



RF Test Report

Issued Date: Nov. 13, 2020

Applicant : Manford Development Limited
Product Type : Intelligent Range Extender
Trade Name : ECTHERM
Model Number : SR200
FCC ID : 2ARFX-SR200
EUT Rated Voltage : DC 5 V, 0.5 A
Test Voltage : 120 Vac / 60 Hz
Receive Date : Sep. 23, 2020
Test Period : Oct. 09 ~ Oct. 13, 2020
Applicable Standard : FCC 47 CFR PART 15 SUBPART C
ANSI C63.10:2013
Test Result : Complied

Testing Laboratory

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<http://www.atl-lab.com.tw/e-index.htm>



American Association for Laboratory Accreditation number: 3464.02

Test Firm designation number: CN1168

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Approved By

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(Manager)

(Louis Shen)

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Revision History

Rev.	Issue Date	Revisions
00	Nov. 11, 2020	Initial Issue
01	Nov. 13, 2020	Page 7 channel numbers and channel list Page 11 Test Instruments

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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)	6dB 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	-----

Standard	Description
CFR47, Part 15, Subpart C §15.247	Intentional Radiators
ANSI C63. 10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63. 4: 2014	American National Standard for methods of measurement of radio – noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz
KDB558074 D01 v05	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

The test results of this report relate only to the tested sample(s) identified in this report. Manufacturer or whom it may concern should recognize the pass or fail of the test result.

A Test Lab Techno Corp. tested the above equipment under the requirements outlined 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. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

A Test Lab Techno Corp. will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

1.2. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty (dB)
Conducted Emission	9kHz ~ 150KHz	2.7
	150kHz ~ 30MHz	2.7
Radiated Emission	9kHz ~ 30MHz	1.7
	30MHz ~ 1000MHz	5.7
	1000MHz ~ 18000MHz	5.5
	18000MHz ~ 26500MHz	4.8
	26500MHz ~ 40000MHz	4.8
Conducted Output Power	+0.27 dB / -0.28 dB	
RF Bandwidth	4.96%	
Power Spectral Density	+0.71 dB / -0.77 dB	

2 EUT Description

Applicant	Manford Development Limited Unit 12, Factory A, 2/F, Gee Fat Factory Building, No.78-80 FukTsun Street, Tai Kok Tsui, Kowloon, Hong Kong	
Manufacturer	Manford Development Limited Unit 12, Factory A, 2/F, Gee Fat Factory Building, No.78-80 FukTsun Street, Tai Kok Tsui, Kowloon, Hong Kong	
Factory	ATR (DONG GUAN) ELECTRONICS MANUFACTORY CO., LTD. 38, XIAN FENG ROAD, PING SHAN, TANGXIA TOWN, DONGGUAN CITY, GUANG DONG PROVINCE	
Product	Intelligent Range Extender	
Trade Name	ECTHERM	
Model Number	SR200	
FCC ID	2ARFX-SR200	
Frequency Range	2402 ~ 2480 MHz	
Modulation Type	GFSK	
Operate Temp. Range	0~45 °C	
Antenna information	Type	Max. Gain (dBi)
	Chip Antenna	0.5
RF Output Power	0.002 W	

2.1. Channel numbers and channel list

Channel	Frequency	Channel	Frequency
0	2402	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

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: 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 as shown below except radiated spurious emission below 1GHz and power line conducted emissions below 30MHz, which worst case was in TX mode only.

By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that "X axis" position was the worst, then the final test was executed the worst condition and test data were recorded in this report.

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

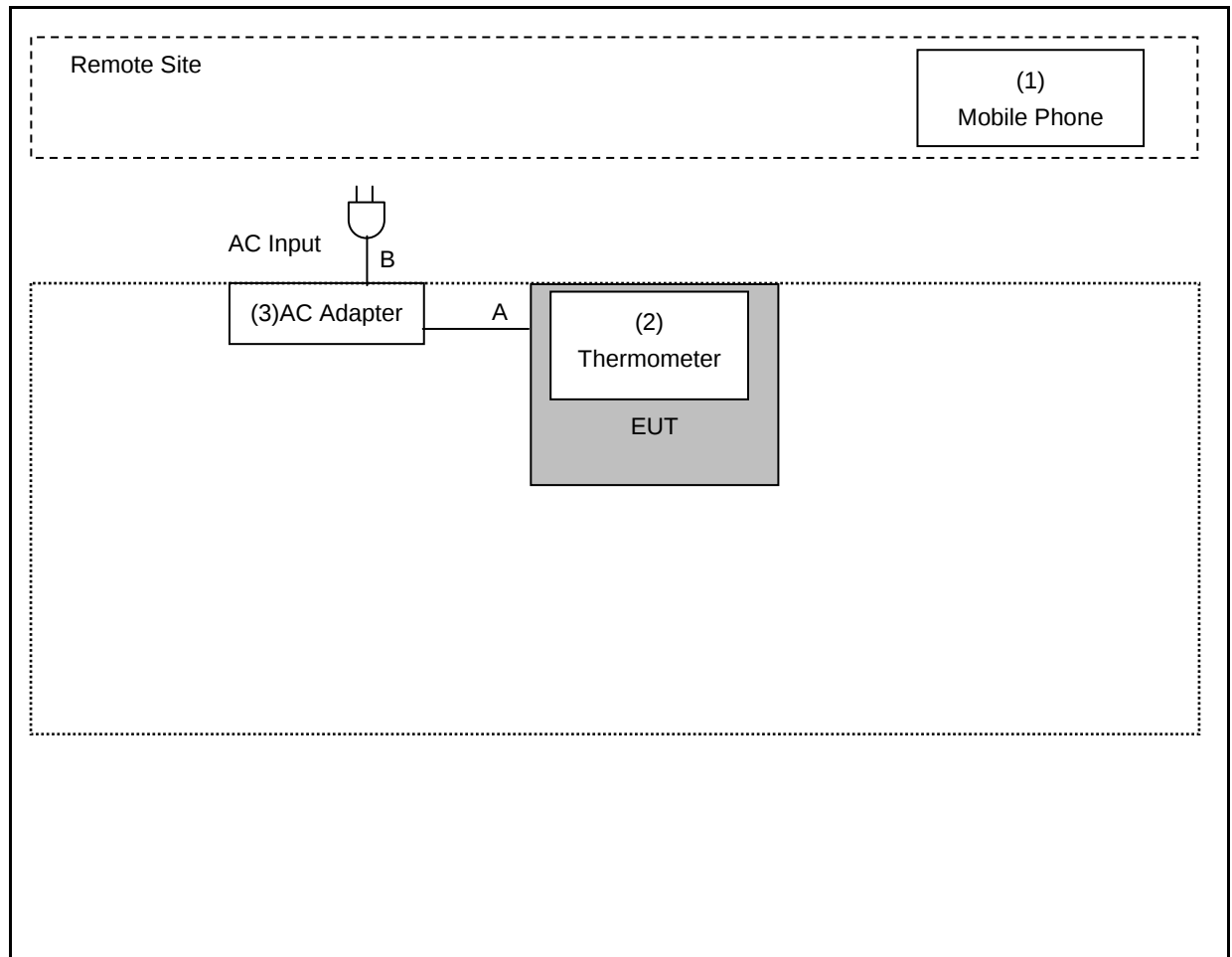


3.2. EUT Exercise Software

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	
1	EZ-EMC Ver. ATL-03A1-1
2	EZ-EMC Ver ATL-ITC-3A1-1 (for Conducted Emission)

3.3. Configuration of Test System Details



Devices Description					
	Product	Manufacturer	Model Number	Serial Number	Power Cord
(1)	Mobile Phone	LG	NEXUS 5	N/A	N/A
(2)	Thermometer	ECTHERM	ET180	N/A	N/A
(3)	AC Adapter	LENOVO	C-P56	N/A	Non-Shielded, 0.8 m



3.4. Test Instruments

For Conducted Emission

Test Period: Oct. 09, 2020

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
Test Receiver	R&S	ESR3	101923	09/01/2020	1 year
LISN	R&S	ENV216	101942	09/01/2020	1 year
ISN	TESEQ	ISN T800	39216	09/01/2020	1 year
RF Cable	EMCI	EMCCFD400	433LFC	09/01/2020	1 year
Test Site	ATL	CE	CE	N.C.R.	-----

For Radiated Emissions

Test Period: Oct. 13, 2020

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
Preamplifier	EMCI	EMC001330	980300	09/01/2020	1 year
Preamplifier	EMCI	EMC012645SE	980318	09/01/2020	1 year
Bilog Antenna	Schwarzbeck	VULB 9168	672	10/16/2019	1 year
Horn Antenna	ETS	3117	00204949	10/16/2019	1 year
Receiver	Keysight	N9038A	MY51210179	09/01/2020	1 year
Cable	EMCI	N/A	1066LFC	09/01/2020	1 year
Cable	EMCI	N/A	160719	09/01/2020	1 year
Test Site	OuHeng	MFAC3M	RE-026	02/24/2020	1 year

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

3.5. Test Site Environment

Items	Required (IEC 60068-1)	Actual
Temperature (°C)	15-35	26
Humidity (%RH)	25-75	60
Barometric pressure (mbar)	860-1060	950

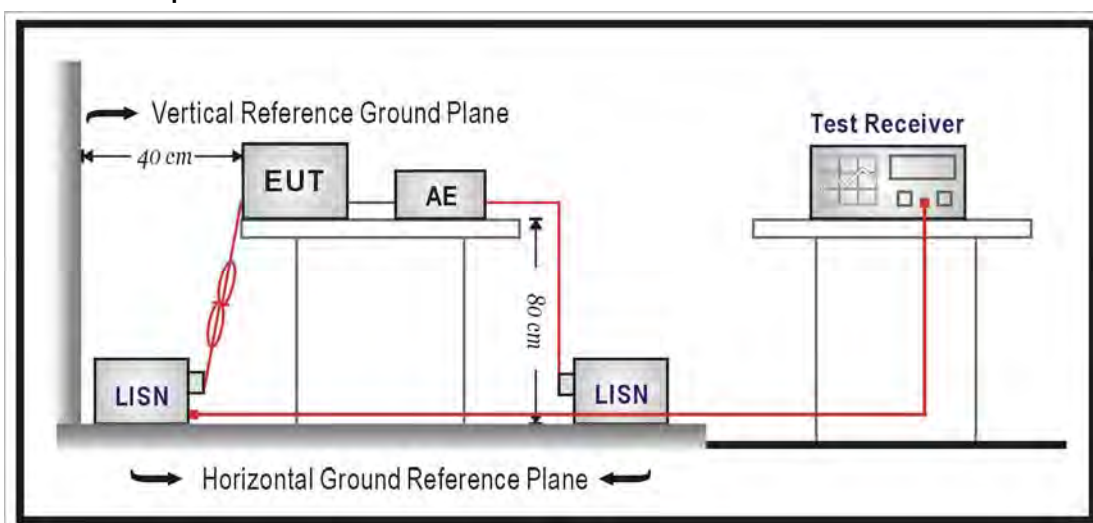
4 Measurement Procedure

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 $50\Omega//50\text{ uH}$ coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a $50\Omega//50\text{ uH}$ coupling impedance with 50ohm 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 40cm to the rear of the EUT. Other surfaces of tabletop or floor standing EUT shall be at least 80cm 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 1m 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 40cm 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

