RF Test Report

Applicant	：	Ring LLC
Product Type	：	Video Doorbell 4
Trade Name	：	Ring
Model Number	：	5D22E9
Applicable Standard	：	FCC 47 CFR PART 15 SUBPART C ANSI C63.10:2013
Received Date	：	Jan. 25, 2021
Test Period	：	Jan. 27 ~ Feb. 21, 2021
Issued Date	：	Mar. 09, 2021

Issued by

A Test Lab Techno Corp.
No. 140-1, Changan Street, Bade District,
Taoyuan City 33465, Taiwan (R.O.C.)
Tel：+886-3-2710188 / Fax：+886-3-2710190

Taiwan Accreditation Foundation accreditation number: 1330
Frequency Range : 9 kHz to 40 GHz
Test Firm MRA designation number: TW0010

Note:
1.The test results are valid only for samples provided by customers and under the test conditions described in this report.
2.This report shall not be reproduced except in full, without the written approval of A Test Lab Technology Corporation.
3.The relevant information is provided by customers in this test report. According to the correctness, appropriateness or completeness of the information provided by the customer, if there is any doubt or error in the information which affects the validity of the test results, the laboratory does not take the responsibility.

Revision History

Rev.	Issued Date	Revisions	Revised By
00	Mar. 09, 2021	Initial Issue	Yu Chiang

Verification of Compliance

Applicant	:	Ring LLC
Product Type	:	Video Doorbell 4
Trade Name	:	Ring
Model Number	:	5D22E9
FCC ID	:	2AEUPBHARG071
EUT Rated Voltage	:	8-24 Vac, 50/60 Hz, 200 mA
Test Voltage	:	AC 24 V / DC 3.65 V
Applicable Standard	:	FCC 47 CFR PART 15 SUBPART C ANSI C63.10:2013
Test Result	:	Complied
Performing Lab.	:	A Test Lab Techno Corp. No. 140-1, Changan Street, Bade District, Taoyuan City 33465, Taiwan (R.O.C.) Tel：+886-3-2710188 / Fax：+886-3-2710190 Taiwan Accreditation Foundation accreditation number: 1330 http://www.atl-lab.com.tw/e-index.htm

A Test Lab Techno Corp. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by A Test Lab Techno Corp. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Approved By : Fly Lu

(Manager) (Fly Lu)

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1 General Information

1.1. Summary of Test Result

Standard	Item	Result	Remark
15.207	AC Power Conducted Emission	PASS	-----
15.247(d)	Transmitter Radiated Emissions	PASS	-----
15.247(b)(3)	Max. Output Power	PASS	-----
15.247(a)(2)	6 dB RF Bandwidth	PASS	-----
15.247(e)	Maximum Power Spectral Density	PASS	-----
15.247(d)	Out of Band Conducted Spurious Emission	PASS	-----
15.203	Antenna Requirement	PASS	-----

Decision Rule

■ Uncertainty is not included.

□ Uncertainty is included.

Standard	Description
CFR47, Part 15, Subpart C	Intentional Radiators
ANSI C63. 10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB 558074 D01 15.247 Meas Guidance v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES

1.2. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Conducted Emission	150 kHz ~ 30 MHz	2.7 dB
Radiated Emission	9 kHz ~ 30 MHz	2.2 dB
	30 MHz ~ 1000 MHz	5.1 dB
	1000 MHz ~ 18000 MHz	5.1 dB
	18000 MHz ~ 26500 MHz	4.4 dB
	26500 MHz ~ 40000 MHz	4.6 dB
Conducted Output Power	1.1 dB	
RF Bandwidth	4.7 %	
Power Spectral Density	1.1 dB	

2 EUT Description

Applicant	Ring LLC 1523 26th Street, Santa Monica United States 90404			
Manufacturer	Ring LLC 1523 26th Street, Santa Monica United States 90404			
Product Type	Video Doorbell 4			
Trade Name	Ring			
Model No.	5D22E9			
FCC ID	2AEUPBHARG071			
Frequency Range	2402 ~ 2480 MHz			
Modulation Type	GFSK			
Operate Temp. Range	-20 ~ +50 ℃			
Antenna information	ANT	Model Number	Type	Max. Gain (dBi)
	ANT-0(AUX)	RFPCA491914EMLB301	PCB Antenna	0.72
	ANT-1(MAIN)	RFPCA491910EMLB303	PCB Antenna	0.61
RF Output Power	0.00098 W			

3 Test Methodology

3.1. Mode of Operation

Decision of Test ATL has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: Transmit mode
Mode 2: LE, GFSK Continuous TX Mode
Mode 3: 2LE, GFSK Continuous TX Mode

Software used to control the EUT for staying in continuous transmitting mode was programmed.
After verification, all tests were carried out with the worst case test modes.

Note: The EUT was programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98 %.

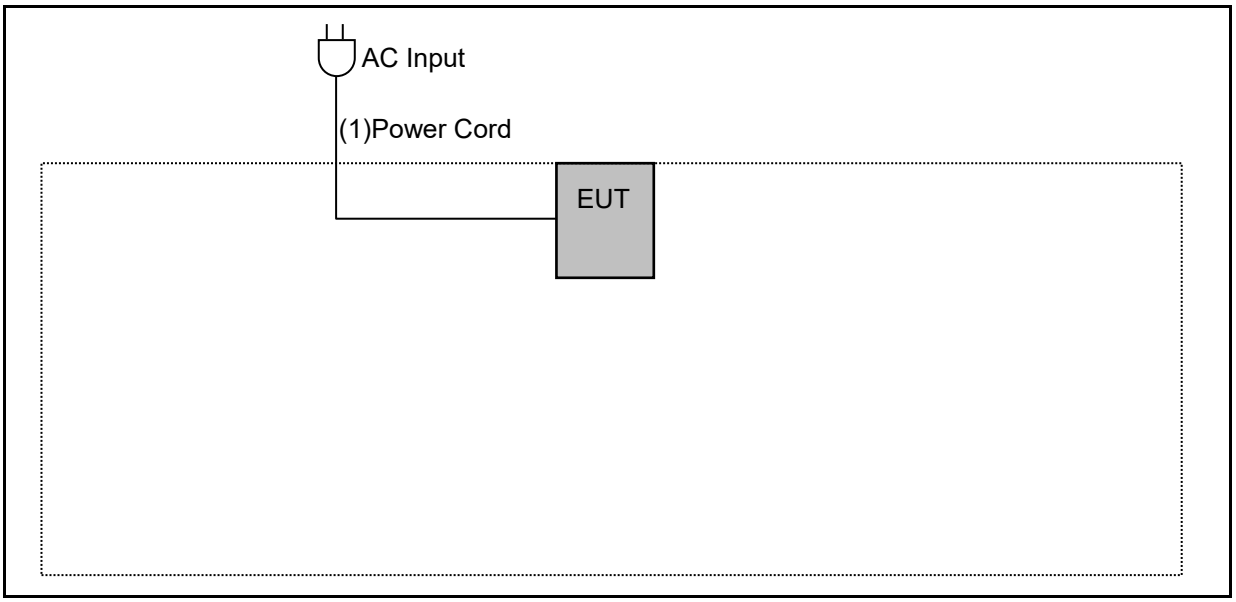
3.2. EUT Test Step

1	Setup the EUT shown on “Configuration of Test System Details”.
2	Turn on the power of all equipment.
3	Turn on TX function.
4	EUT run test program.

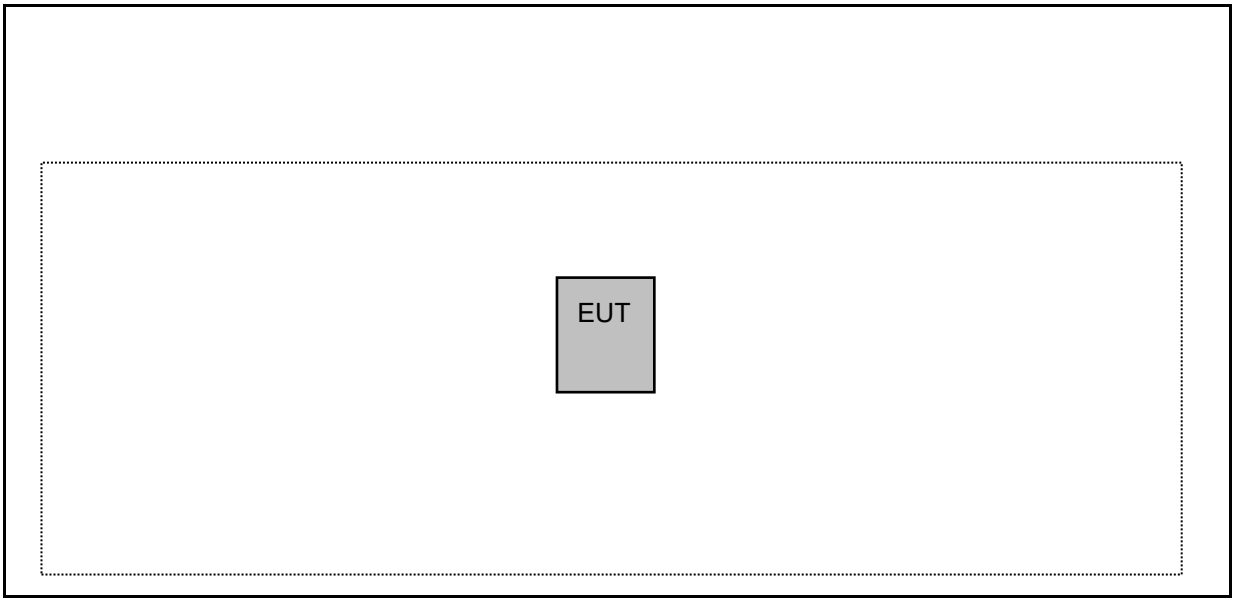
Measurement Software			
No.	Description	Software	Version
1	Conducted Emission	EZ EMC	1.1.4.3
2	Radiated Emission	EZ EMC	1.1.4.4

3.3. Configuration of Test System Details

Conducted Emissions



Radiated Emission



Devices Description					
Product		Manufacturer	Model Number	Serial Number	Power Cord
(1)	Power Cord	BAOHING	ATL-002	--	--

3.4. Test Instruments

For Conducted Emission

Test Period: Jan. 29 ~ Feb. 21, 2021

Testing Engineer: Louis Shen, Andy Lu, Peter Liu

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
Test Receiver	R&S	ESCI	100367	05/25/2020	1 year
RF Cable	Woken	00100D1380194M	TE-02-03	05/25/2020	1 year
LISN	R&S	ENV216	101040	03/23/2020	1 year
LISN	R&S	ENV216	101041	04/06/2020	1 year

For Radiated Emissions

Test Period: Jan. 27, 2021

Testing Engineer: Pink Li

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
Spectrum Analyzer (2 Hz~50 GHz)	Keysight	N9030B	MY57143537	04/14/2020	1 year
Pre Amplifier (1 kHz~1 GHz)	Titan	T0910E00014330A1F	001	07/23/2020	1 year
Pre Amplifier (1~26.5 GHz)	Titan	T0912E01263025A1F	002	07/23/2020	1 year
Horn Antenna (1~18 GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA9120D	02207	06/30/2020	1 year
Horn Antenna (18~40 GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA9170	9170-320	08/18/2020	1 year
Coaxial Cable	Titan	T0710AT327A10A100	J11005	08/13/2020	1 year
Coaxial Cable	Titan	T0710AT327A10A900	J11004	08/13/2020	1 year
Loop Antenna	COM-POWER CORPORATION	AL-130	121014	03/27/2020	1 year

For Conducted

Test Period: Jan. 27, 2021

Testing Engineer: Peter Liu

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
Spectrum Analyzer (10 Hz~26.5 GHz)	KEYSIGHT	N9010B	MY59071418	03/17/2020	1 year
Power Sensor	Agilent	N1921A	MY45241957	12/09/2020	1 year
Power Meter	Agilent	N1911A	MY45101619	12/09/2020	1 year

Note: N.C.R. = No Calibration Request.

3.5. Test Site Environment

Items	Required (IEC 60068-1)	Actual
Temperature (°C)	15-35	20-30
Humidity (%RH)	25-75	45-75

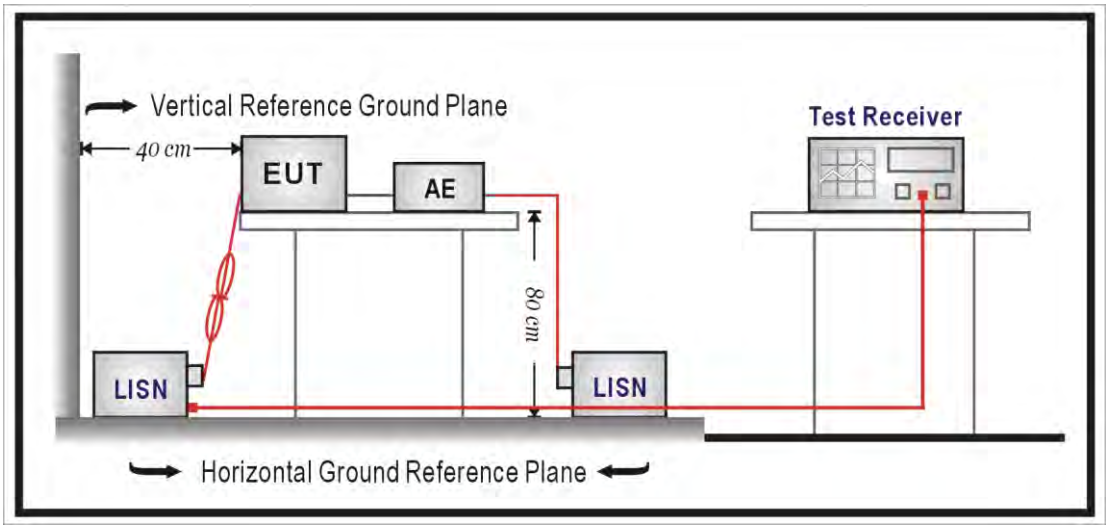
4 Measurement Procedure

4.1. AC Power Line Conducted Emission Measurement

■ **Limit**

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

■ **Test Setup**



■ **Test Procedure**

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 Ω// 50 uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50 Ω// 50 uH coupling impedance with 50 ohm termination.

