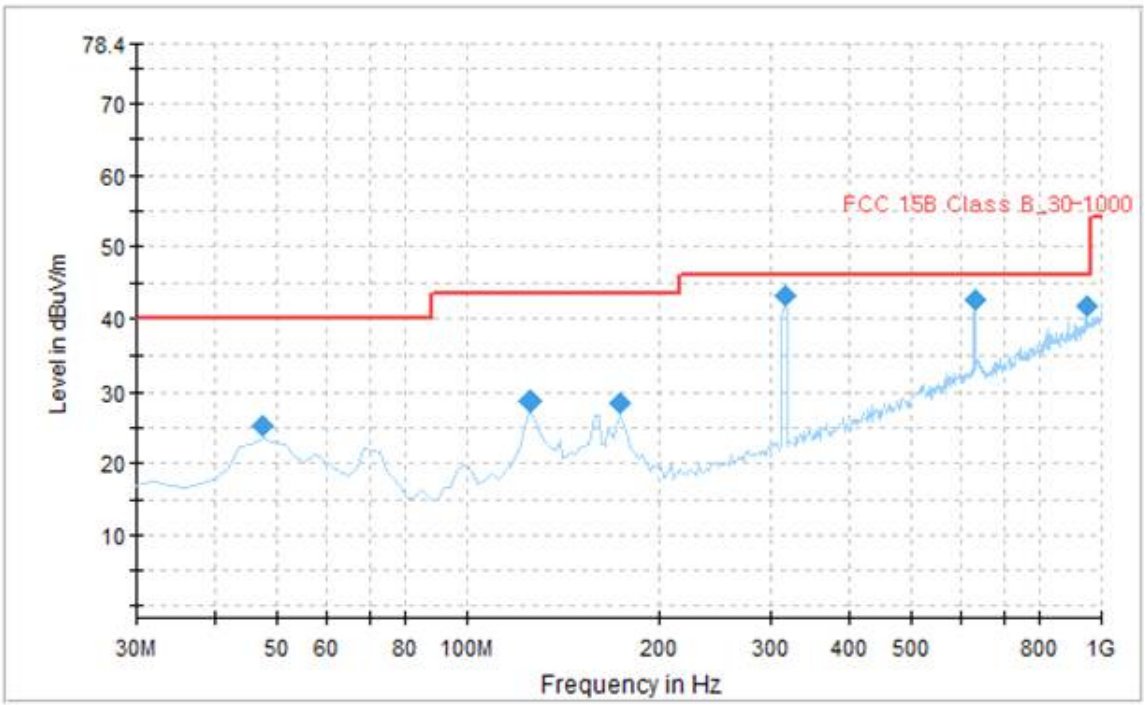
The worst modulation was the ASK of field strength of fundamental, we selected worst modulation to performed the testing of the radiation unwanted emission and the emission within the restricted bands.

Pass.