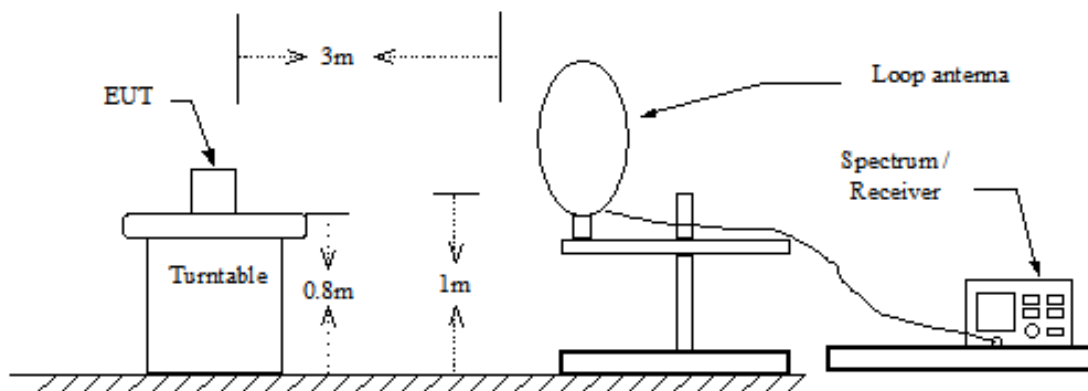
According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$ 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

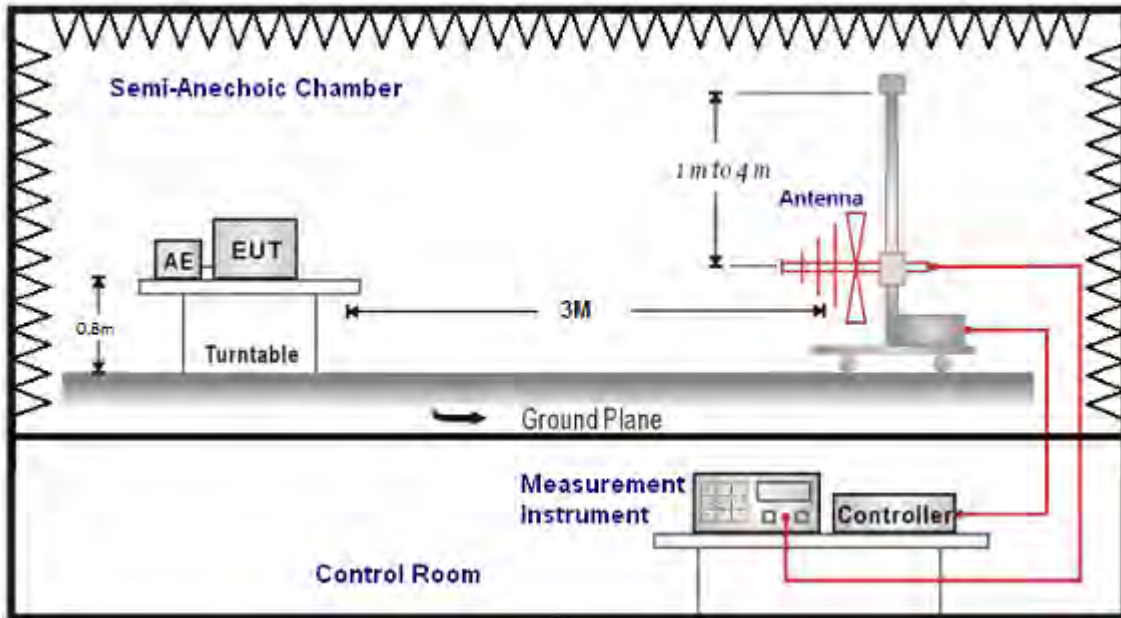
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this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

■ Setup

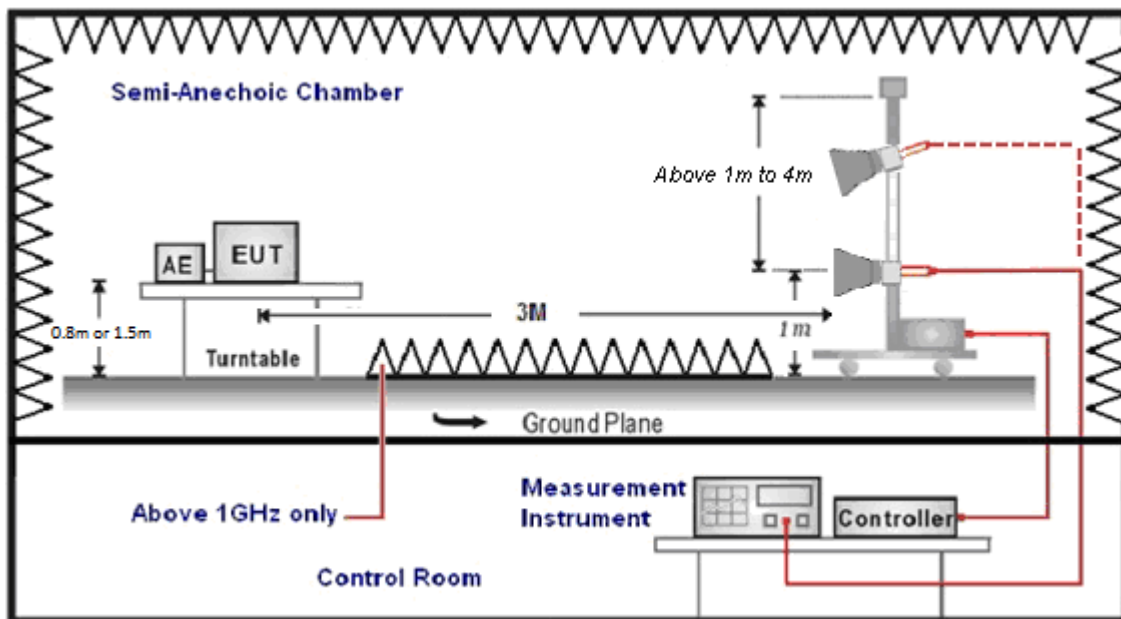
9 kHz ~ 30 MHz



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 1 MHz for peak measurements and 10 Hz for average measurements when Duty cycle >98% / 1/T for average measurements when Duty cycle <98%. A nonconductive material surrounded the EUT to supporting the EUT for standing on three 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 1 meter. 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 per meter (uV/m).

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

The actual field 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) $\text{Amplitude (dBuV/m)} = \text{FI (dBuV)} + \text{AF (dB)} + \text{CL (dB)} - \text{Gain (dB)}$

FI= Reading of the field intensity.

AF= Antenna factor.

CL= Cable loss.

P.S Amplitude is auto calculate in spectrum analyzer.

(2) $\text{Actual Amplitude (dBuV/m)} = \text{Amplitude (dBuV)} - \text{Dis (dB)}$

The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:

(a) For fundamental frequency : Transmitter Output < +30dBm

(b) For spurious frequency : Spurious emission limits = fundamental emission limit /10

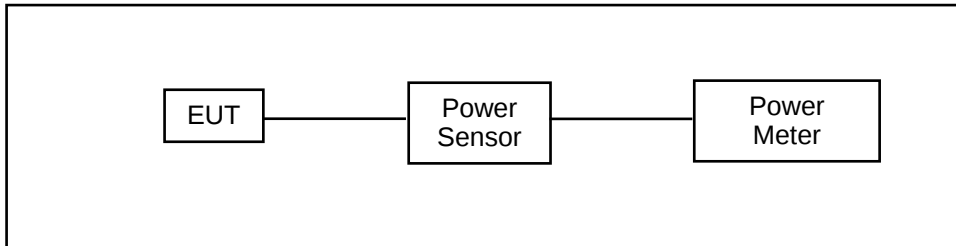
Data of measurement within this frequency range without mark in the table above means the reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.

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 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..

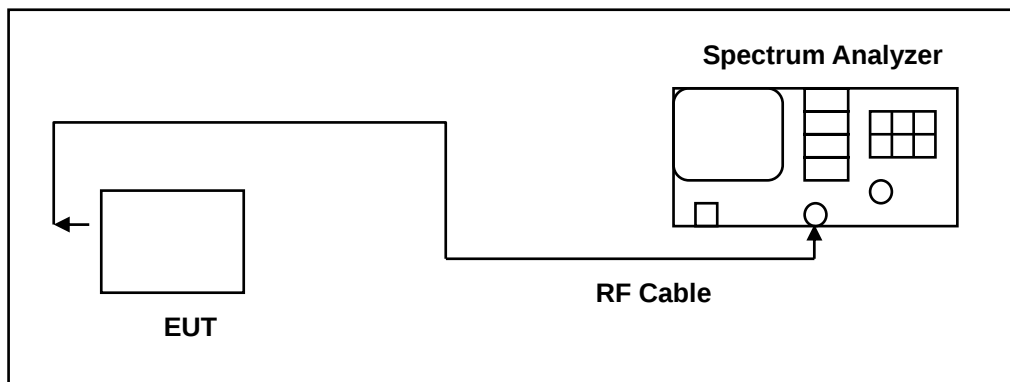
4.4. 6 dB RF Bandwidth Measurement

■ 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 KDB558074D01 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.

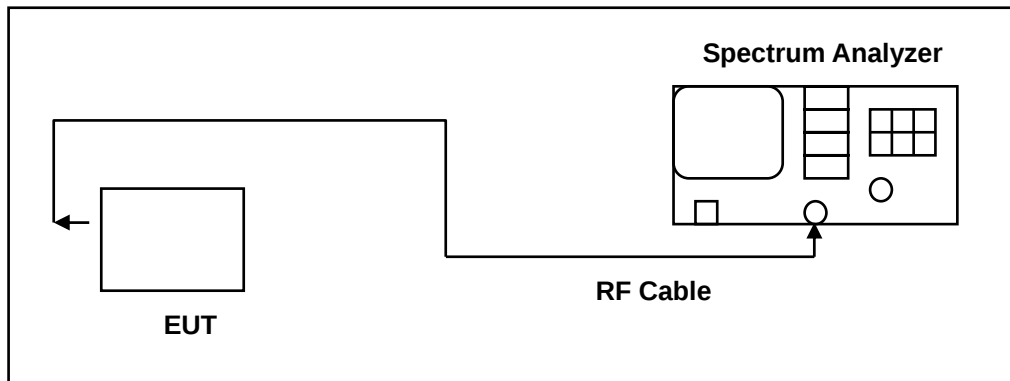
The test was performed at 3 channels (Channel low, middle, high)

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 KDB558074D01 section 10.2 Method PKPSD for compliance to FCC 47CFR 15.247 requirements.