Tabletop device shall be placed on a non-conducting platform, of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The wall of screened room shall be located 40 cm to the rear of the EUT. Other surfaces of tabletop or floor standing EUT shall be at least 80 cm from any other ground conducting surface including one or more LISNs. For floor-standing device shall be placed under the EUT with a 12 mm insulating material.

Conducted emissions were investigated over the frequency range from 0.15 MHz to 30 MHz using a resolution bandwidth of 9 kHz. The equipment under test (EUT) shall be meet the limits in section 4.1, as applicable, including the average limit and the quasi-peak limit when using respectively, an average detector and quasi-peak detector measured in accordance with the methods described of related standard. When all of peak value were complied with quasi-peak and average limit from 150 kHz to 30 MHz then quasi-peak and average measurement was unnecessary.

The AMN shall be placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for AMNs mounted on top of the ground reference plane. This distance is between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8 m from the AMN. If the mains power cable is longer than 1 m then the cable shall be folded back and forth at the centre of the lead to form a bundle no longer than 0.4 m. All of interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long. All of EUT and AE shall be separate place more than 0.1 m. All 50 Ω ports of the LISN shall be resistively terminated into 50 Ω loads when not connected to the measuring instrument.

If the reading of the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the higher reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

4.2. Radiated Emission Measurement

■ **Limit**

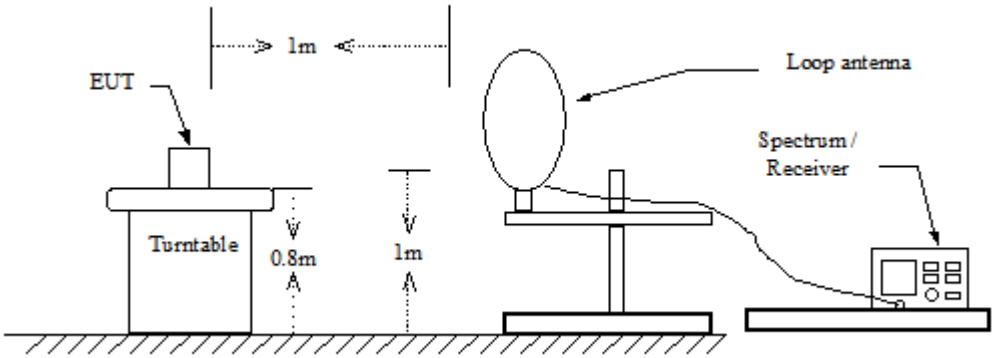
According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m at 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
Above 960	500	3

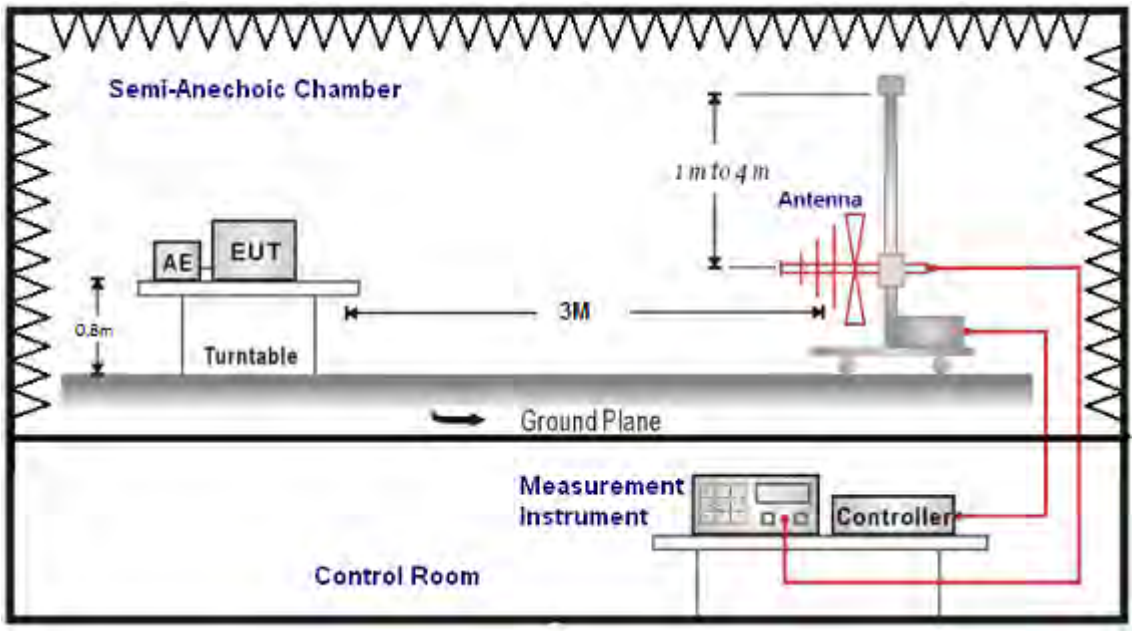
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

■ **Setup**

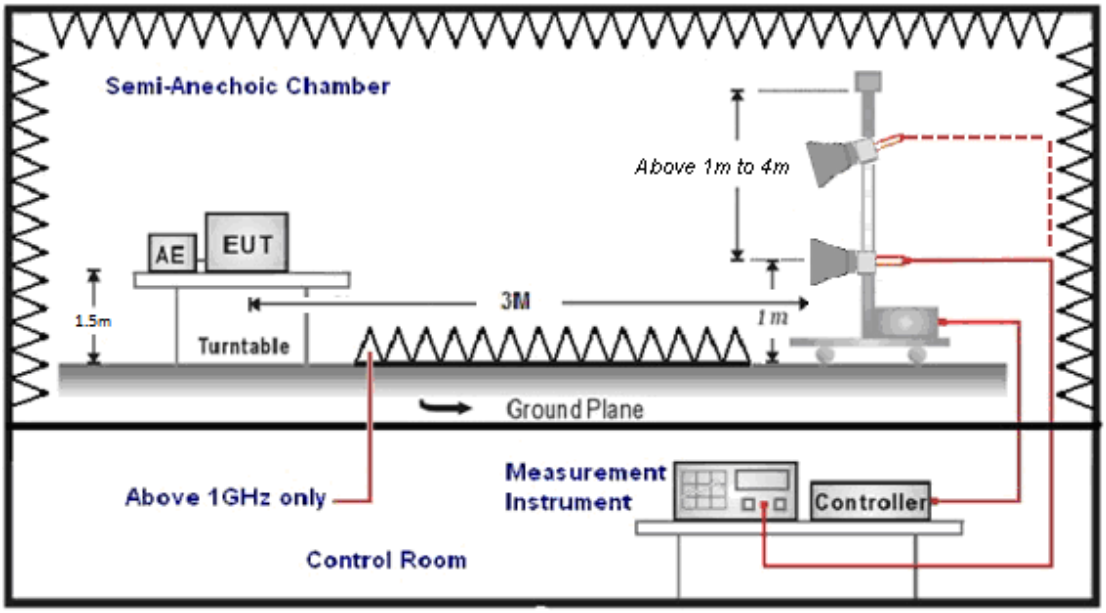
9 kHz ~ 30 MHz



Below 1 GHz



Above 1 GHz



■ **Test Procedure**

Final radiation measurements were made on a three-meter, Semi Anechoic Chamber. The EUT system was placed on a nonconductive turntable which is 0.8 or 1.5 meters height, top surface 1.0 x 1.5 meter. The spectrum was examined from 250 MHz to 2.5 GHz in order to cover the whole spectrum below 10th harmonic which could generate from the EUT. During the test, EUT was set to transmit continuously & Measurements spectrum range from 9 kHz to 26.5 GHz is investigated.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 3 MHz for peak measurements and 10 Hz for average measurements when Duty cycle >0.98 / 1/T for average measurements when Duty cycle <0.98. A nonconductive material surrounded the EUT to supporting the EUT for standing on tree orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

SCHWARZBECK MESS-ELEKTRONIK Biconilog Antenna at 3 Meter and the SCHWARZBECK Double Ridged Guide Antenna was used in frequencies 1 –26.5 GHz at a distance of 3 meter. The antenna at an angle toward the source of the emission. All test results were extrapolated to equivalent signal at 3 meters utilizing an inverse linear distance extrapolation Factor (20 dB/decade).

For testing above 1 GHz, the emission level of the EUT in peak mode was 20 dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer’s 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvolt (dBuV) into field intensity in micro volts pre meter (uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in micro colts per meter (dBuV/m).

The actual field is intensity in referenced to 1 microvolt per meter (dBuV/m) is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

(1) Amplitude (dBuV/m) = FI (dBuV) +AF (dBuV) +CL (dBuV)-Gain (dB)
FI= Reading of the field intensity.
AF= Antenna factor.
CL= Cable loss.
P.S Amplitude is auto calculate in spectrum analyzer.

(2) Actual Amplitude (dBuV/m) = Amplitude (dBuV)-Dis(dB)
The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:
(a) For fundamental frequency : Transmitter Output < +30 dBm
(b) For spurious frequency : Spurious emission limits = fundamental emission limit /10

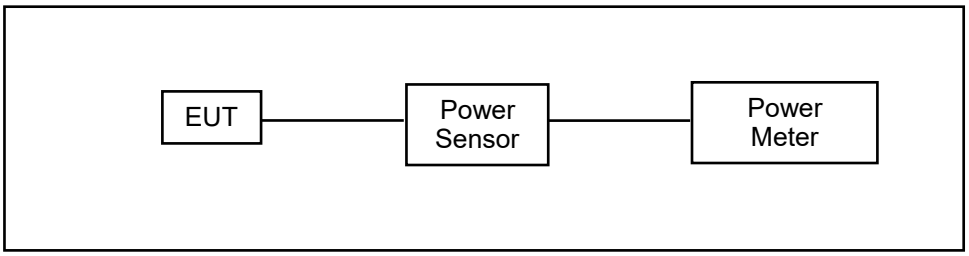
Data of measurement within this frequency range without mark in the table above means the reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.

4.3. Maximum Conducted Output Power Measurement

■ **Limit**

For systems using digital modulation in the 2400-2483.5 MHz, the limit for peak output power is 30 dBm.

■ **Test Setup**



■ **Test Procedure**

The testing follows the Measurement Procedure of ANSI C63.10:2013 section 11.9.2.3.2 Method AVGPM.

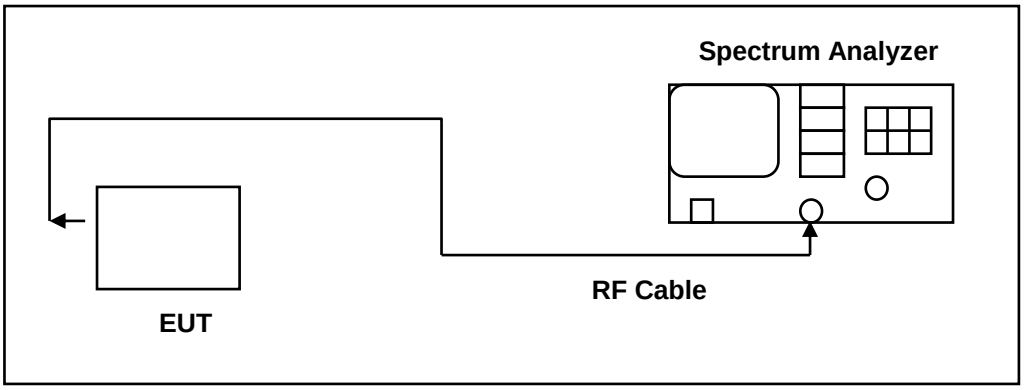
The tests below are run with the EUT's transmitter set at high power in TX mode. The EUT is needed to force selection of output power level and channel number. While testing, EUT was set to transmit continuously. Remove the Subjective device's antenna and connect the RF output port to power sensor..

4.4. 6 dB RF Bandwidth Measurement

■ **Limit**

6 dB RF Bandwidth: Systems using digital modulation techniques may operate in the 2400–2483.5 MHz bands. The minimum 6 dB band-width shall be at least 500 kHz.
99 % Occupied Bandwidth: N/A

■ **Test Setup**



■ **Test Procedure**

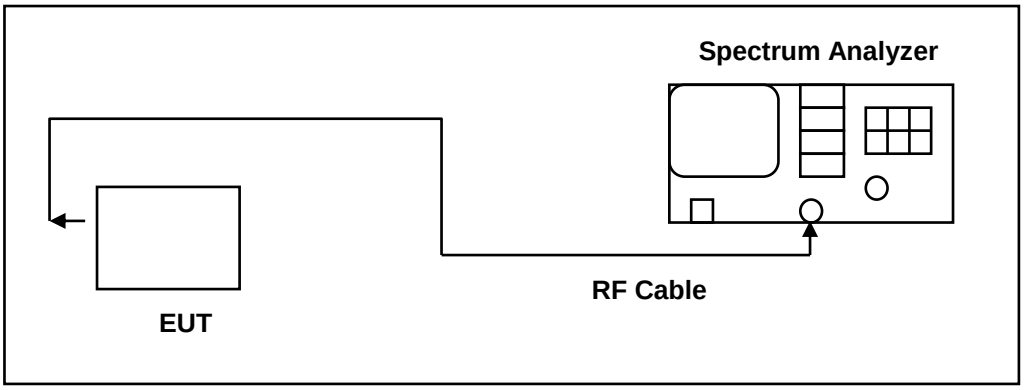
The EUT tested to DTS test procedure of ANSI C63.10-2013 section 11.8.2 option2 for compliance to FCC 47CFR 15.247 requirements.
6 dB RF Bandwidth: The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW was set to 100 kHz. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A peak output reading was taken, a DISPLAY line was drawn 6 dB lower than peak level. The 6 dB bandwidth was determined from where the channel output spectrum intersected the display line.
The test was performed at 3 channels (Channel low, middle, high)

4.5. Maximum Power Density Measurement

■ **Limit**

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

■ **Test Setup**



■ **Test Procedure**

The EUT tested to DTS test procedure of ANSI C63.10:2013 section 11.10.2 Method PKPSD.