Test Data

Below 1GHz

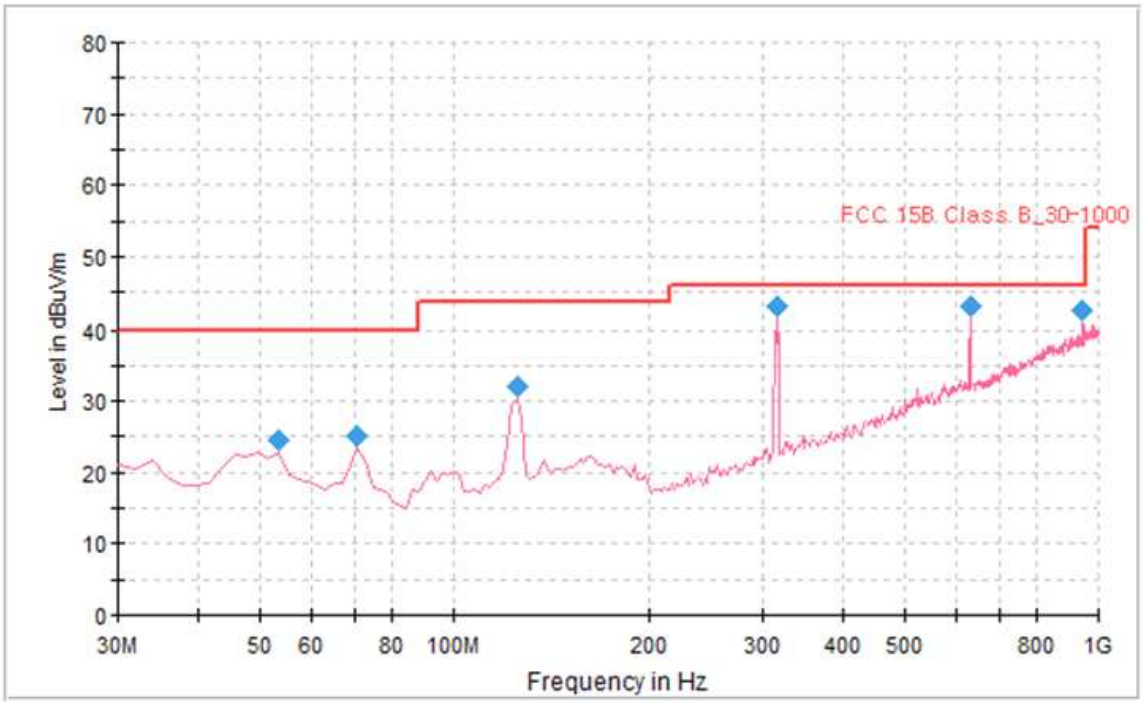
Full Spectrum



Final_Result

Frequency (MHz)	MaxPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol
47.49	23.89	40.00	-16.11	H
125.25	27.26	43.50	-16.24	H
173.85	27.12	43.50	-16.38	H
315.03	42.57	46.00	-3.43	H
630.66	41.82	46.00	-4.18	H
945.57	40.03	46.00	-5.97	H

Full Spectrum



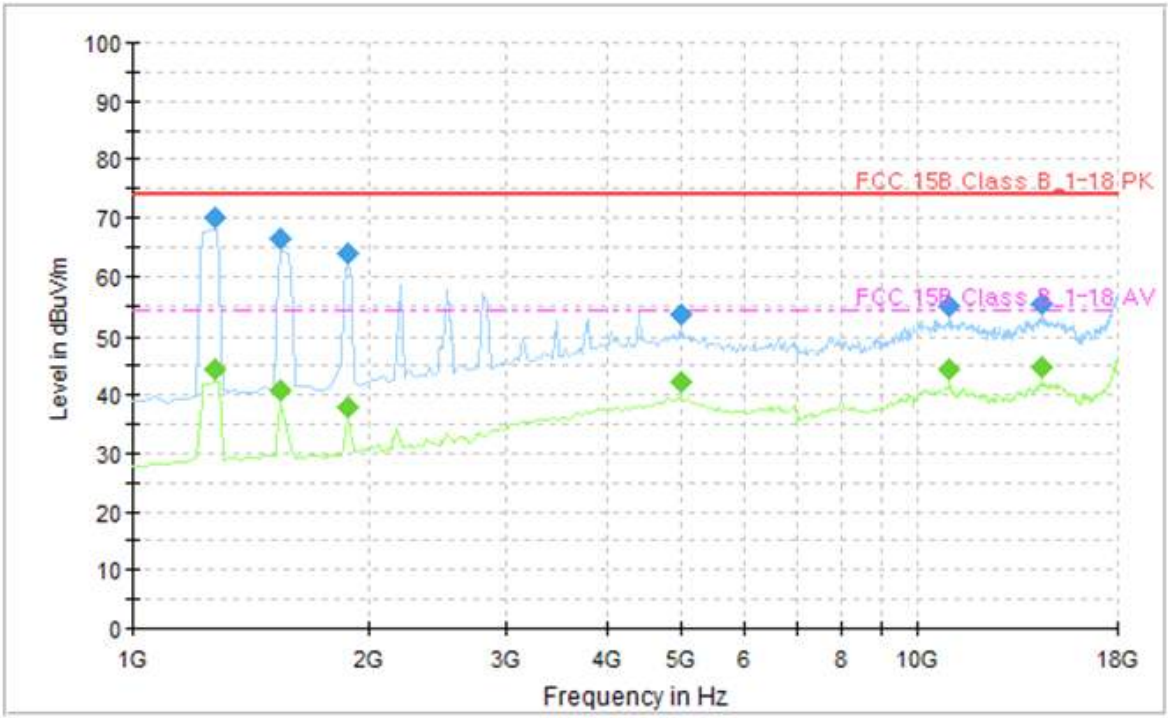
Final_Result

Frequency (MHz)	MaxPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol
53.33	23.25	40.00	-17.75	V
70.82	23.99	40.00	-16.01	V
125.25	31.38	43.50	-12.12	V
315.03	42.26	46.00	-3.74	V
630.66	42.19	46.00	-3.81	V
945.57	41.72	46.00	-4.28	V