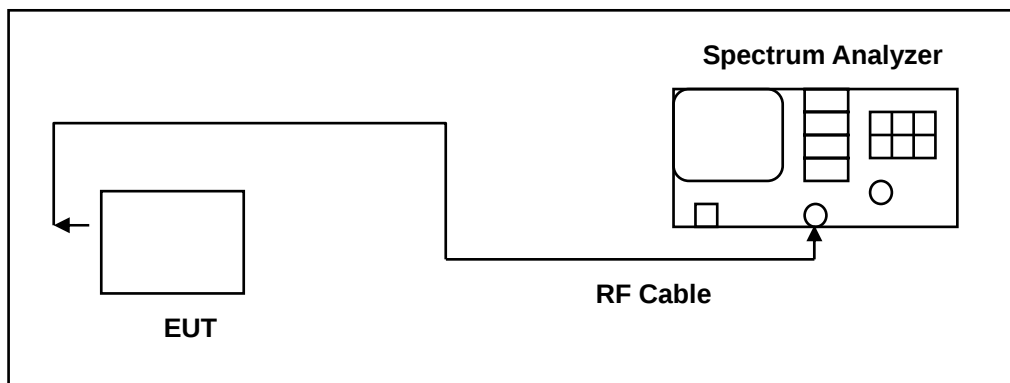
1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
4. Set the VBW $\geq 3 \times \text{RBW}$.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
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

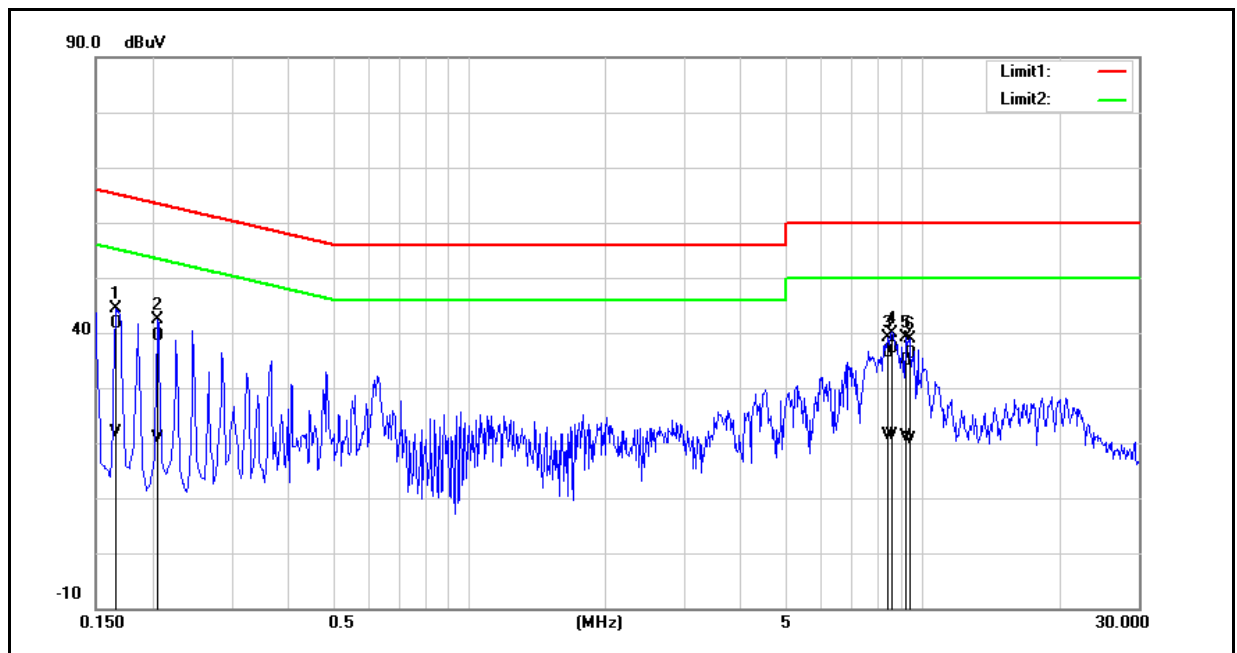
For intentional device, according to 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

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 6dBi.

5 Test Results

Annex A. Conducted Emission

Standard:	FCC Part 15.247	Line:	L1
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Test Mode:	Mode 1	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
Description:	White USB Cable: WA-P189701@00EM		



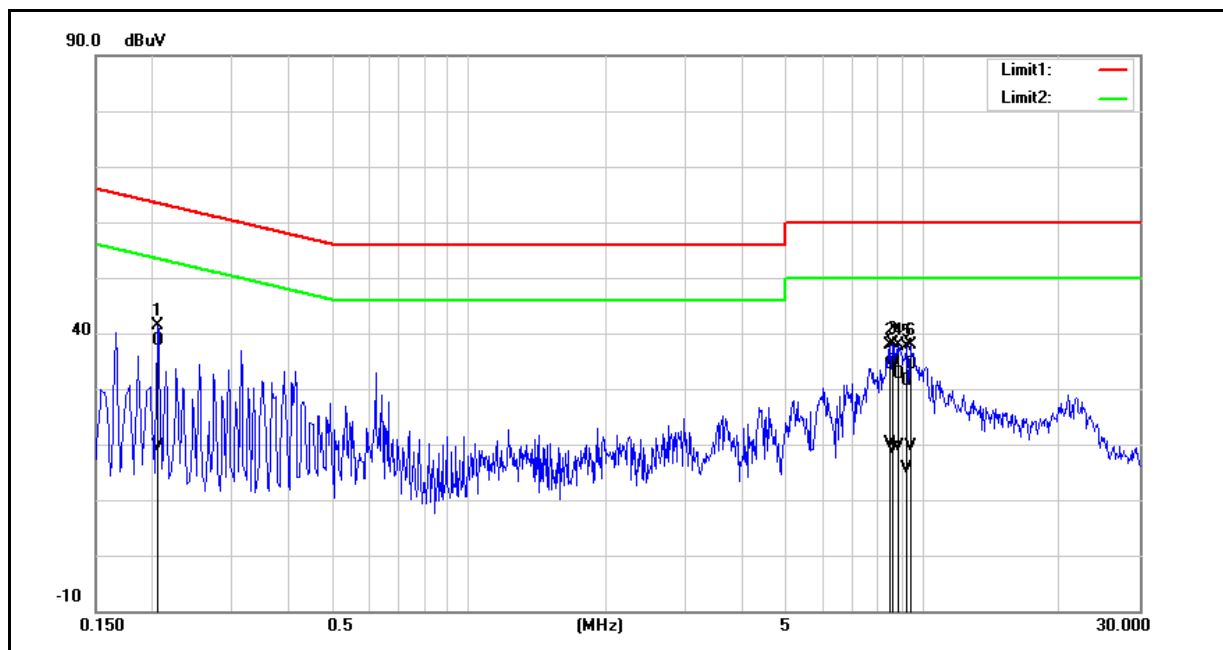
No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	0.1660	31.14	11.59	10.38	41.52	21.97	65.16	55.16	-23.64	-33.19	Pass
2	0.2060	29.12	10.48	10.31	39.43	20.79	63.37	53.37	-23.94	-32.58	Pass
3	8.3860	26.24	11.21	10.21	36.45	21.42	60.00	50.00	-23.55	-28.58	Pass
4	8.5740	26.83	11.22	10.22	37.05	21.44	60.00	50.00	-22.95	-28.56	Pass
5	9.2180	24.76	10.89	10.22	34.98	21.11	60.00	50.00	-25.02	-28.89	Pass
6	9.3940	25.89	10.46	10.23	36.12	20.69	60.00	50.00	-23.88	-29.31	Pass

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

Example: 41.52=10.38+31.14

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 120 V/60 Hz
Test Mode:	Mode 1	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
Description:	White USB Cable: WA-P189701@00EM		

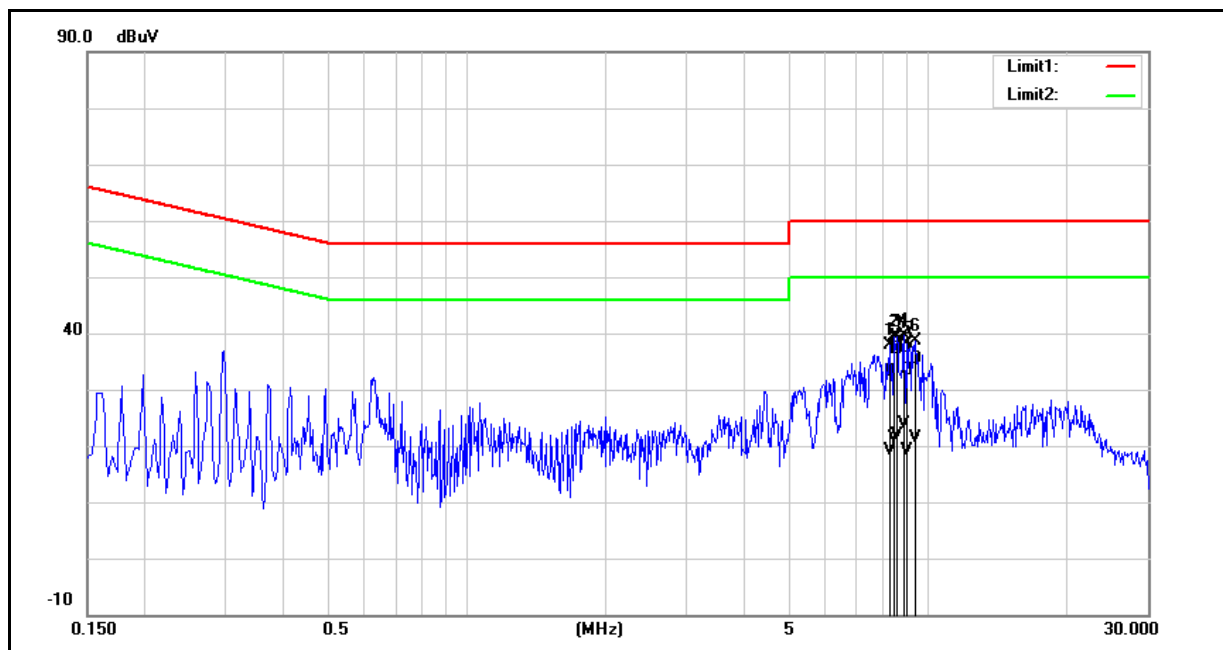


No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	0.2060	28.51	9.33	10.23	38.74	19.56	63.37	53.37	-24.63	-33.81	Pass
2	8.4300	24.14	9.99	10.20	34.34	20.19	60.00	50.00	-25.66	-29.81	Pass
3	8.5860	24.64	8.86	10.22	34.86	19.08	60.00	50.00	-25.14	-30.92	Pass
4	8.8180	22.48	9.32	10.22	32.70	19.54	60.00	50.00	-27.30	-30.46	Pass
5	9.1660	21.13	5.31	10.22	31.35	15.53	60.00	50.00	-28.65	-34.47	Pass
6	9.3980	24.19	9.40	10.22	34.41	19.62	60.00	50.00	-25.59	-30.38	Pass