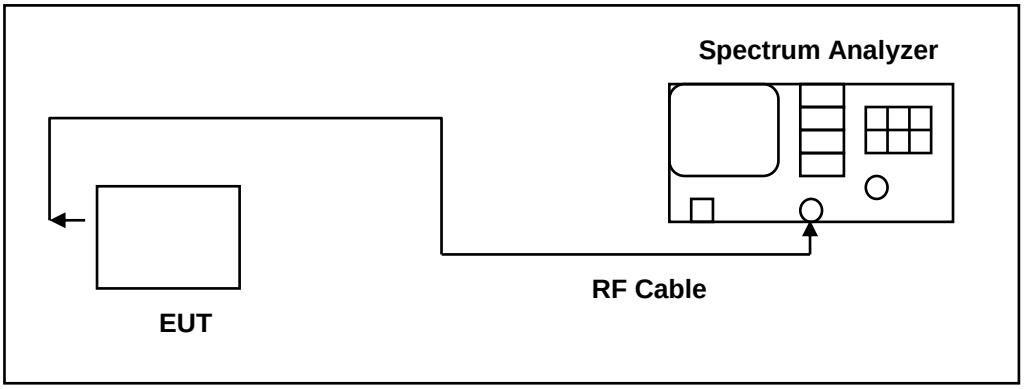
1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 × RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

4.6. Out of Band Conducted Emissions Measurement

■ **Limit**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

■ **Test Setup**



■ **Test Procedure**

In any 100 kHz bandwidth outside the EUT pass band, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.
All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the pass band.
The test was performed at 3 channels.

4.7. Antenna Measurement

■ **Limit**

For intentional device, according to 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.
And According to 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

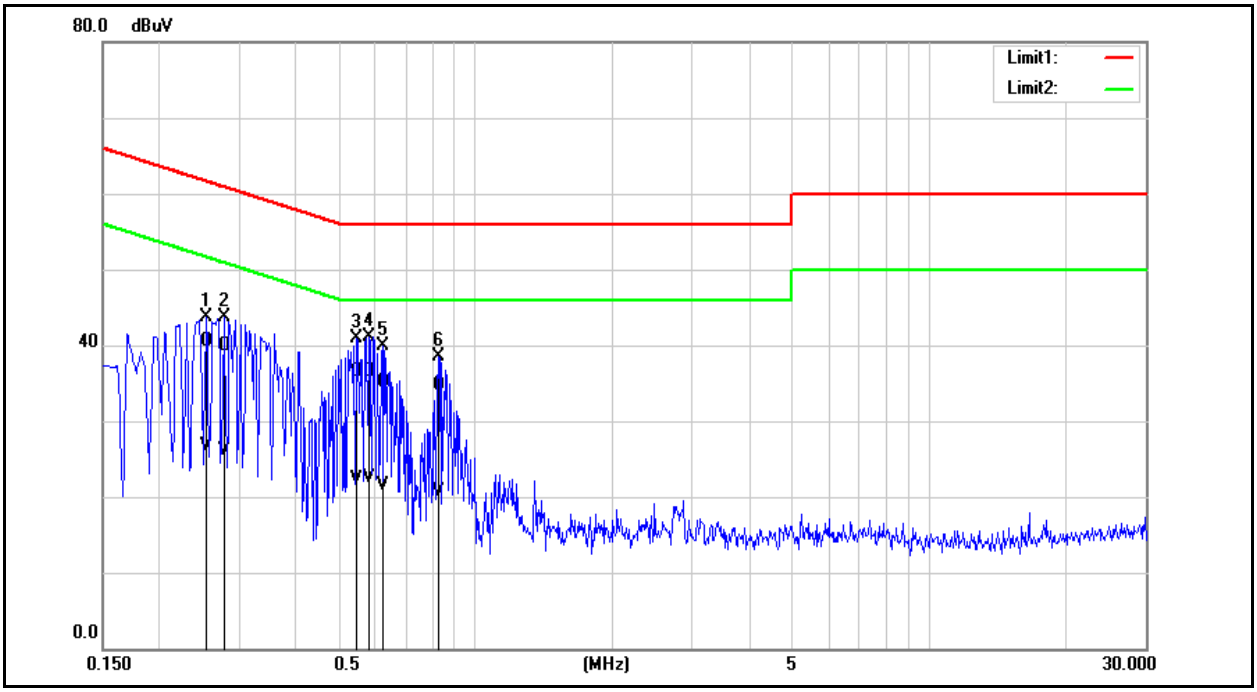
■ **Antenna Connector Construction**

See section 2 – antenna information.

5 Test Results

Annex A. Conducted Emission

Standard:	FCC Part 15.247	Line:	L1
Test item:	Conducted Emission	Power:	AC 24 V
Mode:	Mode 1		
Description:			

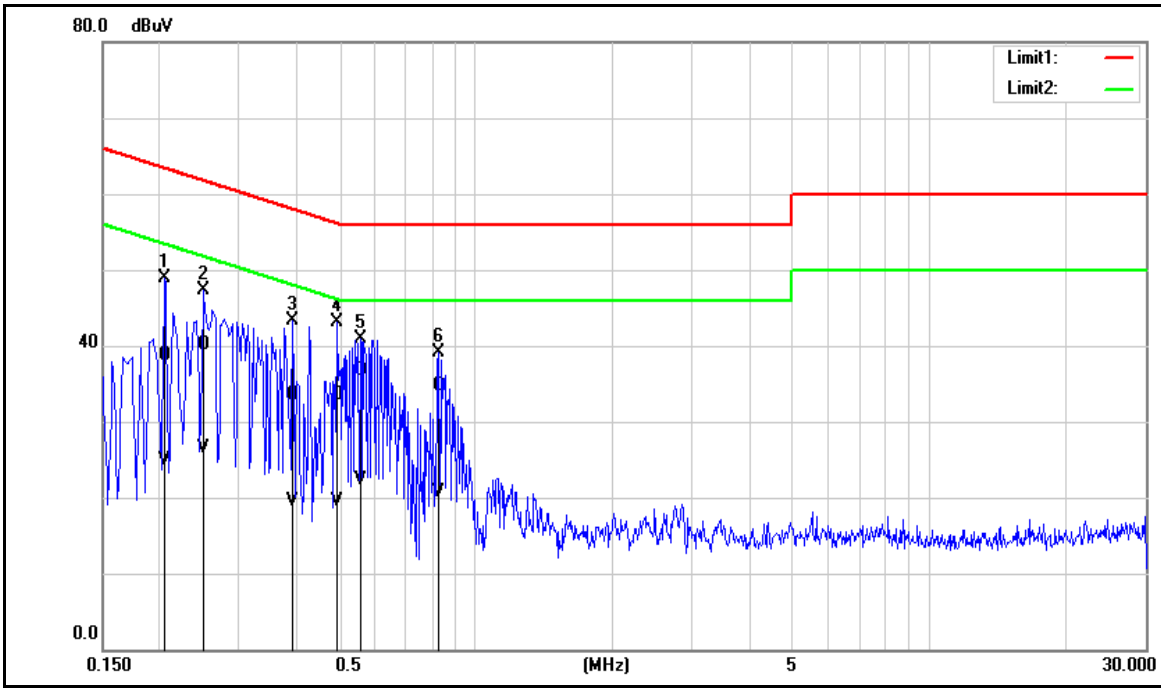


No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	0.2540	30.77	16.91	9.70	40.47	26.61	61.63	51.63	-21.16	-25.02	Pass
2	0.2780	30.21	16.47	9.71	39.92	26.18	60.88	50.88	-20.96	-24.70	Pass
3	0.5460	26.71	12.58	9.71	36.42	22.29	56.00	46.00	-19.58	-23.71	Pass
4	0.5820	26.71	12.76	9.71	36.42	22.47	56.00	46.00	-19.58	-23.53	Pass
5	0.6220	25.40	11.88	9.71	35.11	21.59	56.00	46.00	-20.89	-24.41	Pass
6	0.8300	24.98	10.95	9.71	34.69	20.66	56.00	46.00	-21.31	-25.34	Pass

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

Standard:	FCC Part 15.247	Line:	N
Test item:	Conducted Emission	Power:	AC 24 V
Mode:	Mode 1		
Description:			



No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	0.2060	28.98	15.16	9.69	38.67	24.85	63.37	53.37	-24.70	-28.52	Pass
2	0.2500	30.50	16.87	9.69	40.19	26.56	61.76	51.76	-21.57	-25.20	Pass
3	0.3940	23.74	9.82	9.69	33.43	19.51	57.98	47.98	-24.55	-28.47	Pass
4	0.4940	23.71	9.71	9.70	33.41	19.41	56.10	46.10	-22.69	-26.69	Pass
5	0.5580	27.06	12.64	9.70	36.76	22.34	56.00	46.00	-19.24	-23.66	Pass
6	0.8300	24.93	10.91	9.70	34.63	20.61	56.00	46.00	-21.37	-25.39	Pass

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

Annex B. Conducted Test Results

Maximum Conducted Output Power Measurement

ANT-0					
Test Mode	Mode 2				
Frequency (MHz)	Average Power		Peak Power		Limit (dBm)
	(dBm)	(W)	(dBm)	(W)	
2402	-0.53	0.00089	-0.37	0.00092	≤ 30
2440	-0.42	0.00091	-0.28	0.00094	≤ 30
2480	-0.27	0.00094	-0.10	0.00098	≤ 30

Test Mode	Mode 3				
Frequency (MHz)	Average Power		Peak Power		Limit (dBm)
	(dBm)	(W)	(dBm)	(W)	
2402	-0.52	0.00089	-0.37	0.00092	≤ 30
2440	-0.42	0.00091	-0.27	0.00094	≤ 30
2480	-0.29	0.00094	-0.12	0.00097	≤ 30

ANT-1					
Test Mode	Mode 2				
Frequency (MHz)	Average Power		Peak Power		Limit (dBm)
	(dBm)	(W)	(dBm)	(W)	
2402	-0.62	0.00087	-0.46	0.00090	≤ 30
2440	-0.48	0.00090	-0.37	0.00092	≤ 30
2480	-0.38	0.00092	-0.23	0.00095	≤ 30

Test Mode	Mode 3				
Frequency (MHz)	Average Power		Peak Power		Limit (dBm)
	(dBm)	(W)	(dBm)	(W)	
2402	-0.59	0.00087	-0.44	0.00090	≤ 30
2440	-0.48	0.00090	-0.34	0.00092	≤ 30
2480	-0.39	0.00091	-0.24	0.00095	≤ 30

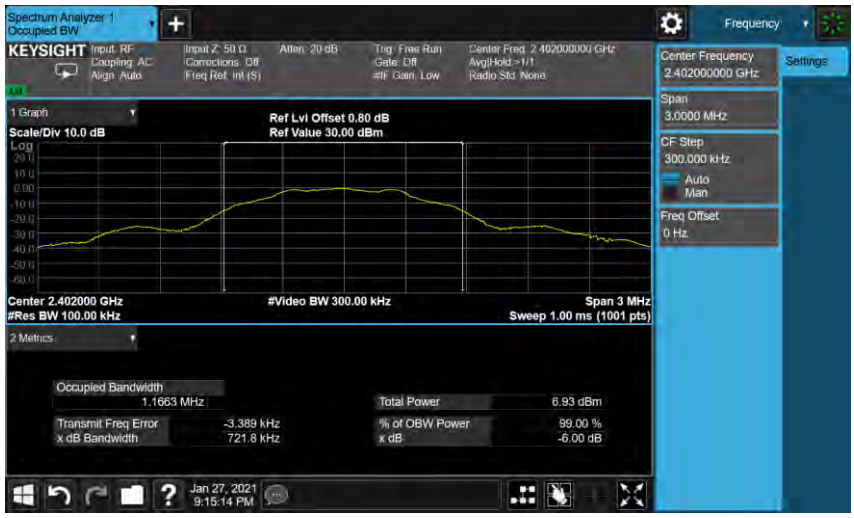
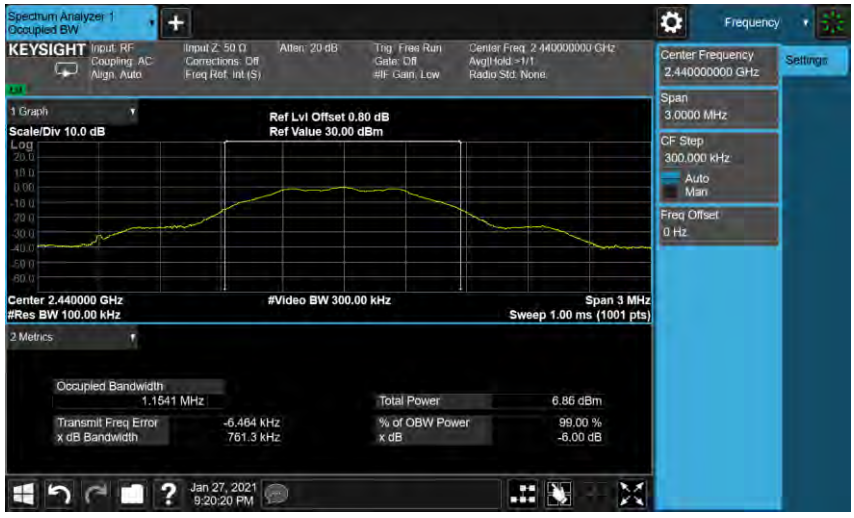
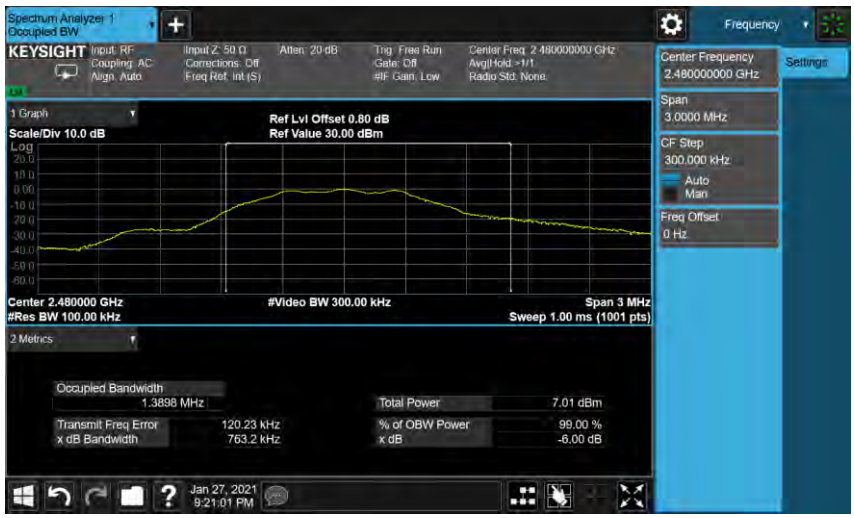
Note: The relevant measured result has the offset with cable loss already.