Test Data

Above 1GHz

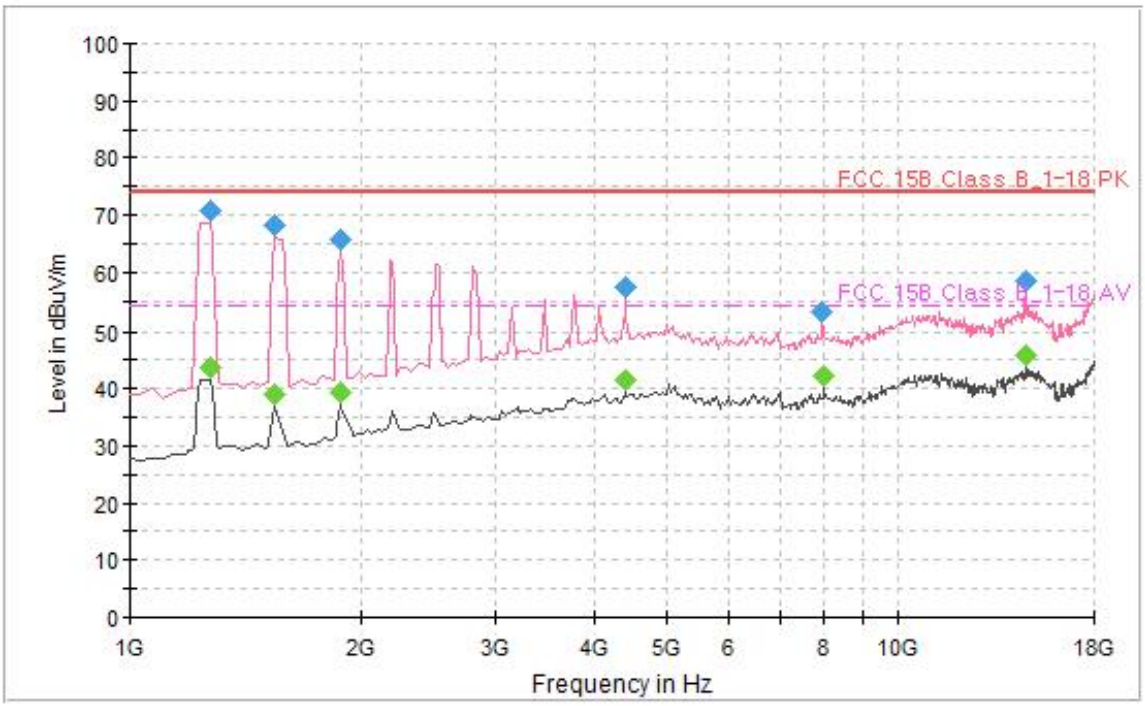
Full Spectrum



Final_Result

Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol
1272.55	---	42.58	54.00	-11.42	H
1272.55	68.24	---	74.00	-5.76	H
1545.09	---	38.65	54.00	-15.35	H
1545.09	64.89	---	74.00	-9.11	H
1885.77	---	35.74	54.00	-18.26	H
1885.77	62.03	---	74.00	-11.97	H
4985.97	---	40.21	54.00	-13.79	H
4985.97	53.08	---	74.00	-20.92	H
10981.96	---	42.83	54.00	-11.17	H
10981.96	53.82	---	74.00	-20.18	H
14388.78	---	42.87	54.00	-11.13	H
14388.78	54.13	---	74.00	-19.87	H

Full Spectrum



Final_Result

Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol
1272.55	---	42.68	54.00	-11.32	V
1272.55	68.93	---	74.00	-5.07	V
1545.09	---	37.02	54.00	-16.98	V
1545.09	66.07	---	74.00	-7.93	V
1885.77	---	37.57	54.00	-16.43	V
1885.77	64.82	---	74.00	-9.18	V
4406.81	---	39.91	54.00	-14.09	V
4406.81	56.17	---	74.00	-17.83	V
7949.89	---	40.03	54.00	-13.97	V
7949.89	52.84	---	74.00	-21.16	V
14661.32	---	43.72	54.00	-10.28	V
14661.32	57.59	---	74.00	-16.41	V