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

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

Standard:	FCC Part 15.247	Line:	L1
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Test Mode:	Mode 1	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
Description:	Black USB Cable: WA-P189701@01EM		

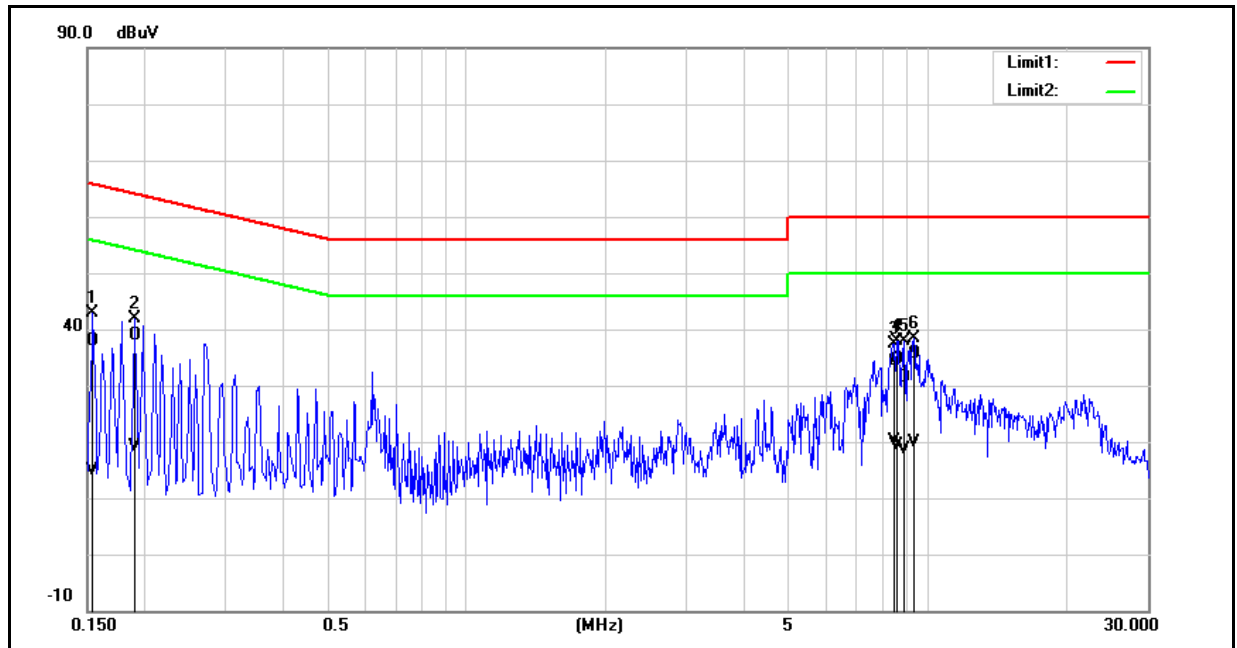


No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	8.2620	23.01	8.98	10.20	33.21	19.18	60.00	50.00	-26.79	-30.82	Pass
2	8.4940	26.93	11.26	10.20	37.13	21.46	60.00	50.00	-22.87	-28.54	Pass
3	8.5500	27.03	11.58	10.22	37.25	21.80	60.00	50.00	-22.75	-28.20	Pass
4	8.8820	27.12	13.62	10.22	37.34	23.84	60.00	50.00	-22.66	-26.16	Pass
5	8.9780	23.07	8.96	10.22	33.29	19.18	60.00	50.00	-26.71	-30.82	Pass
6	9.4220	25.25	11.18	10.22	35.47	21.40	60.00	50.00	-24.53	-28.60	Pass

Note: 1. Result (dBuV/m) = Correct Factor (dB/m) + 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 120 V/60 Hz
Test Mode:	Mode 1	Temp.(°C)/Hum. (%RH):	26(°C)/60 %RH
Description:	Black USB Cable: WA-P189701@01EM		



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	0.1540	27.67	4.61	10.29	37.96	14.90	65.78	55.78	-27.82	-40.88	Pass
2	0.1900	28.69	8.73	10.29	38.98	19.02	64.04	54.04	-25.06	-35.02	Pass
3	8.4500	24.26	9.95	10.20	34.46	20.15	60.00	50.00	-25.54	-29.85	Pass
4	8.5860	24.42	9.11	10.22	34.64	19.33	60.00	50.00	-25.36	-30.67	Pass
5	8.8780	21.15	8.53	10.22	31.37	18.75	60.00	50.00	-28.63	-31.25	Pass
6	9.3220	25.32	9.56	10.22	35.54	19.78	60.00	50.00	-24.46	-30.22	Pass

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

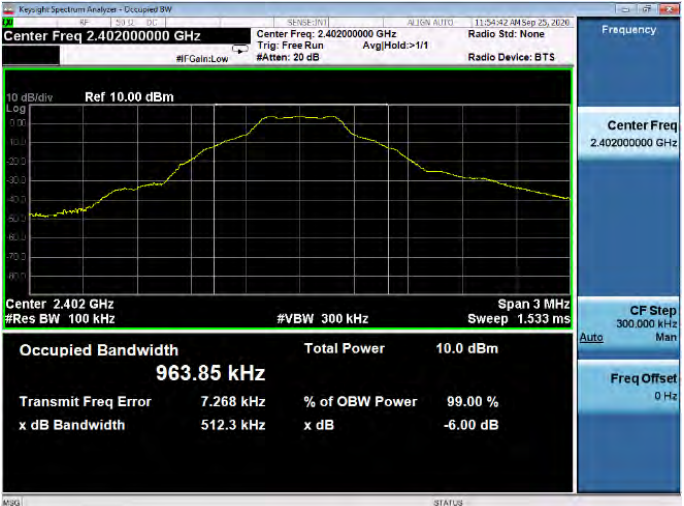
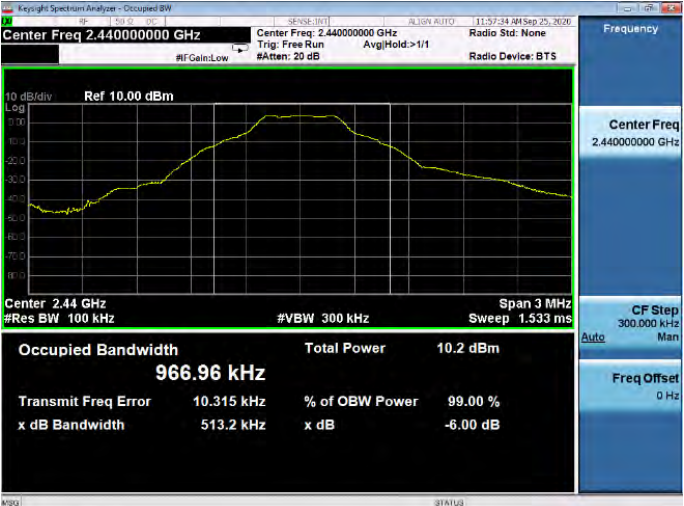
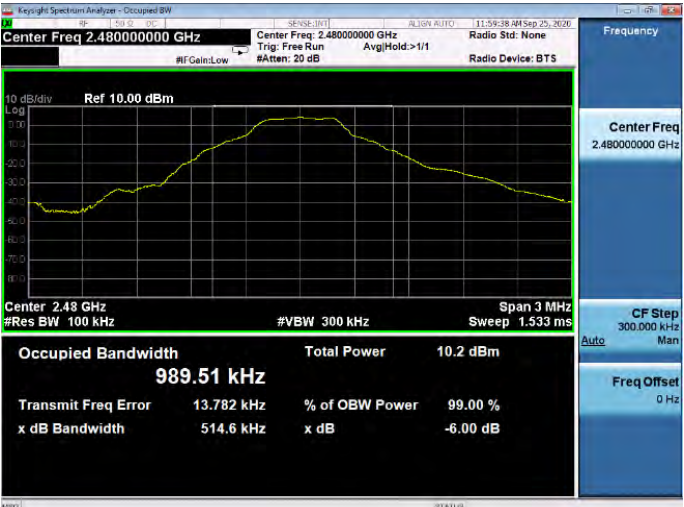
Test Mode	Frequency (MHz)	Peak Power		Limit (W)
		(dBm)	(W)	
Mode 2	2402	3.16	0.00207	< 0.125
	2440	3.15	0.00206	< 0.125
	2480	3.29	0.00213	< 0.125

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

6dB RF Bandwidth Measurement

Test Mode	Mode 2	
Frequency (MHz)	Measurement Results (kHz)	Limit (kHz)
2402	512.300	> 500
2440	513.200	> 500
2480	514.600	> 500