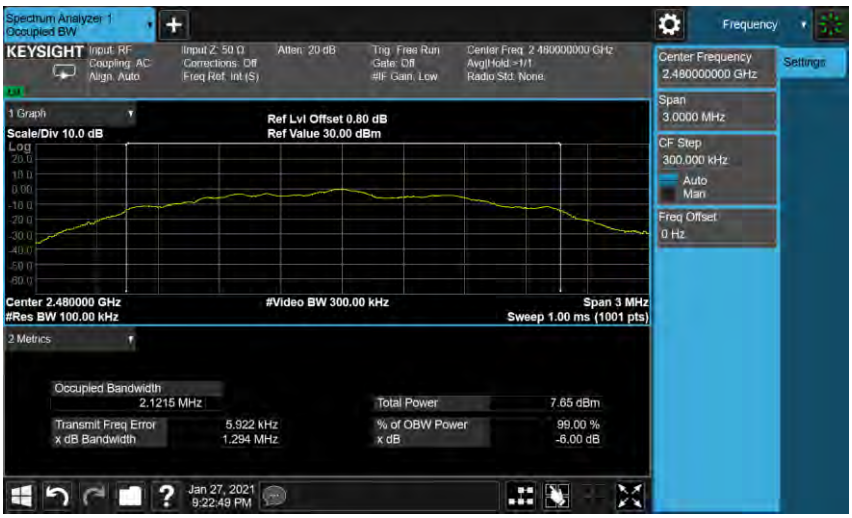
6 dB RF Bandwidth Measurement

ANT-0		
Test Mode	Mode 2	
Frequency (MHz)	Measurement Results (kHz)	Limit (kHz)
2402	721.800	≥ 500
2440	761.300	≥ 500
2480	763.200	≥ 500

ANT-0		
Test Mode	Mode 3	
Frequency (MHz)	Measurement Results (kHz)	Limit (kHz)
2402	1151.000	≥ 500
2440	1291.000	≥ 500
2480	1294.000	≥ 500

■ **Test Graphs**

Mode 2	
2402 MHz	
2440 MHz	
2480 MHz	

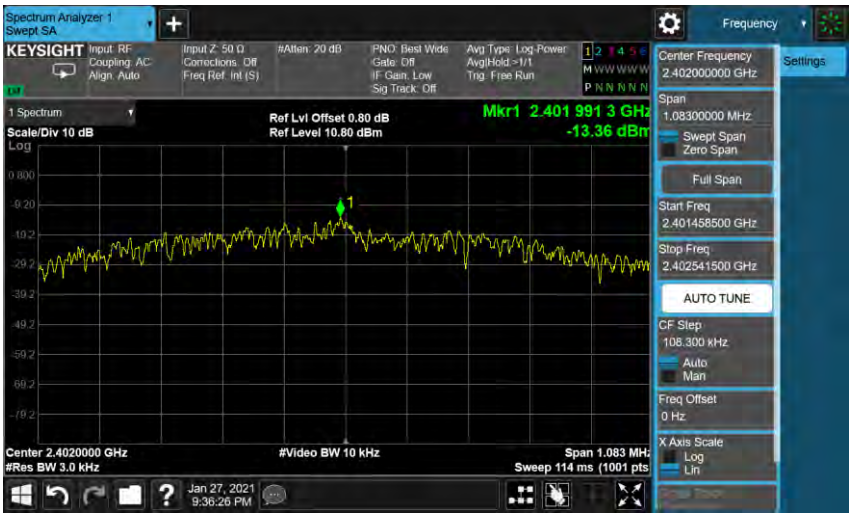
Mode 3	
2402 MHz	
2440 MHz	
2480 MHz	

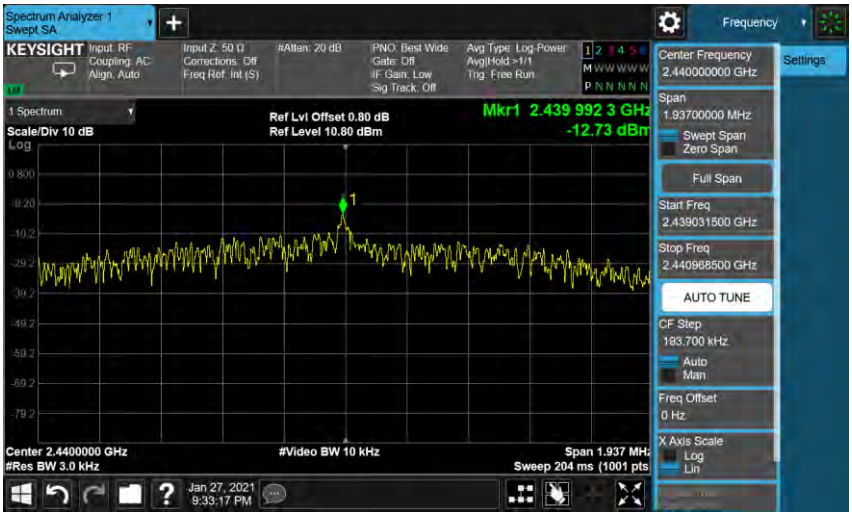
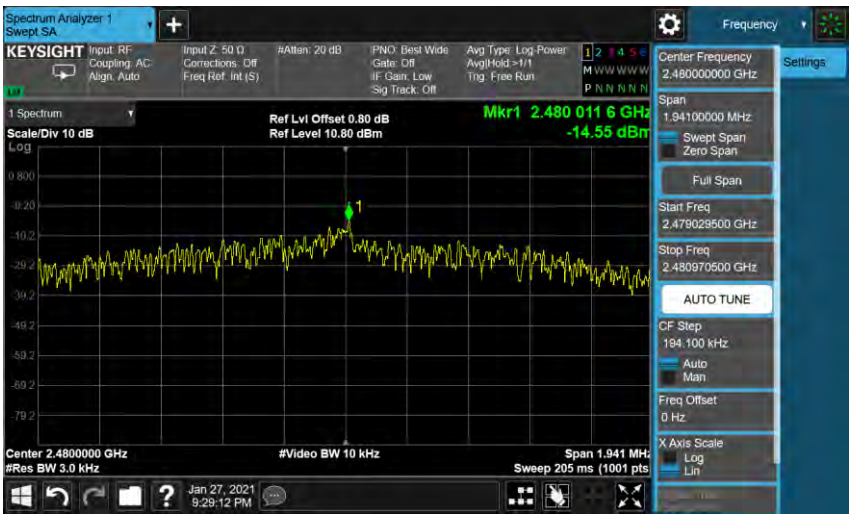
Maximum Power Density Measurement

ANT-0		
Test Mode	Mode 2	
Frequency (MHz)	Measurement Results (dBm/ 3 kHz)	Limit (dBm/3 kHz)
2402	-13.36	≤ 8
2440	-12.11	≤ 8
2480	-14.44	≤ 8

ANT-0		
Test Mode	Mode 3	
Frequency (MHz)	Measurement Results (dBm/ 3 kHz)	Limit (dBm/3 kHz)
2402	-13.82	≤ 8
2440	-12.73	≤ 8
2480	-14.55	≤ 8

■ **Test Graphs**

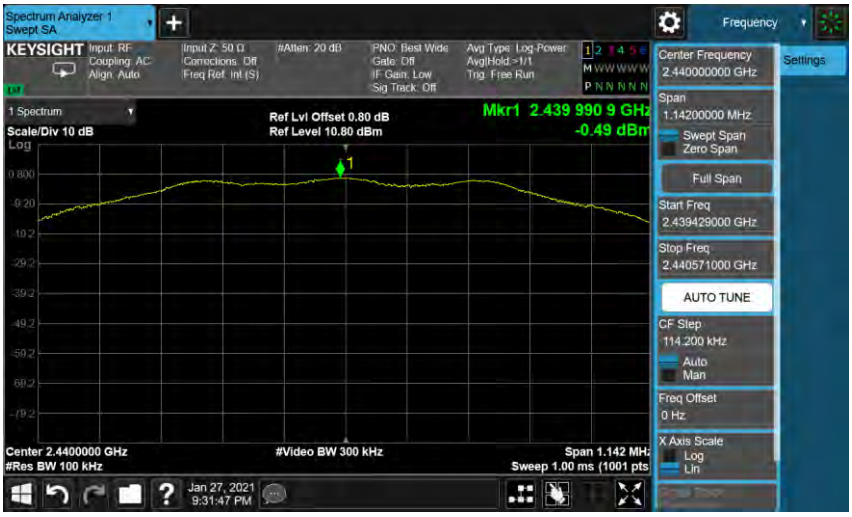
Mode 2	
2402 MHz	
2440 MHz	
2480 MHz	

Mode 3	
2402 MHz	
2440 MHz	
2480 MHz	

Out of Band Conducted Emissions Measurement

■ **Test Graphs**

Reference level

Mode 2	
2402 MHz	
2440 MHz	
2480 MHz	

Mode 3	
2402 MHz	
2440 MHz	
2480 MHz	

Out of Band Conducted Emissions

Mode 2	
2402 MHz	
2440 MHz	
2480 MHz	

Mode 3	
2402 MHz	
2440 MHz	
2480 MHz	

Conducted Band Edge

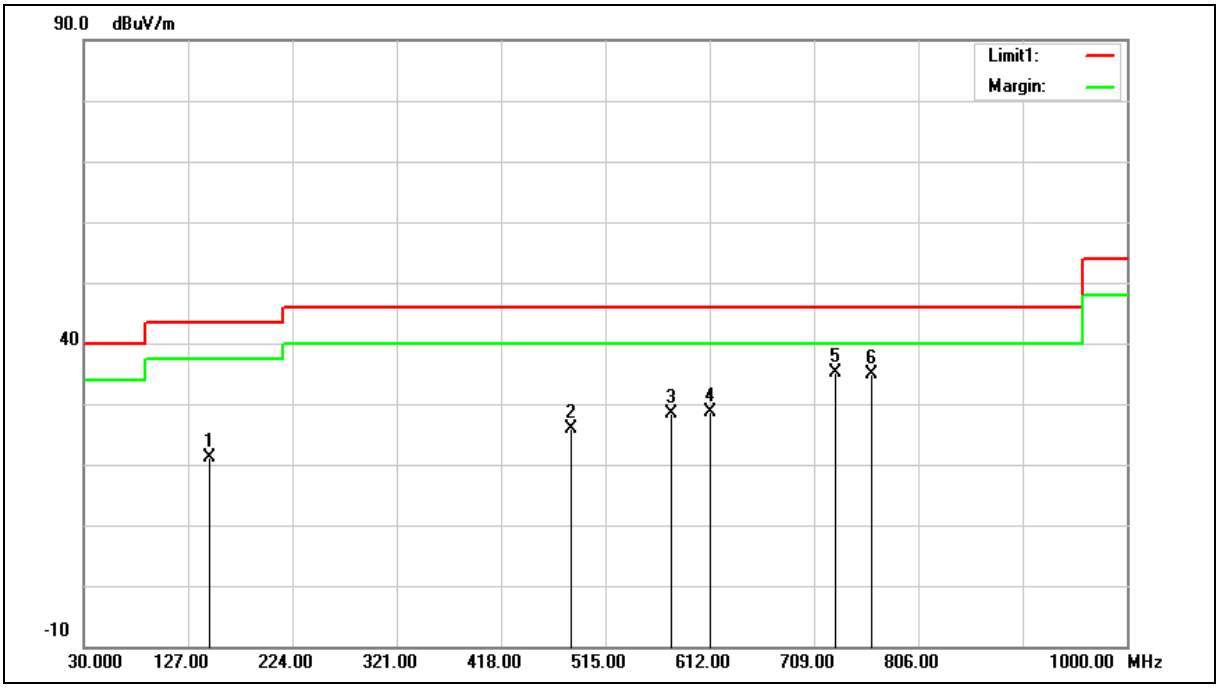
Mode 2	
2402 MHz	
2480 MHz	

Mode 3	
2402 MHz	
2480 MHz	

Annex C. Radiated Emission Measurement

Below 1 GHz

Standard:	FCC Part 15.247	Test Distance:	3 m
Frequency:	2402 MHz		
Mode:	Mode 2		
Ant.Polar.:	Horizontal		



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	147.3700	45.63	-24.47	21.16	43.50	-22.34	QP
2	482.9900	45.67	-19.82	25.85	46.00	-20.15	QP
3	576.1100	46.21	-17.73	28.48	46.00	-17.52	QP
4	612.0000	45.66	-17.01	28.65	46.00	-17.35	QP
5	729.3700	50.73	-15.56	35.17	46.00	-10.83	QP
6	762.3500	49.91	-15.05	34.86	46.00	-11.14	QP

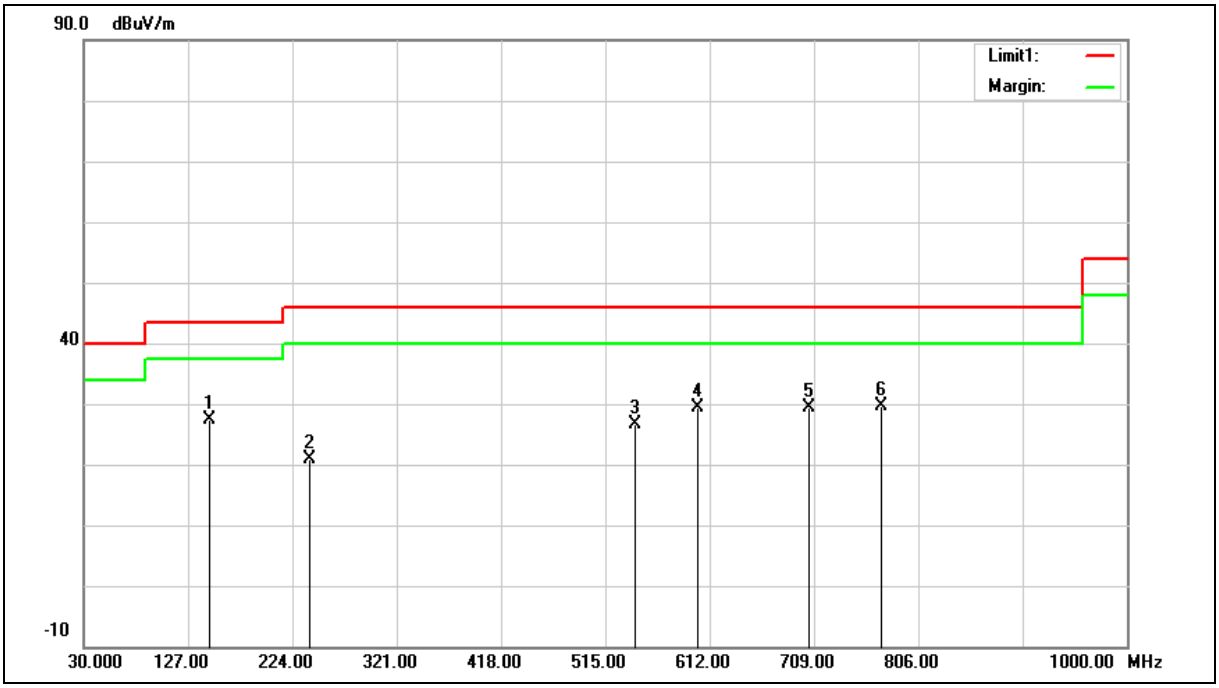
Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

Example: 21.16 = -24.47 + 45.63.