4.5. Operation Restriction

4.5.1. Test Limit

15.231(a)(1),

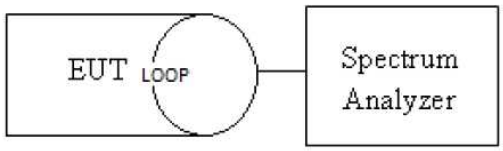
A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

4.5.2. Test Procedure

Test method Refer as ANSI 63.10:2013 clause 7.4

The Loop antenna connected to the spectrum analyzer, was touching to the transmitter antenna. Set the RBW=1MHz, VBW=1MHz, Detector = Peak, Trace mode = Max hold, Sweep = 1s. Measure

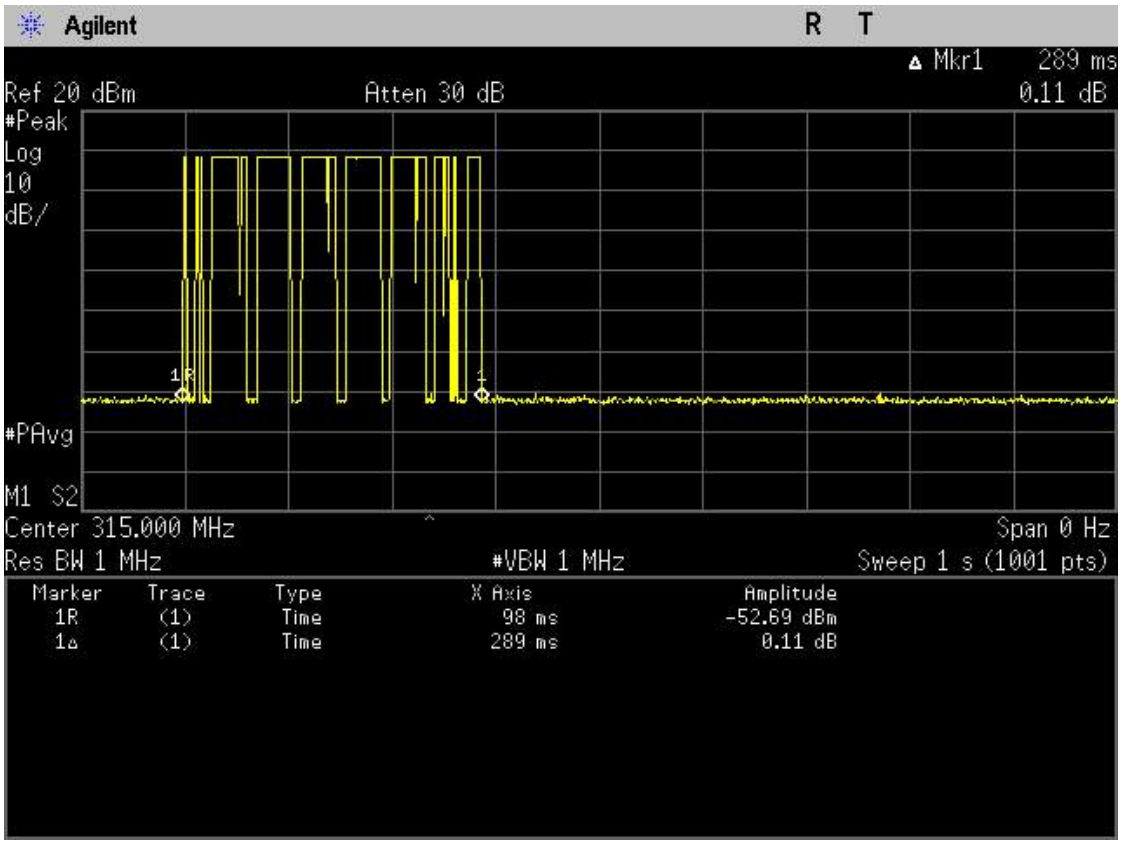
4.5.3. Test Setup



4.5.4. Test Result

Dwell Time			
Operation condition	**Pulse On Time (s)**	**Limits**	**Result**
manually operated	0.289 s	5 sec	PASS

Test Data



APPENDIX A : Photographs of E.U.T.

1. EUT photo

APPENDIX B : Photographs of Test Setup

1. Radiated Spurious Emission