■ Test Graphs

Mode 2: GFSK Continuous TX mode	
2402 MHz	 Center Freq 2.402000000 GHz Center Freq: 2.402000000 GHz Trig: Free Run #Atten: 20 dB Avg/Hold: 1/1 Radio Std: None Radio Device: BTS 10 dB/div Ref 10.00 dBm Center 2.402 GHz #Res BW 100 kHz #VBW 300 kHz Sweep 1.533 ms Occupied Bandwidth 963.85 kHz Total Power 10.0 dBm Transmit Freq Error 7.268 kHz % of OBW Power 99.00 % x dB Bandwidth 512.3 kHz x dB -6.00 dB Frequency Center Freq 2.402000000 GHz CF Step 300.000 kHz Man Freq Offset 0 Hz
2440 MHz	 Center Freq 2.440000000 GHz Center Freq: 2.440000000 GHz Trig: Free Run #Atten: 20 dB Avg/Hold: 1/1 Radio Std: None Radio Device: BTS 10 dB/div Ref 10.00 dBm Center 2.44 GHz #Res BW 100 kHz #VBW 300 kHz Sweep 1.533 ms Occupied Bandwidth 966.96 kHz Total Power 10.2 dBm Transmit Freq Error 10.315 kHz % of OBW Power 99.00 % x dB Bandwidth 513.2 kHz x dB -6.00 dB Frequency Center Freq 2.440000000 GHz CF Step 300.000 kHz Man Freq Offset 0 Hz
2480 MHz	 Center Freq 2.480000000 GHz Center Freq: 2.480000000 GHz Trig: Free Run #Atten: 20 dB Avg/Hold: 1/1 Radio Std: None Radio Device: BTS 10 dB/div Ref 10.00 dBm Center 2.48 GHz #Res BW 100 kHz #VBW 300 kHz Sweep 1.533 ms Occupied Bandwidth 989.51 kHz Total Power 10.2 dBm Transmit Freq Error 13.782 kHz % of OBW Power 99.00 % x dB Bandwidth 514.6 kHz x dB -6.00 dB Frequency Center Freq 2.480000000 GHz CF Step 300.000 kHz Man Freq Offset 0 Hz



Maximum Power Density Measurement

Test Mode	Mode 2	
Frequency (MHz)	Measurement Results (dBm/3KHz)	Limit (dBm/3KHz)
2402	-5.274	< 8
2440	-5.419	< 8
2480	-6.465	< 8