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Frequency:	2402 MHz		
Mode:	Mode 2		
Ant.Polar.:	Vertical		



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	147.3700	51.81	-24.47	27.34	43.50	-16.16	QP
2	239.5200	46.52	-25.59	20.93	46.00	-25.07	QP
3	542.1600	45.18	-18.58	26.60	46.00	-19.40	QP
4	600.3600	46.39	-17.12	29.27	46.00	-16.73	QP
5	704.1500	45.43	-15.95	29.48	46.00	-16.52	QP
6	772.0500	44.46	-14.92	29.54	46.00	-16.46	QP

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

Example: 27.34 = -24.47 + 51.81.

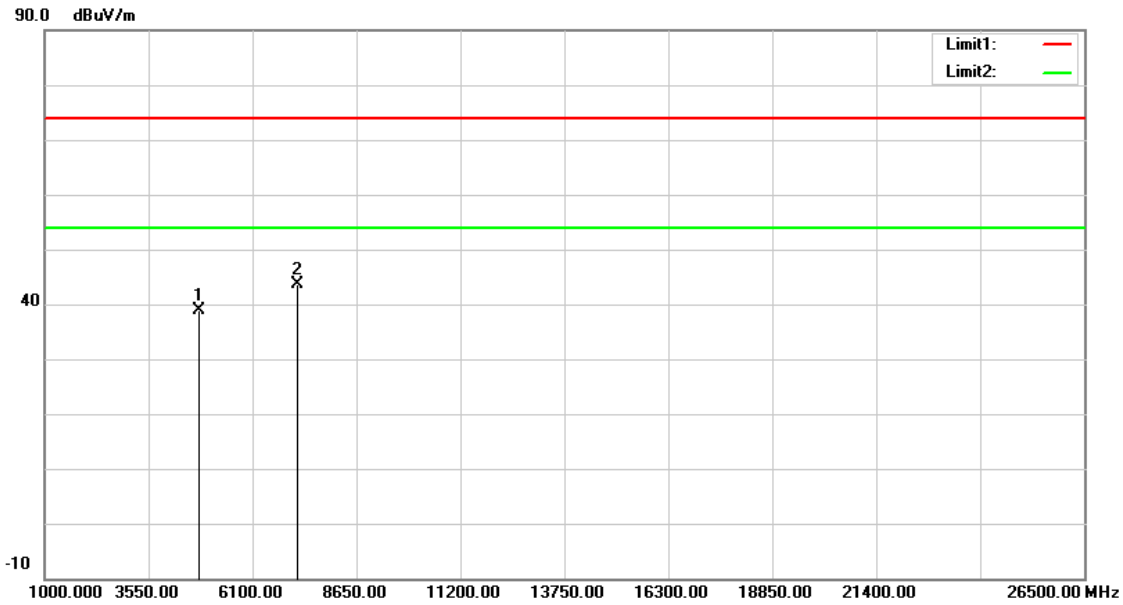
2.Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3.When the peak results are less than average limit, so not need to evaluate the average.

Harmonic

Above 1 GHz

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	2402 MHz		
Mode:	Mode 2		
Ant.Polar.:	Horizontal		



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4804.000	40.07	-1.30	38.77	74.00	-35.23	peak
2	7206.000	37.79	5.74	43.53	74.00	-30.47	peak

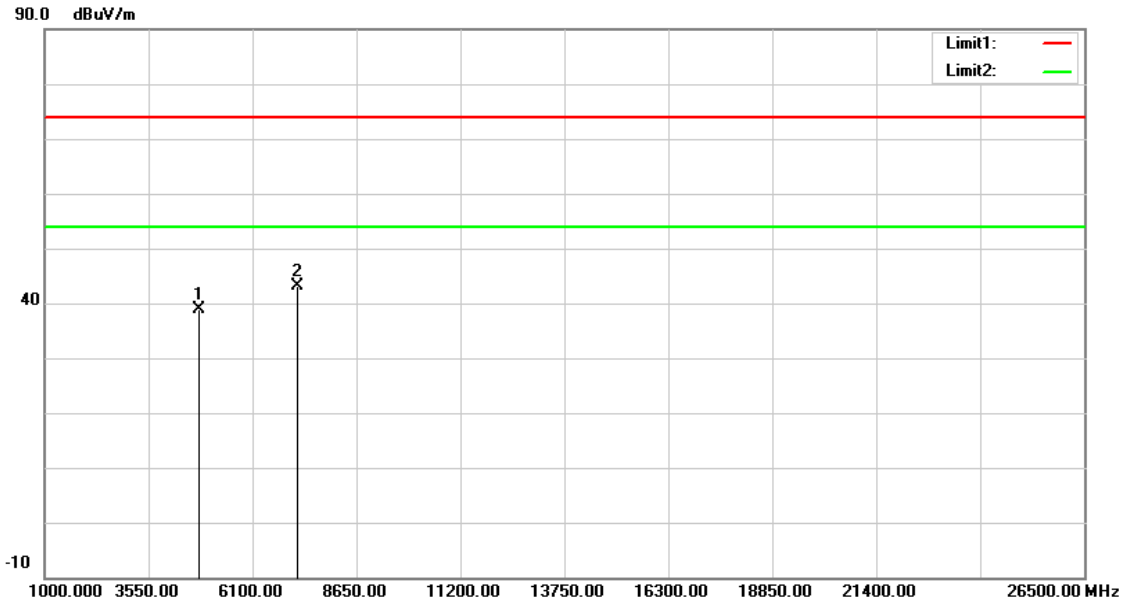
Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

Example: 38.77 = -1.30 + 40.07.

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	2402 MHz		
Mode:	Mode 2		
Ant.Polar.:	Vertical		



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4804.000	40.13	-1.30	38.83	74.00	-35.17	peak
2	7206.000	37.29	5.74	43.03	74.00	-30.97	peak

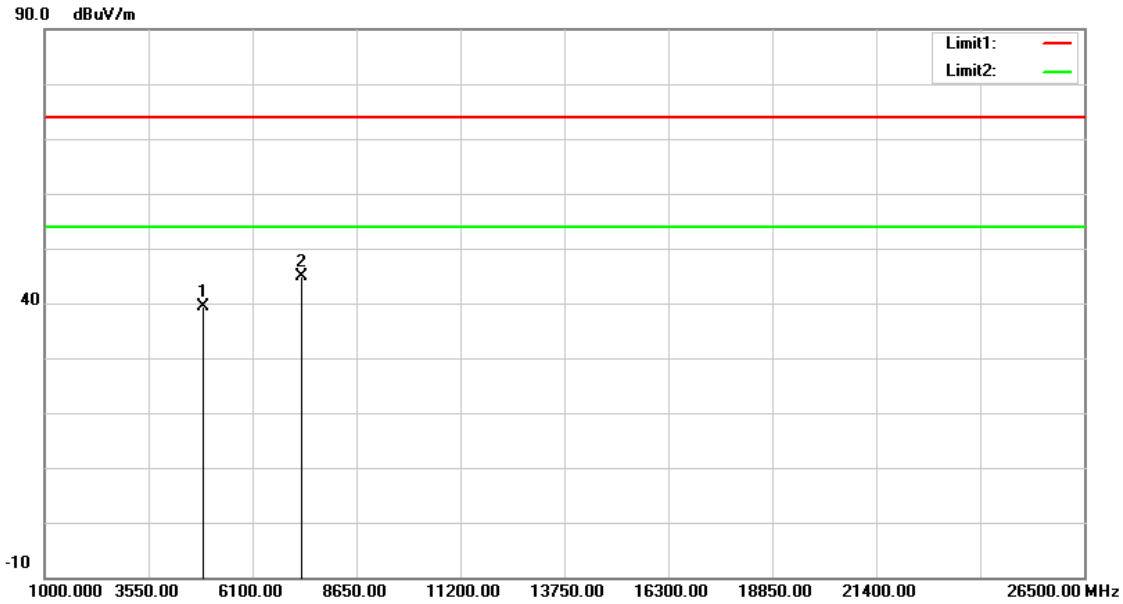
Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

Example: 38.83 = -1.30 + 40.13.

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	2440 MHz		
Mode:	Mode 2		
Ant.Polar.:	Horizontal		



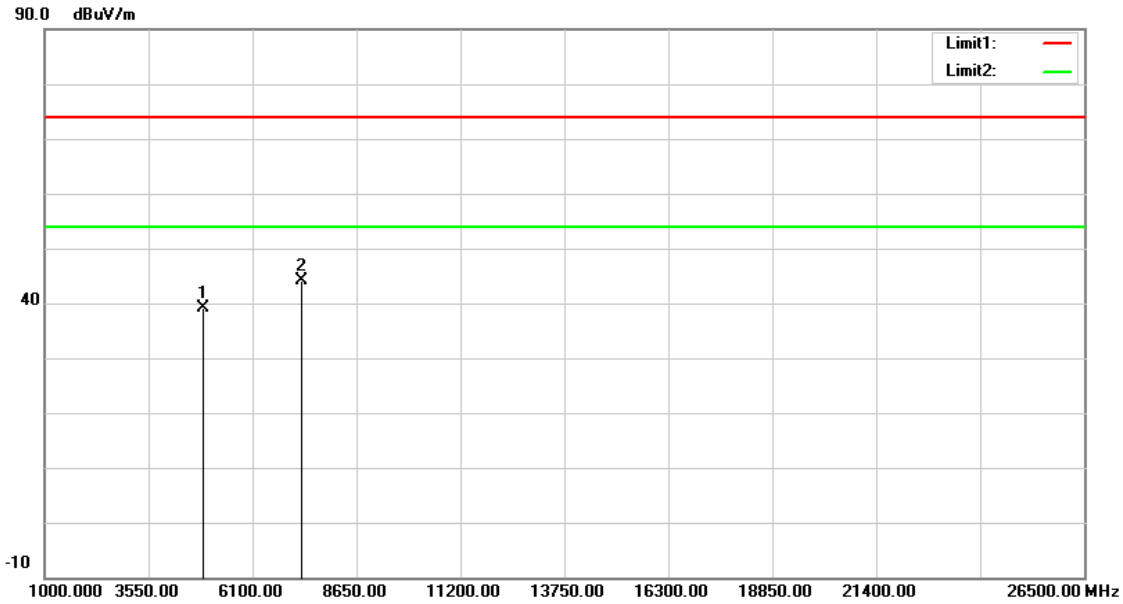
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4880.000	40.37	-1.11	39.26	74.00	-34.74	peak
2	7320.000	38.74	6.15	44.89	74.00	-29.11	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	2440 MHz		
Mode:	Mode 2		
Ant.Polar.:	Vertical		



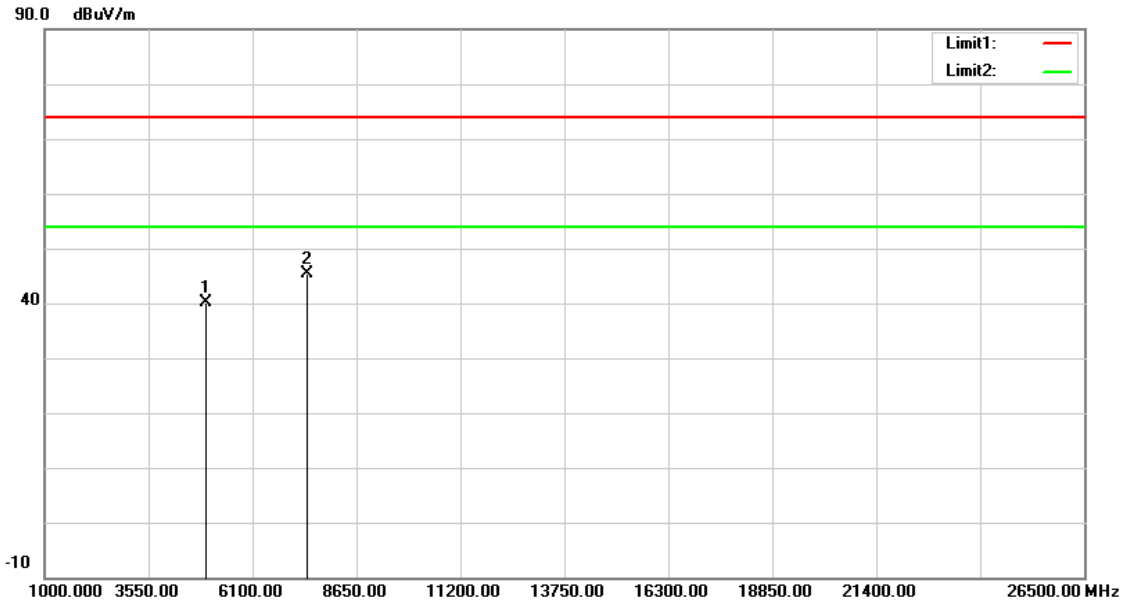
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4880.000	40.26	-1.11	39.15	74.00	-34.85	peak
2	7320.000	37.92	6.15	44.07	74.00	-29.93	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	2480 MHz		
Mode:	Mode 2		
Ant.Polar.:	Horizontal		



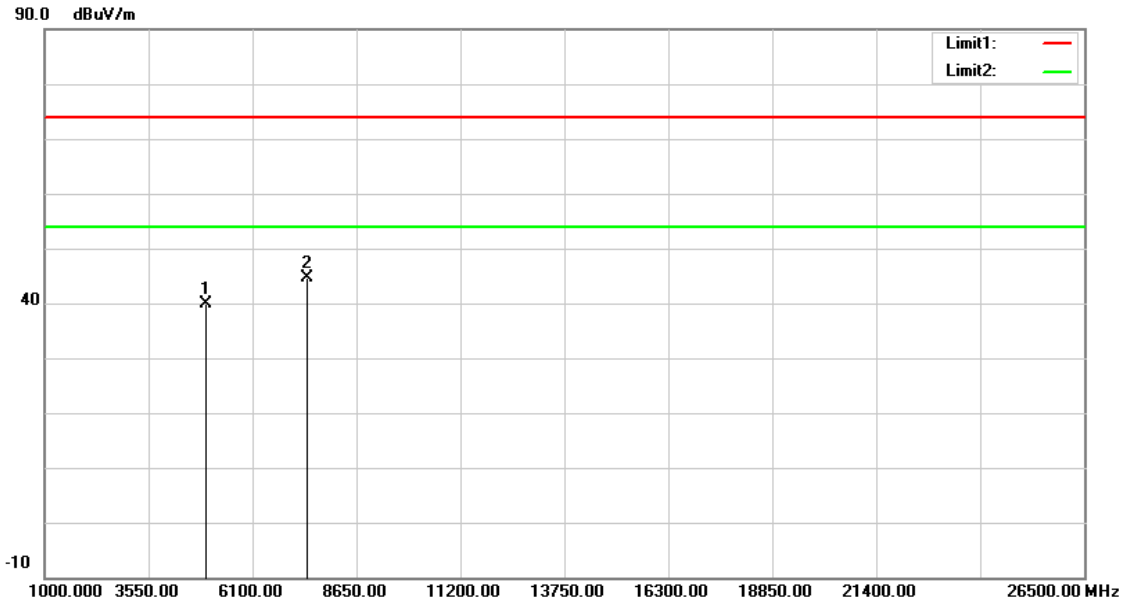
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4960.000	41.02	-0.88	40.14	74.00	-33.86	peak
2	7440.000	38.79	6.56	45.35	74.00	-28.65	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	2480 MHz		
Mode:	Mode 2		
Ant.Polar.:	Vertical		



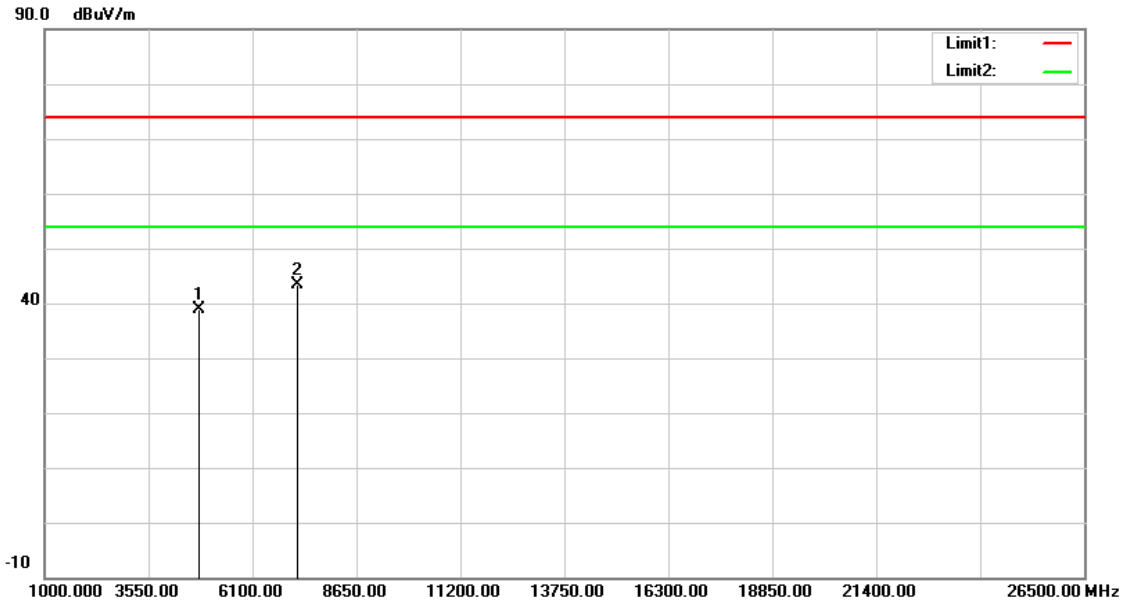
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4960.000	40.64	-0.88	39.76	74.00	-34.24	peak
2	7440.000	38.05	6.56	44.61	74.00	-29.39	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	2402 MHz		
Mode:	Mode 3		
Ant.Polar.:	Horizontal		



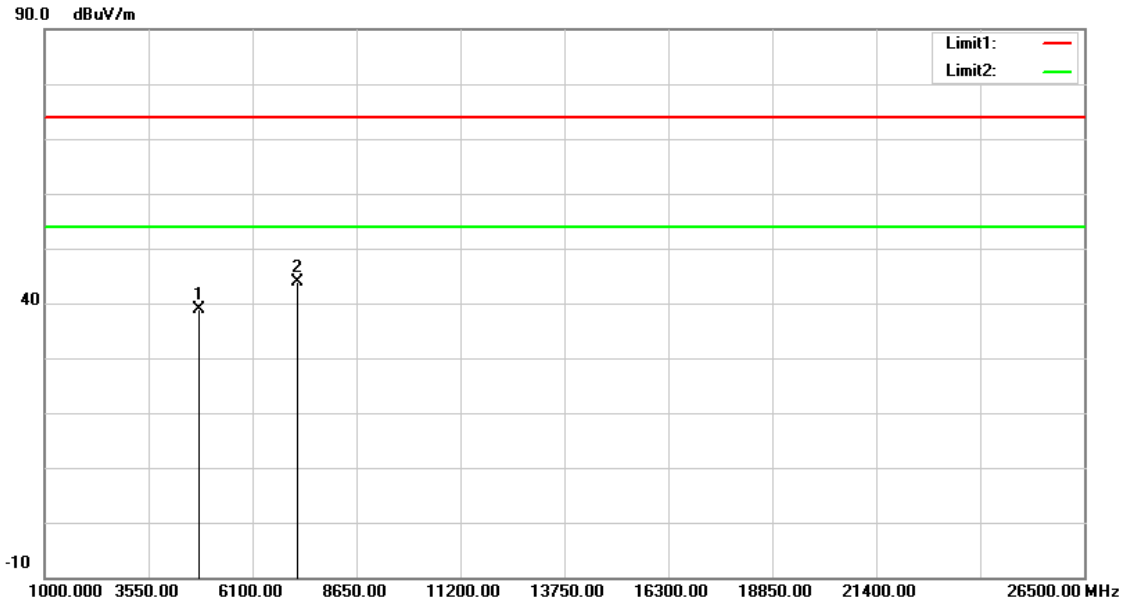
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4804.000	40.14	-1.30	38.84	74.00	-35.16	peak
2	7206.000	37.74	5.74	43.48	74.00	-30.52	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	2402 MHz		
Mode:	Mode 3		
Ant.Polar.:	Vertical		



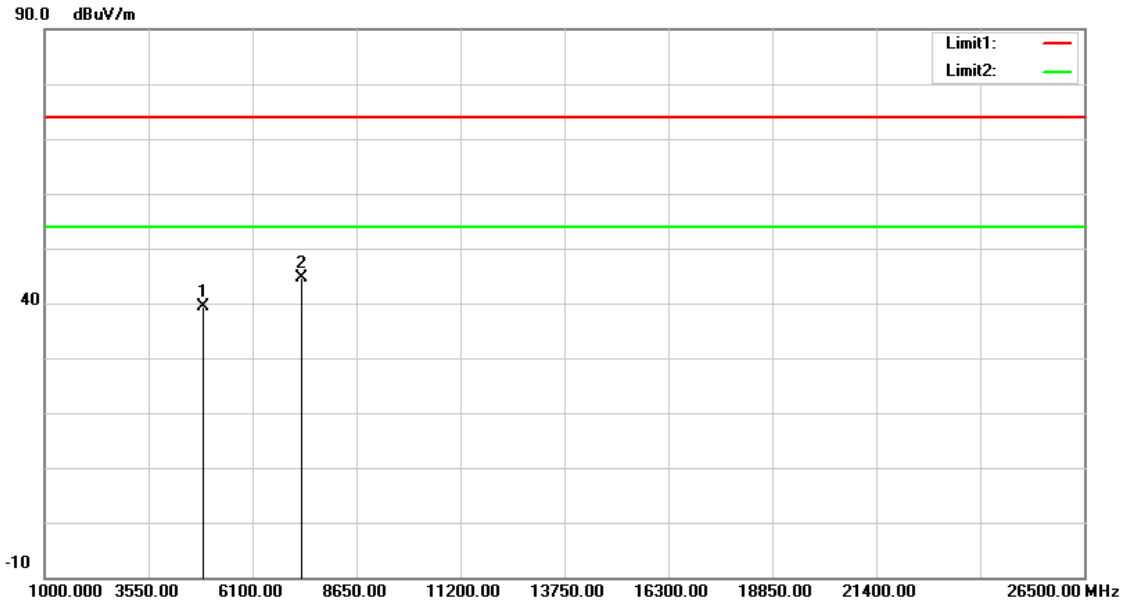
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4804.000	40.11	-1.30	38.81	74.00	-35.19	peak
2	7206.000	38.16	5.74	43.90	74.00	-30.10	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	2440 MHz		
Mode:	Mode 3		
Ant.Polar.:	Horizontal		



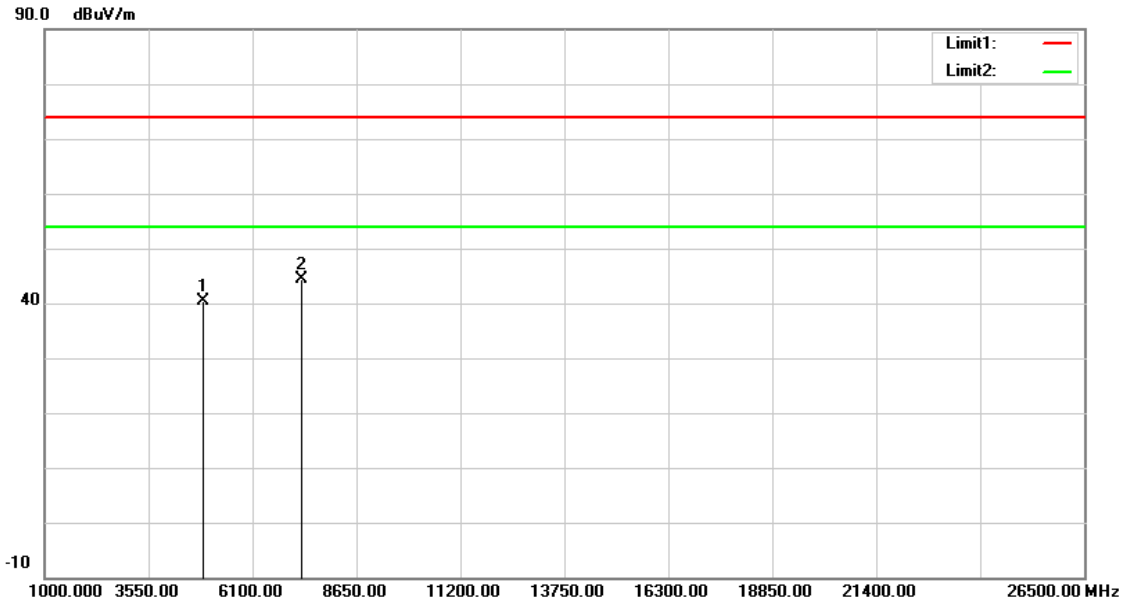
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4880.000	40.50	-1.11	39.39	74.00	-34.61	peak
2	7320.000	38.36	6.15	44.51	74.00	-29.49	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	2440 MHz		
Mode:	Mode 3		
Ant.Polar.:	Vertical		



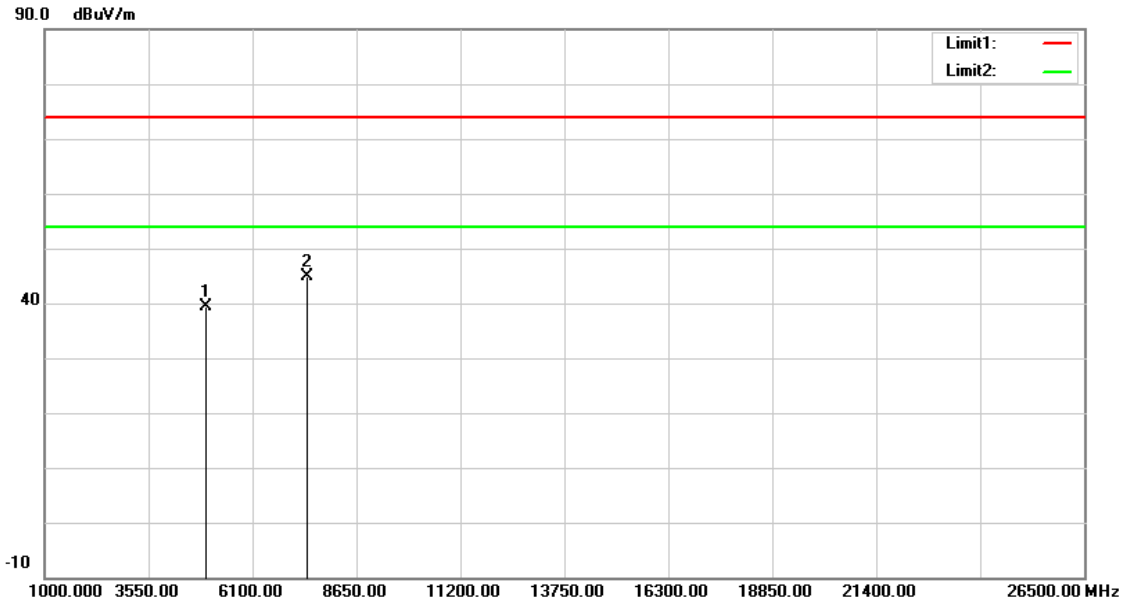
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4880.000	41.59	-1.11	40.48	74.00	-33.52	peak
2	7320.000	38.28	6.15	44.43	74.00	-29.57	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	2480 MHz		
Mode:	Mode 3		
Ant.Polar.:	Horizontal		