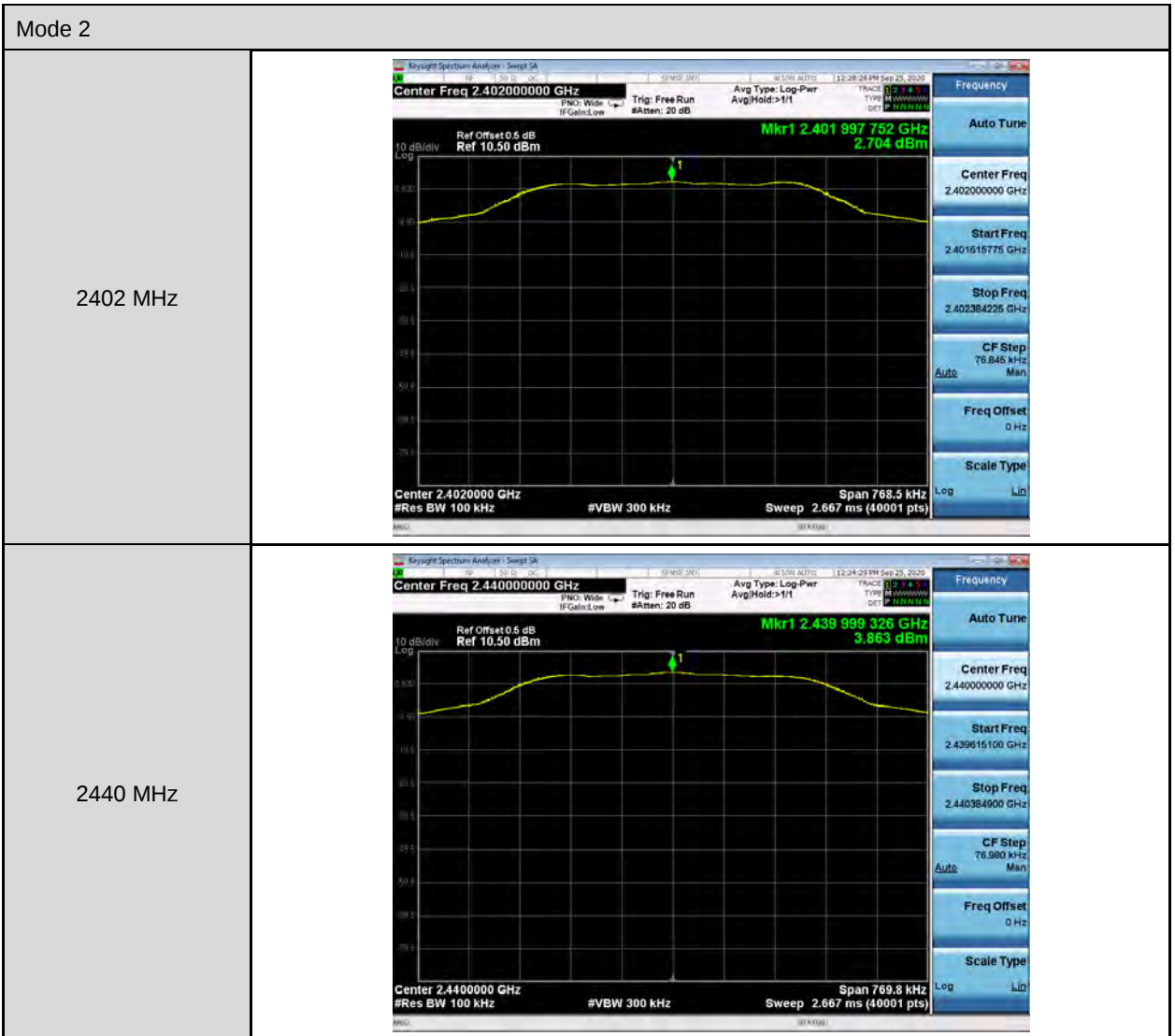
■ Test Graphs

Mode 2	
2402 MHz	
2440 MHz	
2480 MHz	

Out of Band Conducted Emissions Measurement

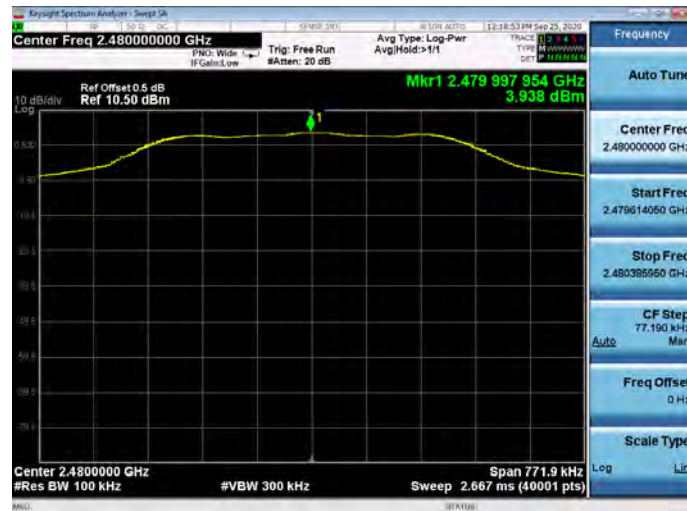
■ Test Graphs

Reference level



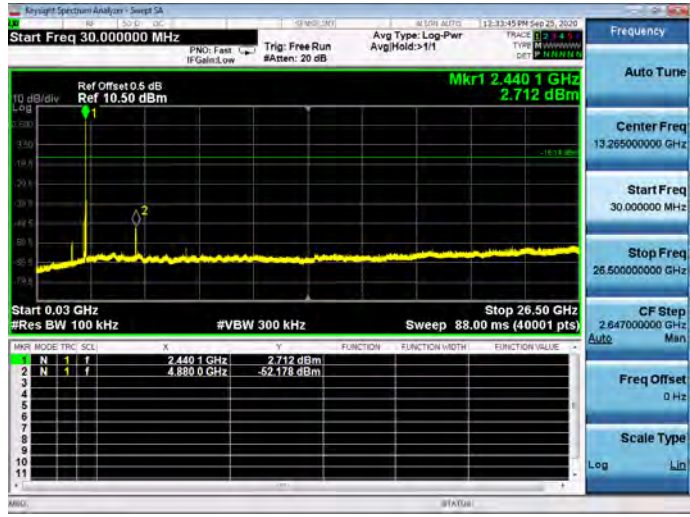


2480 MHz





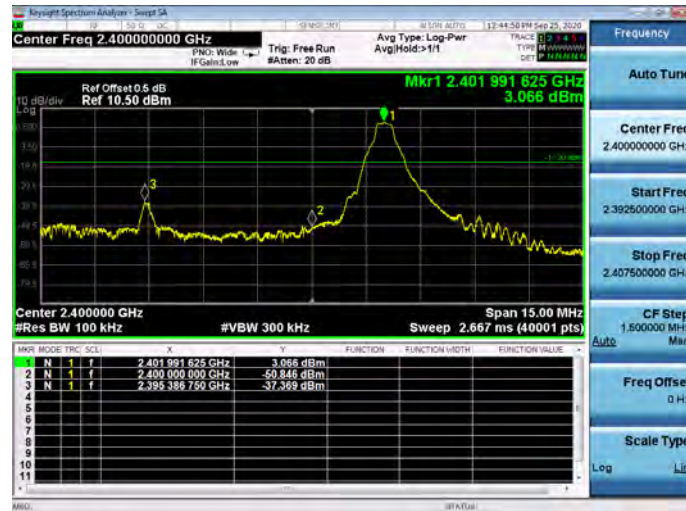
Out of Band Conducted Emissions

Mode 2																																					
2402 MHz	 <table><tr><th>Mkr</th><th>Mode</th><th>Trig</th><th>SC1</th><th>X</th><th>Y</th><th>FUNCTION</th><th>FUNCTION WIDTH</th><th>FUNCTION VALUE</th></tr><tr><td>1</td><td>N</td><td>1</td><td>f</td><td>2401.7 GHz</td><td>2.726 dBm</td><td></td><td></td><td></td></tr><tr><td>2</td><td>N</td><td>1</td><td>f</td><td>4.803.9 GHz</td><td>-58.999 dBm</td><td></td><td></td><td></td></tr><tr><td>3</td><td>N</td><td>1</td><td>f</td><td>7.209.7 GHz</td><td>-59.228 dBm</td><td></td><td></td><td></td></tr></table>	Mkr	Mode	Trig	SC1	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	N	1	f	2401.7 GHz	2.726 dBm				2	N	1	f	4.803.9 GHz	-58.999 dBm				3	N	1	f	7.209.7 GHz	-59.228 dBm			
Mkr	Mode	Trig	SC1	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE																													
1	N	1	f	2401.7 GHz	2.726 dBm																																
2	N	1	f	4.803.9 GHz	-58.999 dBm																																
3	N	1	f	7.209.7 GHz	-59.228 dBm																																
2440 MHz	 <table><tr><th>Mkr</th><th>Mode</th><th>Trig</th><th>SC1</th><th>X</th><th>Y</th><th>FUNCTION</th><th>FUNCTION WIDTH</th><th>FUNCTION VALUE</th></tr><tr><td>1</td><td>N</td><td>1</td><td>f</td><td>2440.1 GHz</td><td>2.712 dBm</td><td></td><td></td><td></td></tr><tr><td>2</td><td>N</td><td>1</td><td>f</td><td>4.880.0 GHz</td><td>-52.178 dBm</td><td></td><td></td><td></td></tr></table>	Mkr	Mode	Trig	SC1	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	N	1	f	2440.1 GHz	2.712 dBm				2	N	1	f	4.880.0 GHz	-52.178 dBm												
Mkr	Mode	Trig	SC1	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE																													
1	N	1	f	2440.1 GHz	2.712 dBm																																
2	N	1	f	4.880.0 GHz	-52.178 dBm																																
2480 MHz	 <table><tr><th>Mkr</th><th>Mode</th><th>Trig</th><th>SC1</th><th>X</th><th>Y</th><th>FUNCTION</th><th>FUNCTION WIDTH</th><th>FUNCTION VALUE</th></tr><tr><td>1</td><td>N</td><td>1</td><td>f</td><td>2479.8 GHz</td><td>2.931 dBm</td><td></td><td></td><td></td></tr><tr><td>2</td><td>N</td><td>1</td><td>f</td><td>4.960.0 GHz</td><td>-55.553 dBm</td><td></td><td></td><td></td></tr><tr><td>3</td><td>N</td><td>1</td><td>f</td><td>7.439.6 GHz</td><td>-50.298 dBm</td><td></td><td></td><td></td></tr></table>	Mkr	Mode	Trig	SC1	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	N	1	f	2479.8 GHz	2.931 dBm				2	N	1	f	4.960.0 GHz	-55.553 dBm				3	N	1	f	7.439.6 GHz	-50.298 dBm			
Mkr	Mode	Trig	SC1	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE																													
1	N	1	f	2479.8 GHz	2.931 dBm																																
2	N	1	f	4.960.0 GHz	-55.553 dBm																																
3	N	1	f	7.439.6 GHz	-50.298 dBm																																

Conducted Band Edge

Mode 2

2402 MHz



2480 MHz



Annex C. Radiated Emission Measurement

Harmonic

Below 1GHz

Standard:		FCC Part 15.247		Test Distance:		3 m	
Test item:		Harmonic		Power:		AC 120 V/60 Hz	
Test Mode:		Mode 1(White USB Cable: WA-P189701@00EM)		Temp.(°C)/Hum.(%RH):		26(°C)/60 %RH	
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
648.8600	28.81	-2.17	26.64	46.00	-19.36	peak	H
724.5200	28.47	-1.04	27.43	46.00	-18.57	peak	H
768.1700	33.60	-0.25	33.35	46.00	-12.65	peak	H
783.6900	34.23	0.03	34.26	46.00	-11.74	peak	H
818.6100	28.70	0.45	29.15	46.00	-16.85	peak	H
881.6600	29.21	0.89	30.10	46.00	-15.90	peak	H
39.7000	41.54	-11.78	29.76	40.00	-10.24	peak	V
59.1000	32.40	-11.33	21.07	40.00	-18.93	peak	V
84.3200	36.42	-15.84	20.58	40.00	-19.42	peak	V
141.5500	32.61	-10.87	21.74	43.50	-21.76	peak	V
800.1800	32.76	0.32	33.08	46.00	-12.92	peak	V
898.1500	28.76	1.01	29.77	46.00	-16.23	peak	V

Standard:		FCC Part 15.247		Test Distance:		3 m	
Test item:		Harmonic		Power:		AC 120 V/60 Hz	
Test Mode:		Mode 1(Black USB Cable: WA-P189701@01EM)		Temp.(°C)/Hum.(%RH):		26(°C)/60 %RH	
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
31.9400	33.19	-12.74	20.45	40.00	-19.55	peak	H
144.4600	30.18	-10.81	19.37	43.50	-24.13	peak	H
589.6900	28.45	-3.08	25.37	46.00	-20.63	peak	H
650.8000	28.76	-2.15	26.61	46.00	-19.39	peak	H
779.8100	28.99	-0.04	28.95	46.00	-17.05	peak	H
869.0500	29.19	0.80	29.99	46.00	-16.01	peak	H
39.7000	41.77	-11.78	29.99	40.00	-10.01	peak	V
48.4300	34.72	-11.17	23.55	40.00	-16.45	peak	V
50.3700	25.00	0.00	25.00	40.00	-15.00	peak	V
53.2800	24.31	0.00	24.31	40.00	-15.69	peak	V
836.0700	29.63	0.00	29.63	46.00	-16.37	peak	V
846.7400	29.88	0.00	29.88	46.00	-16.12	peak	V

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

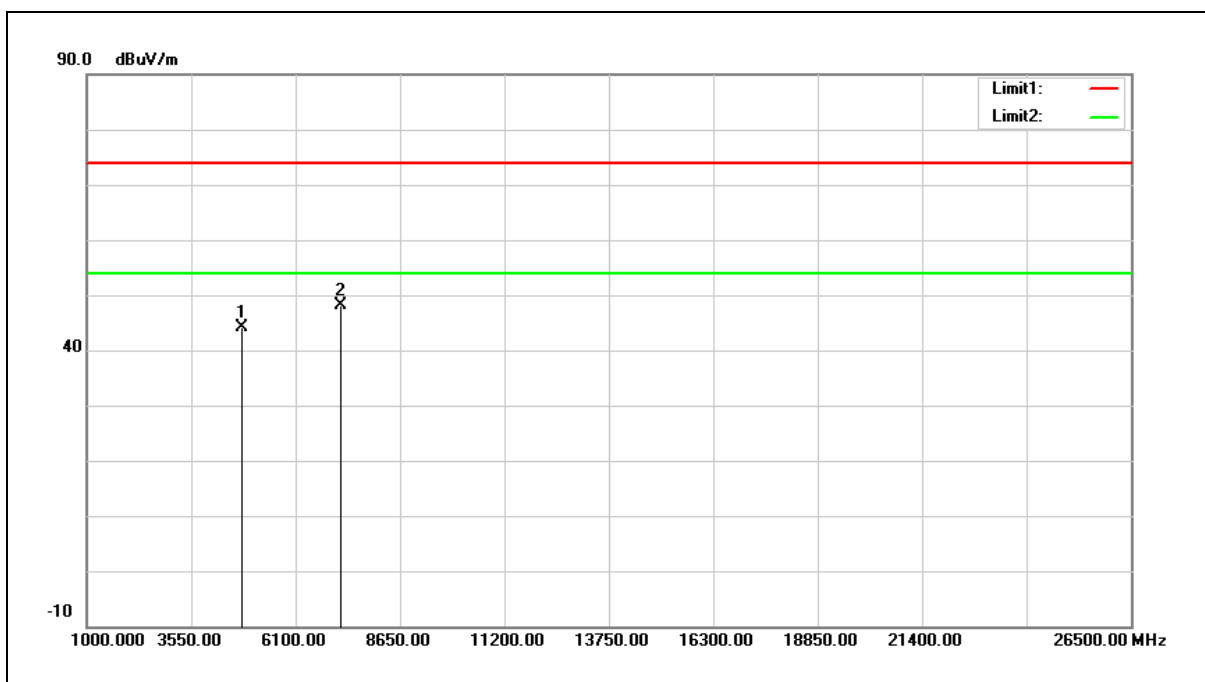
Example: 56.51=-10.95+67.46

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.

Above 1GHz

Standard:	FCC Part 15.247	Test Distance:	3 m
Test item:	Harmonic	Power:	AC 120 V/60 Hz
Frequency:	2402 MHz	Temp.(°C)/Hum. (%RH):	26(°C)/60 %RH
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	49.73	-5.57	44.16	74.00	-29.84	peak
2	7206.000	49.52	-1.37	48.15	74.00	-25.85	peak

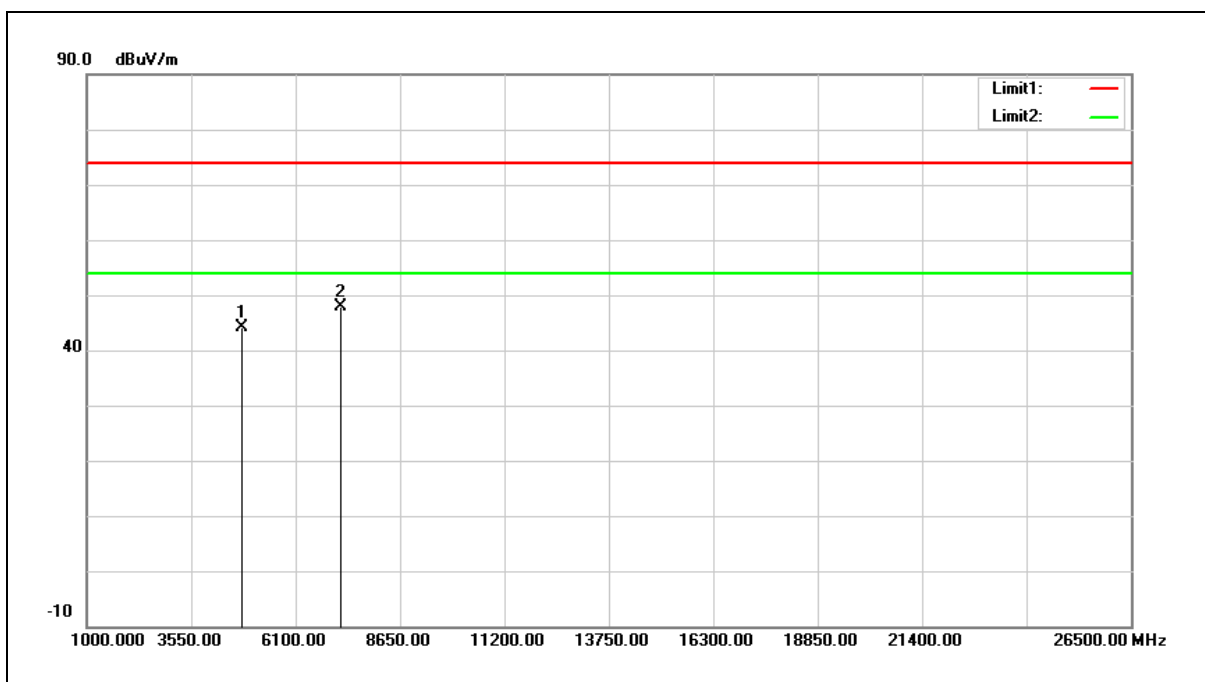
Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

Example: $44.16 = -5.57 + 49.73$

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	Power:	AC 120 V/60 Hz
Frequency:	2402 MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
Mode:	Mode 2		
Ant.Polar.:	Vertical		