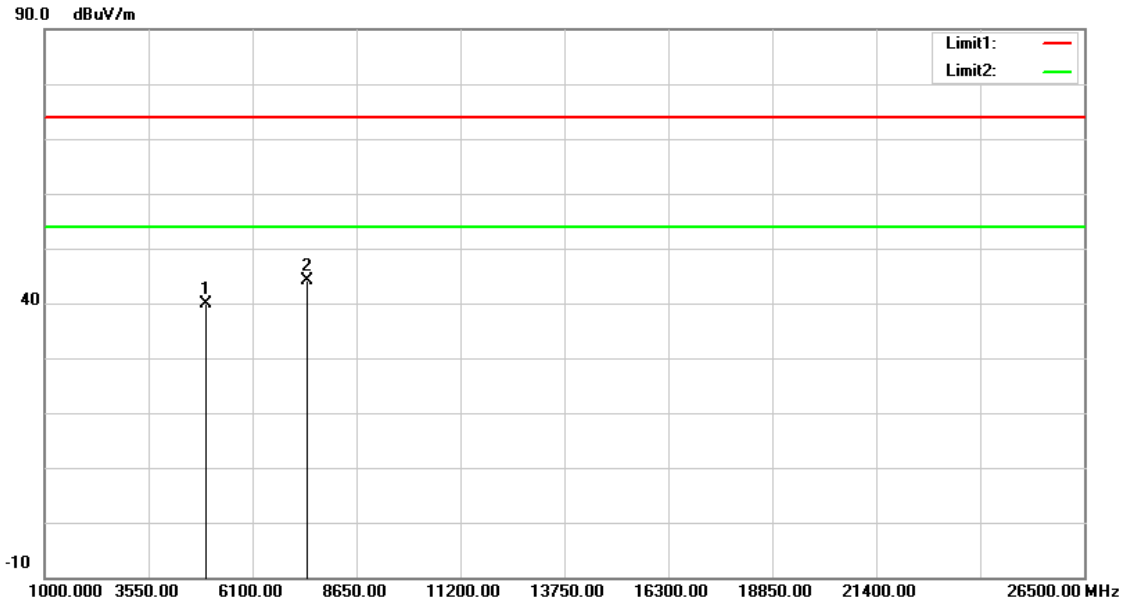
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4960.000	40.25	-0.88	39.37	74.00	-34.63	peak
2	7440.000	38.24	6.56	44.80	74.00	-29.20	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	2480 MHz		
Mode:	Mode 3		
Ant.Polar.:	Vertical		



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4960.000	40.69	-0.88	39.81	74.00	-34.19	peak
2	7440.000	37.61	6.56	44.17	74.00	-29.83	peak

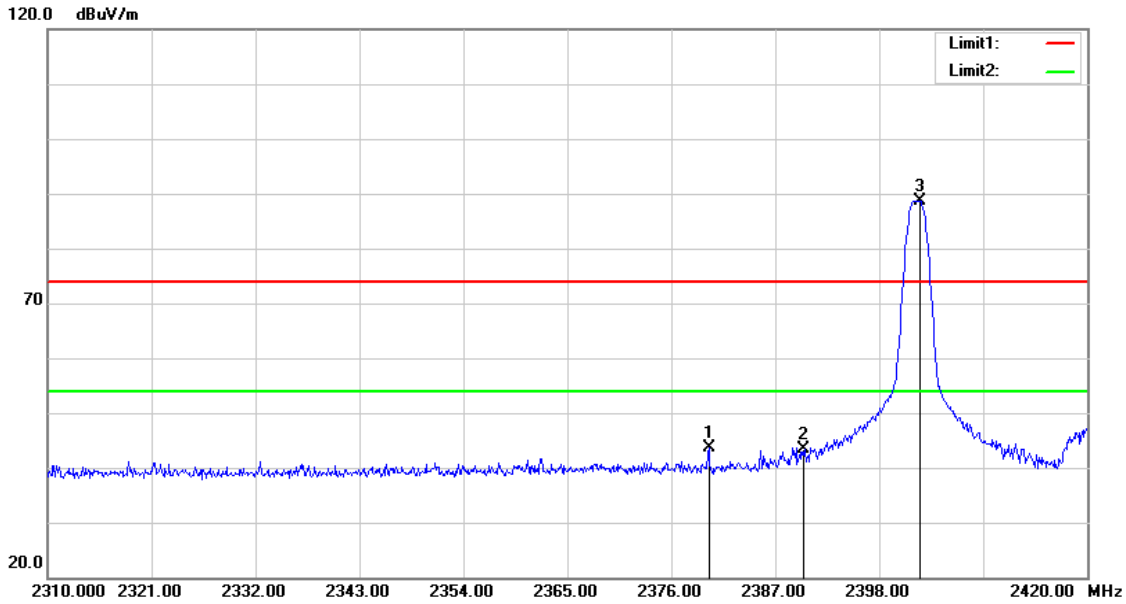
Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Band Edge

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Band edge		
Frequency:	2402 MHz		
Mode:	Mode 2		
Ant.Polar.:	Horizontal		



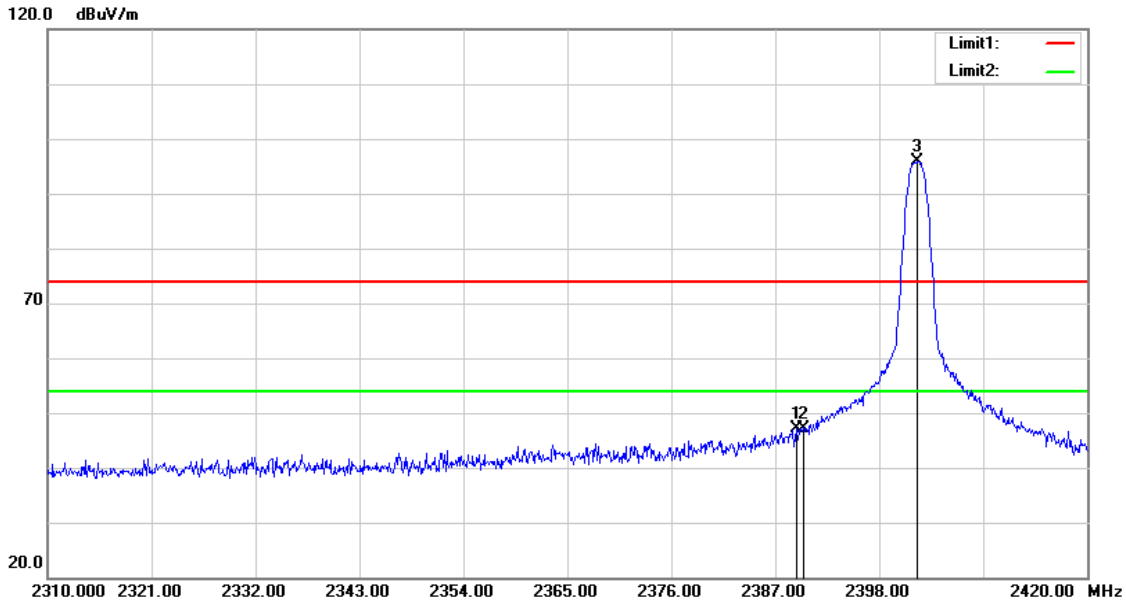
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2379.960	51.47	-7.76	43.71	74.00	-30.29	peak
2	2390.000	51.02	-7.72	43.30	74.00	-30.70	peak
3	2402.290	96.39	-7.66	88.73	--	--	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Band edge		
Frequency:	2402 MHz		
Mode:	Mode 2		
Ant.Polar.:	Vertical		



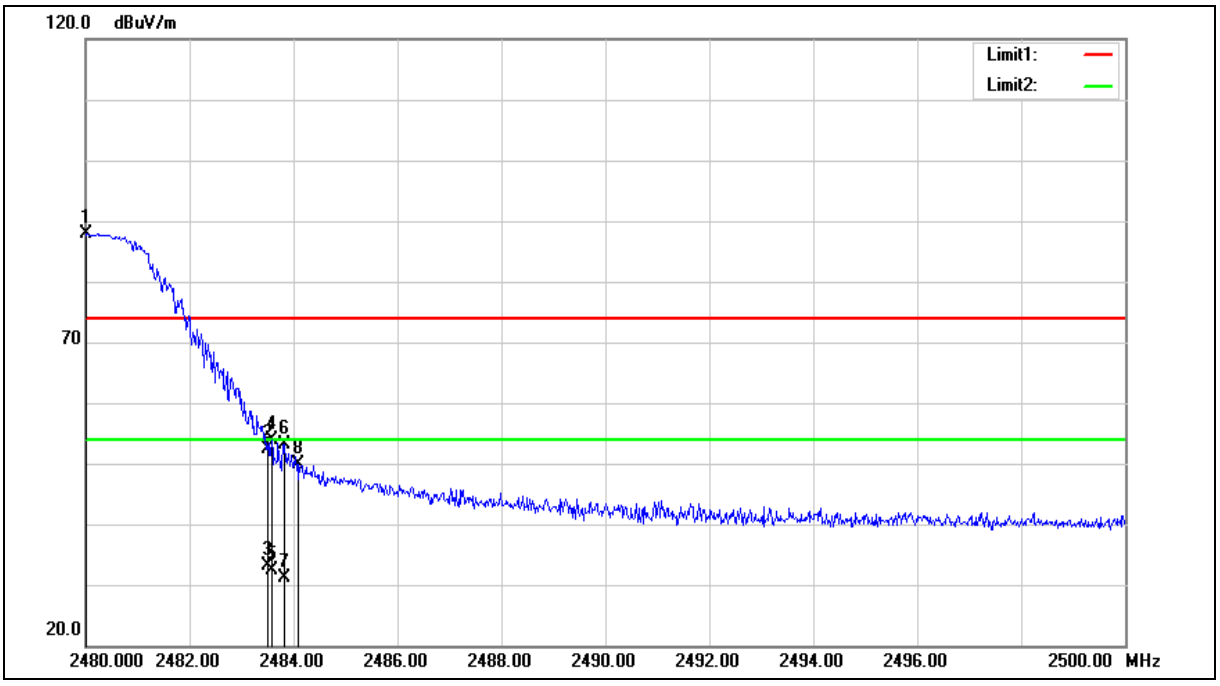
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2389.200	54.94	-7.72	47.22	74.00	-26.78	peak
2	2390.000	54.85	-7.72	47.13	74.00	-26.87	peak
3	2401.960	103.42	-7.66	95.76	--	--	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Band edge		
Frequency:	2480 MHz		
Mode:	Mode 2		
Ant.Polar.:	Horizontal		



Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Band edge		
Frequency:	2480 MHz		
Mode:	Mode 2		
Ant.Polar.:	Horizontal		

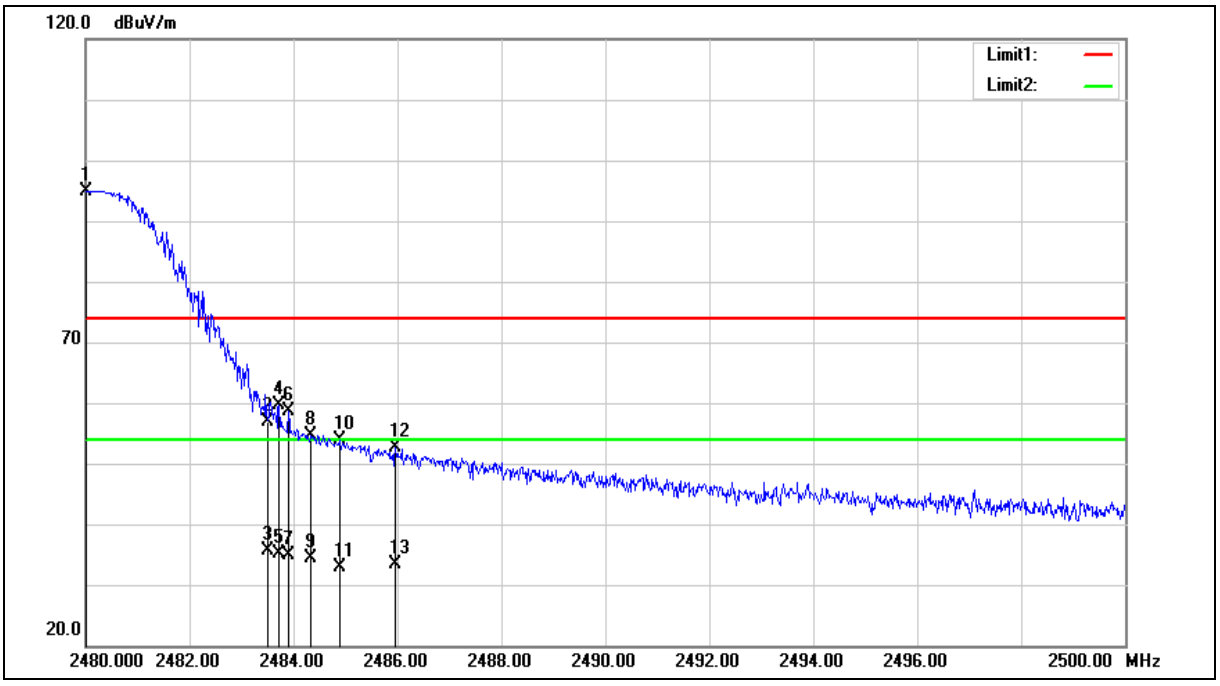
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2480.020	95.14	-7.35	87.79	--	--	peak
2	2483.500	59.69	-7.34	52.35	74.00	-21.65	peak
3	2483.500	40.51	-7.34	33.17	54.00	-20.83	AVG
4	2483.580	61.23	-7.34	53.89	74.00	-20.11	peak
5	2483.580	39.82	-7.34	32.48	54.00	-21.52	AVG
6	2483.820	60.51	-7.34	53.17	74.00	-20.83	peak
7	2483.820	38.43	-7.34	31.09	54.00	-22.91	AVG
8	2484.080	57.33	-7.34	49.99	74.00	-24.01	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Band edge		
Frequency:	2480 MHz		
Mode:	Mode 2		
Ant.Polar.:	Vertical		



Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Band edge		
Frequency:	2480 MHz		
Mode:	Mode 2		
Ant.Polar.:	Vertical		

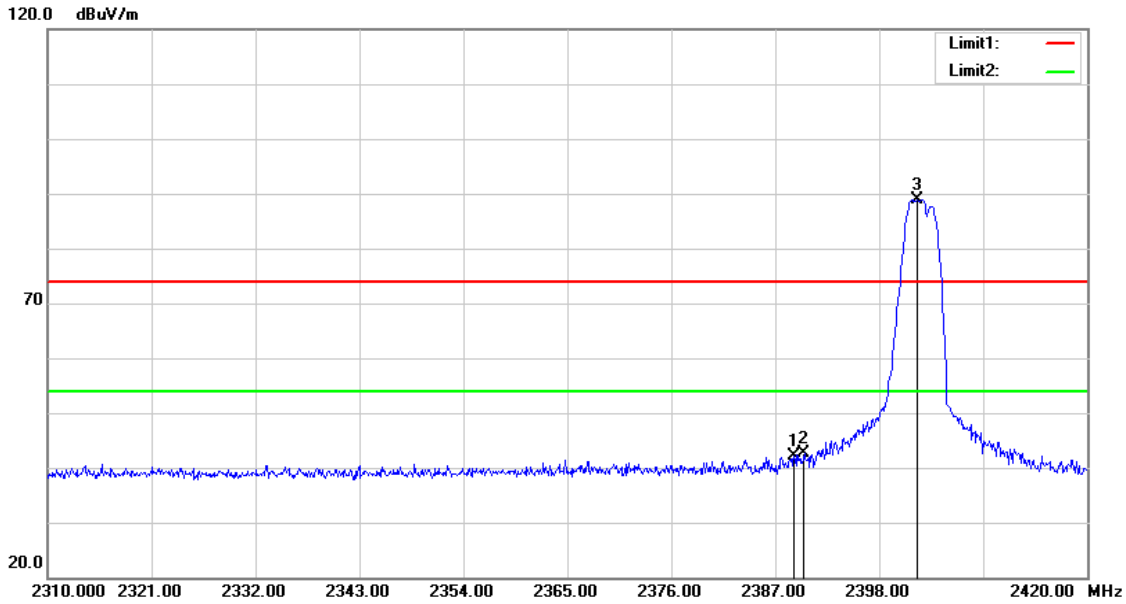
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2480.000	102.17	-7.35	94.82	--	--	peak
2	2483.500	64.34	-7.34	57.00	74.00	-17.00	peak
3	2483.500	42.98	-7.34	35.64	54.00	-18.36	AVG
4	2483.720	67.05	-7.34	59.71	74.00	-14.29	peak
5	2483.720	42.48	-7.34	35.14	54.00	-18.86	AVG
6	2483.900	65.98	-7.34	58.64	74.00	-15.36	peak
7	2483.900	42.24	-7.34	34.90	54.00	-19.10	AVG
8	2484.340	61.99	-7.34	54.65	74.00	-19.35	peak
9	2484.340	41.83	-7.34	34.49	54.00	-19.51	AVG
10	2484.900	61.10	-7.34	53.76	74.00	-20.24	peak
11	2484.900	40.15	-7.34	32.81	54.00	-21.19	AVG
12	2485.960	59.92	-7.32	52.60	74.00	-21.40	peak
13	2485.960	40.62	-7.32	33.30	54.00	-20.70	AVG

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Band edge		
Frequency:	2402 MHz		
Mode:	Mode 3		
Ant.Polar.:	Horizontal		



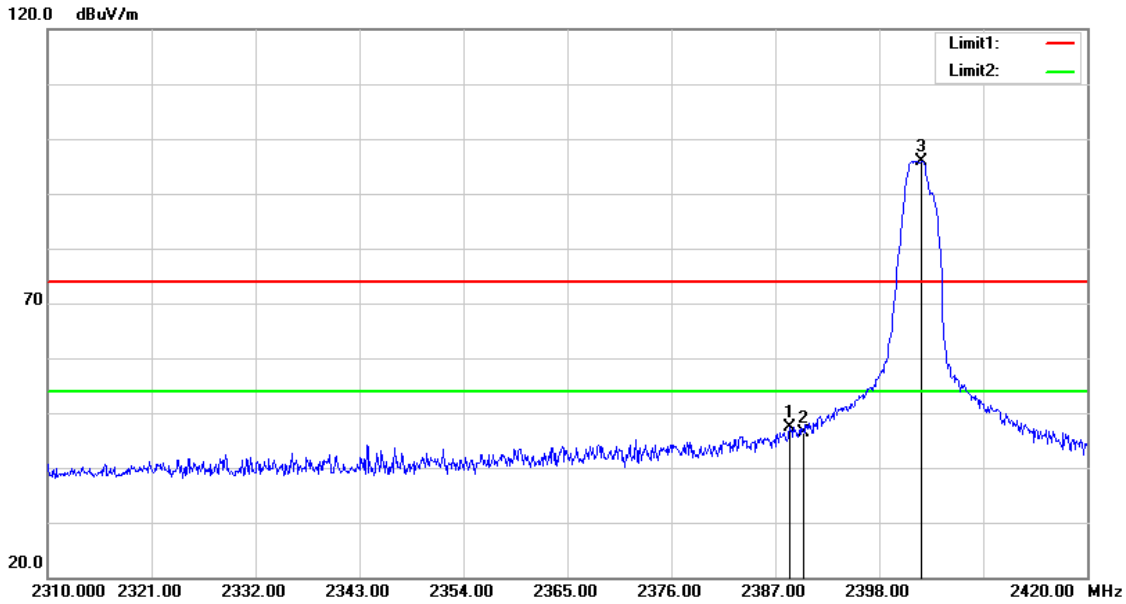
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2388.980	49.84	-7.72	42.12	74.00	-31.88	peak
2	2390.000	50.24	-7.72	42.52	74.00	-31.48	peak
3	2401.960	96.47	-7.66	88.81	--	--	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Band edge		
Frequency:	2402 MHz		
Mode:	Mode 3		
Ant.Polar.:	Vertical		



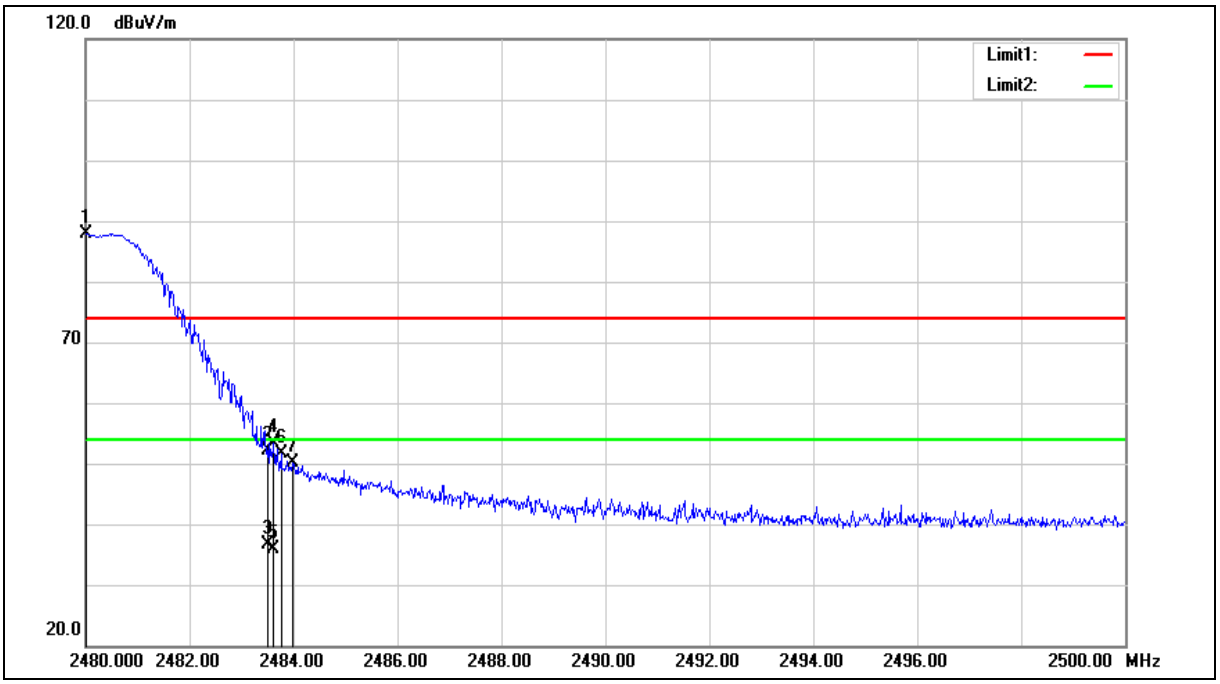
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2388.540	55.13	-7.72	47.41	74.00	-26.59	peak
2	2390.000	53.98	-7.72	46.26	74.00	-27.74	peak
3	2402.510	103.53	-7.66	95.87	--	--	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Band edge		
Frequency:	2480 MHz		
Mode:	Mode 3		
Ant.Polar.:	Horizontal		



Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Band edge		
Frequency:	2480 MHz		
Mode:	Mode 3		
Ant.Polar.:	Horizontal		

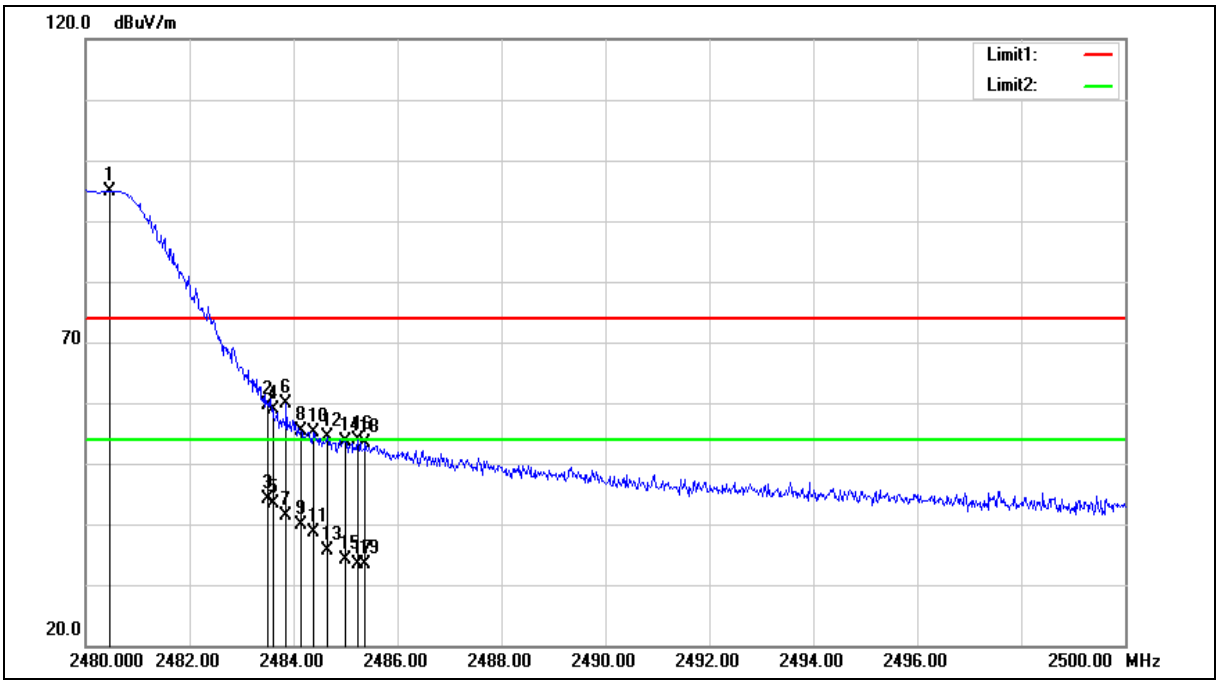
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2480.000	95.14	-7.35	87.79	--	--	peak
2	2483.500	59.50	-7.34	52.16	74.00	-21.84	peak
3	2483.500	44.05	-7.34	36.71	54.00	-17.29	AVG
4	2483.620	60.80	-7.34	53.46	74.00	-20.54	peak
5	2483.620	43.19	-7.34	35.85	54.00	-18.15	AVG
6	2483.760	59.05	-7.34	51.71	74.00	-22.29	peak
7	2483.980	57.37	-7.34	50.03	74.00	-23.97	peak

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Band edge		
Frequency:	2480 MHz		
Mode:	Mode 3		
Ant.Polar.:	Vertical		



Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Band edge		
Frequency:	2480 MHz		
Mode:	Mode 3		
Ant.Polar.:	Vertical		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2480.460	102.31	-7.35	94.96	--	--	peak
2	2483.500	66.95	-7.34	59.61	74.00	-14.39	peak
3	2483.500	51.52	-7.34	44.18	54.00	-9.82	AVG
4	2483.600	66.18	-7.34	58.84	74.00	-15.16	peak
5	2483.600	50.61	-7.34	43.27	54.00	-10.73	AVG
6	2483.860	67.25	-7.34	59.91	74.00	-14.09	peak
7	2483.860	48.74	-7.34	41.40	54.00	-12.60	AVG
8	2484.140	62.67	-7.34	55.33	74.00	-18.67	peak
9	2484.140	47.34	-7.34	40.00	54.00	-14.00	AVG
10	2484.380	62.39	-7.34	55.05	74.00	-18.95	peak
11	2484.380	45.85	-7.34	38.51	54.00	-15.49	AVG
12	2484.660	61.76	-7.34	54.42	74.00	-19.58	peak
13	2484.660	42.99	-7.34	35.65	54.00	-18.35	AVG
14	2485.000	61.00	-7.34	53.66	74.00	-20.34	peak
15	2485.000	41.45	-7.34	34.11	54.00	-19.89	AVG
16	2485.240	61.14	-7.33	53.81	74.00	-20.19	peak
17	2485.240	40.81	-7.33	33.48	54.00	-20.52	AVG
18	2485.380	60.60	-7.32	53.28	74.00	-20.72	peak
19	2485.380	40.62	-7.32	33.30	54.00	-20.70	AVG

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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

3.When the peak results are less than average limit, so not need to evaluate the average.

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