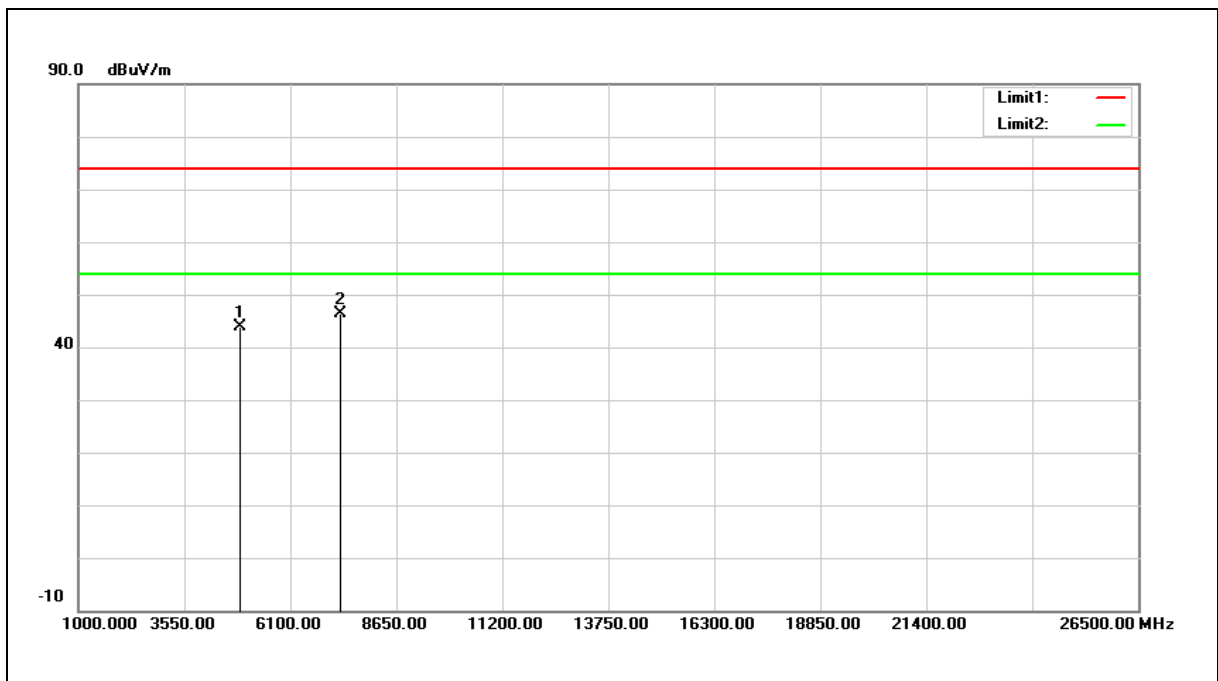
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4804.000	49.79	-5.57	44.22	74.00	-29.78	peak
2	7206.000	49.25	-1.37	47.88	74.00	-26.12	peak

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	Power:	AC 120 V/60 Hz
Frequency:	2440 MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
Mode:	Mode 2		
Ant.Polar.:	Horizontal		



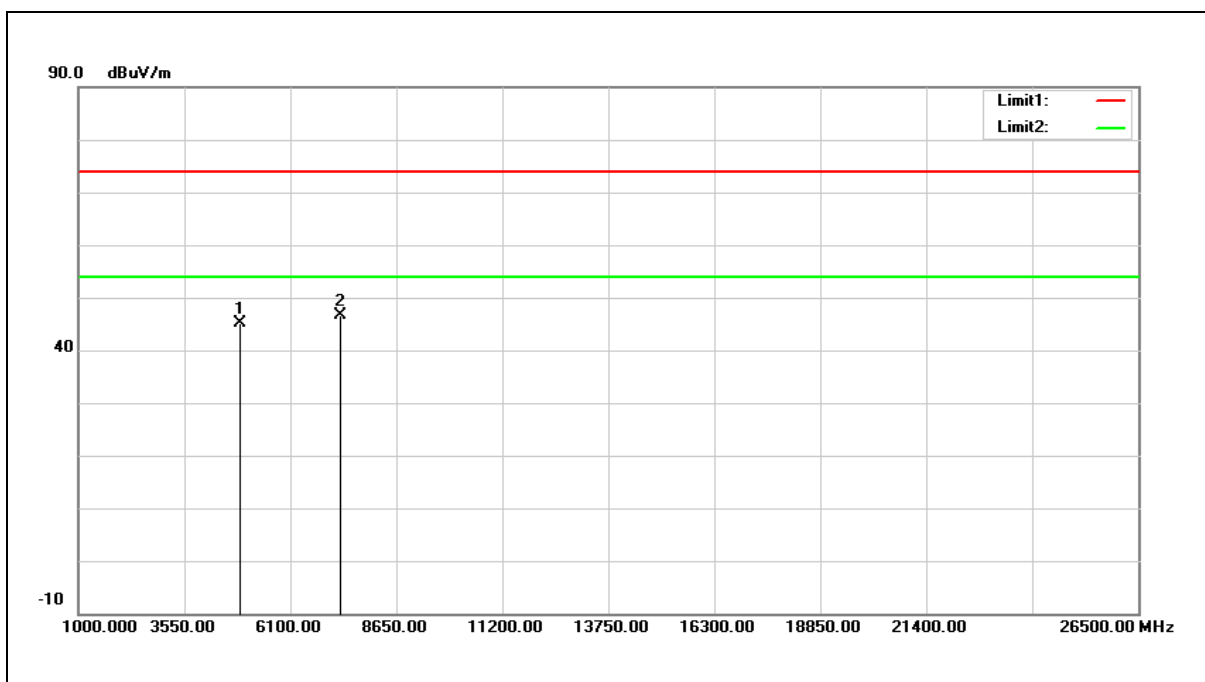
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4880.000	49.36	-5.45	43.91	74.00	-30.09	peak
2	7320.000	47.45	-1.19	46.26	74.00	-27.74	peak

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	Power:	AC 120 V/60 Hz
Frequency:	2440 MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
Mode:	Mode 2		
Ant.Polar.:	Vertical		



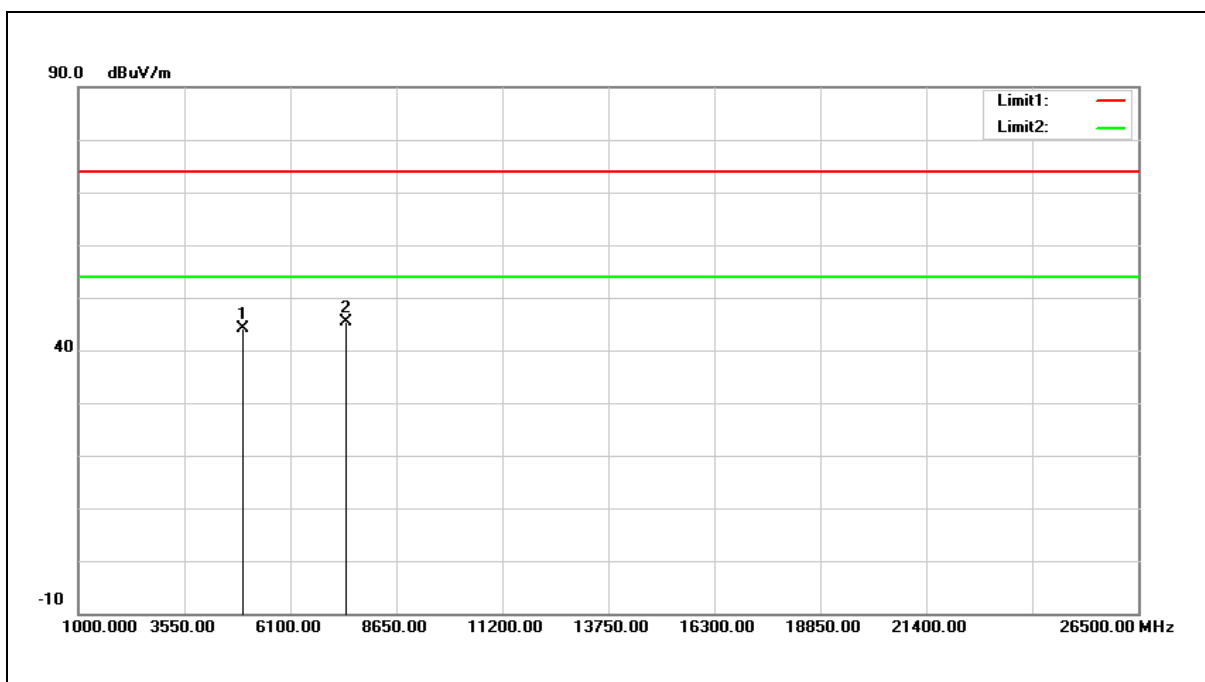
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4880.000	50.67	-5.45	45.22	74.00	-28.78	peak
2	7320.000	47.92	-1.19	46.73	74.00	-27.27	peak

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	Power:	AC 120 V/60 Hz
Frequency:	2480 MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
Mode:	Mode 2		
Ant.Polar.:	Horizontal		



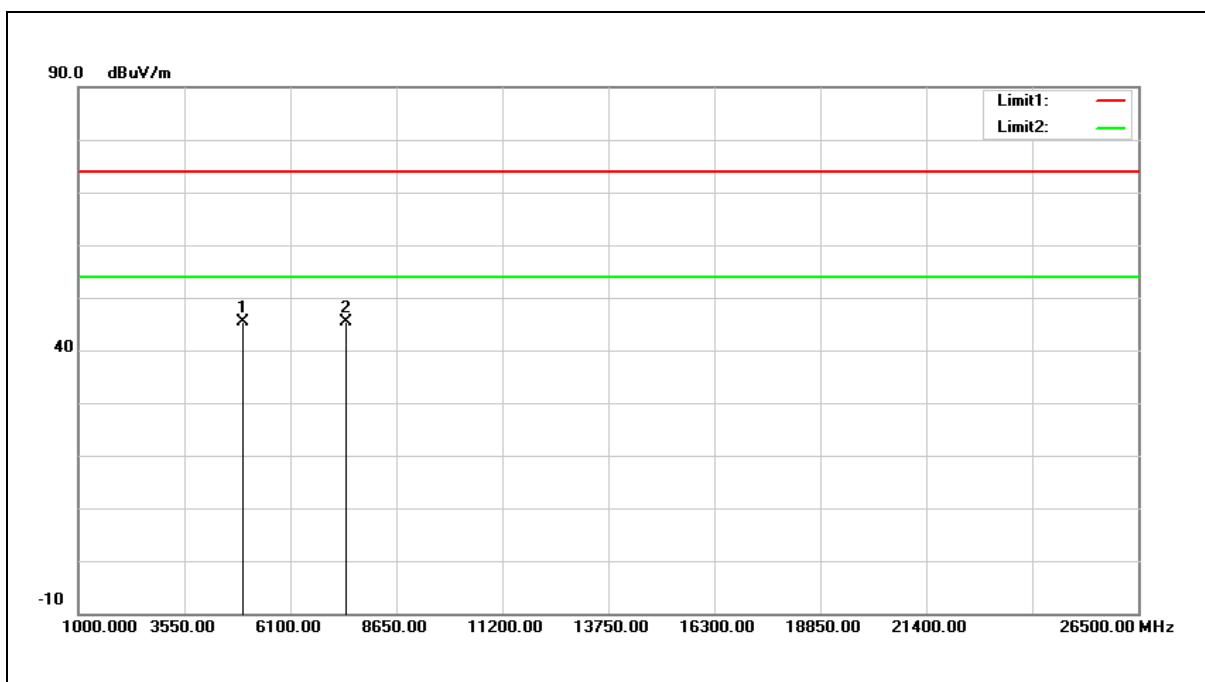
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4960.000	49.52	-5.33	44.19	74.00	-29.81	peak
2	7440.000	46.38	-1.00	45.38	74.00	-28.62	peak

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	Power:	AC 120 V/60 Hz
Frequency:	2480 MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
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	50.74	-5.33	45.41	74.00	-28.59	peak
2	7440.000	46.50	-1.00	45.50	74.00	-28.50	peak

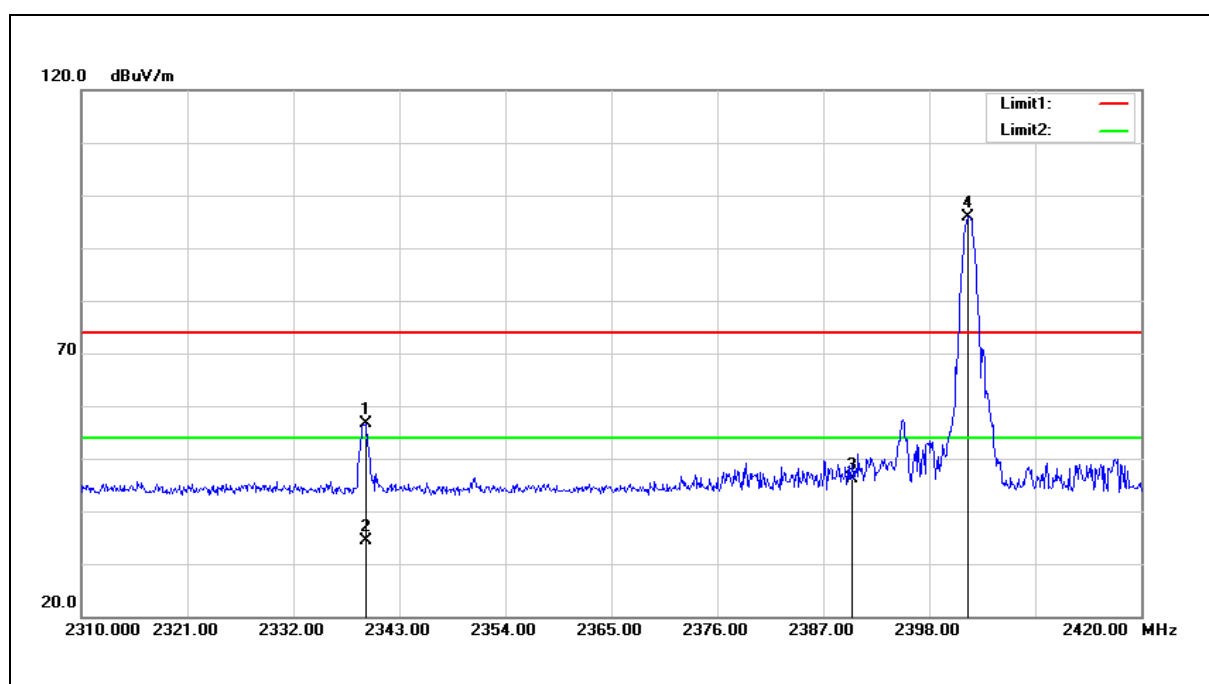
Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

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	Power:	AC 120 V/60 Hz
Frequency:	2402 MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
Mode:	Mode 2		
Ant.Polar.:	Horizontal		



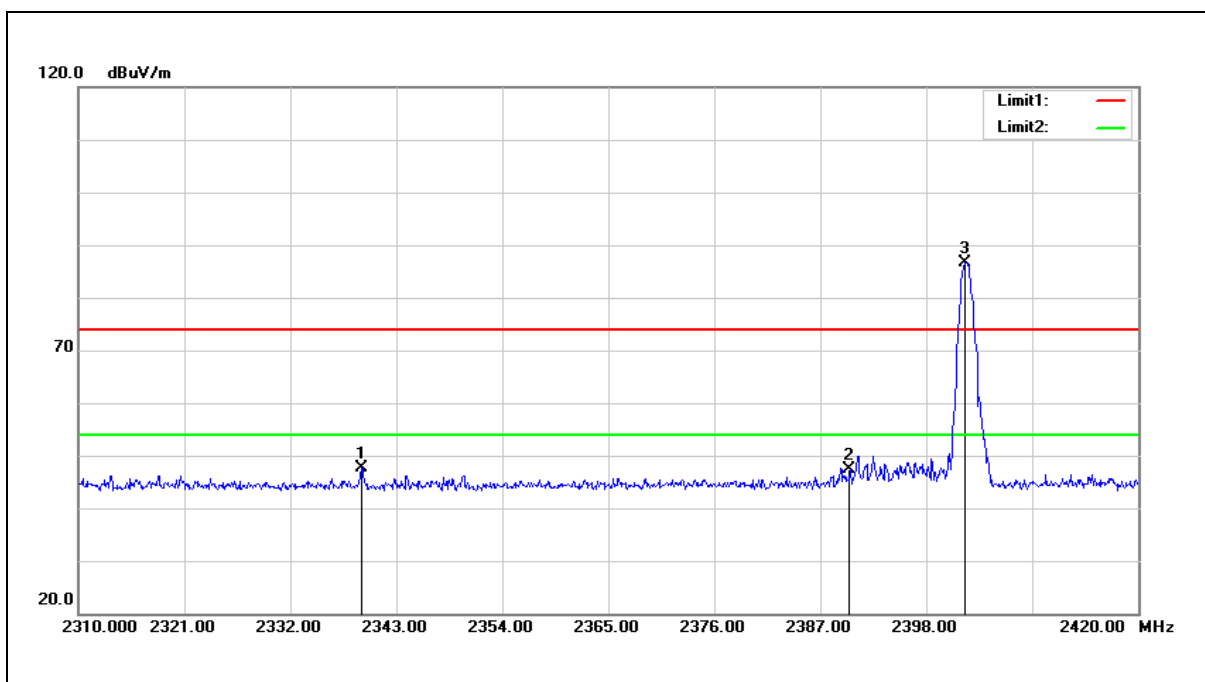
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2339.480	67.46	-10.95	56.51	74.00	-17.49	peak
2	2339.480	45.23	-10.95	34.28	54.00	-19.72	AVG
3	2390.000	57.00	-10.85	46.15	74.00	-27.85	peak
4	2402.070	106.63	-10.82	95.81	---	---	peak

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	Power:	AC 120 V/60 Hz
Frequency:	2402 MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
Mode:	Mode 2		
Ant.Polar.:	Vertical		



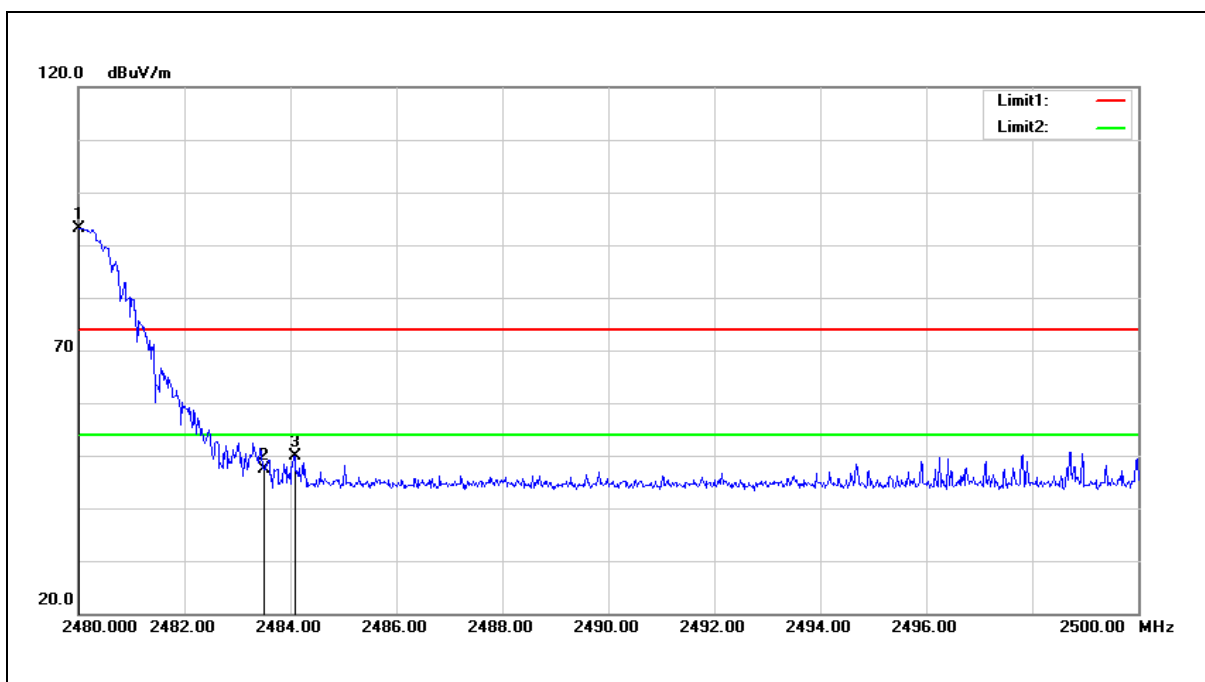
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2339.370	58.54	-10.95	47.59	74.00	-26.41	peak
2	2390.000	58.28	-10.85	47.43	74.00	-26.57	peak
3	2402.070	97.38	-10.82	86.56	---	---	peak

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	Power:	AC 120 V/60 Hz
Frequency:	2480 MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
Mode:	Mode 2		
Ant.Polar.:	Horizontal		



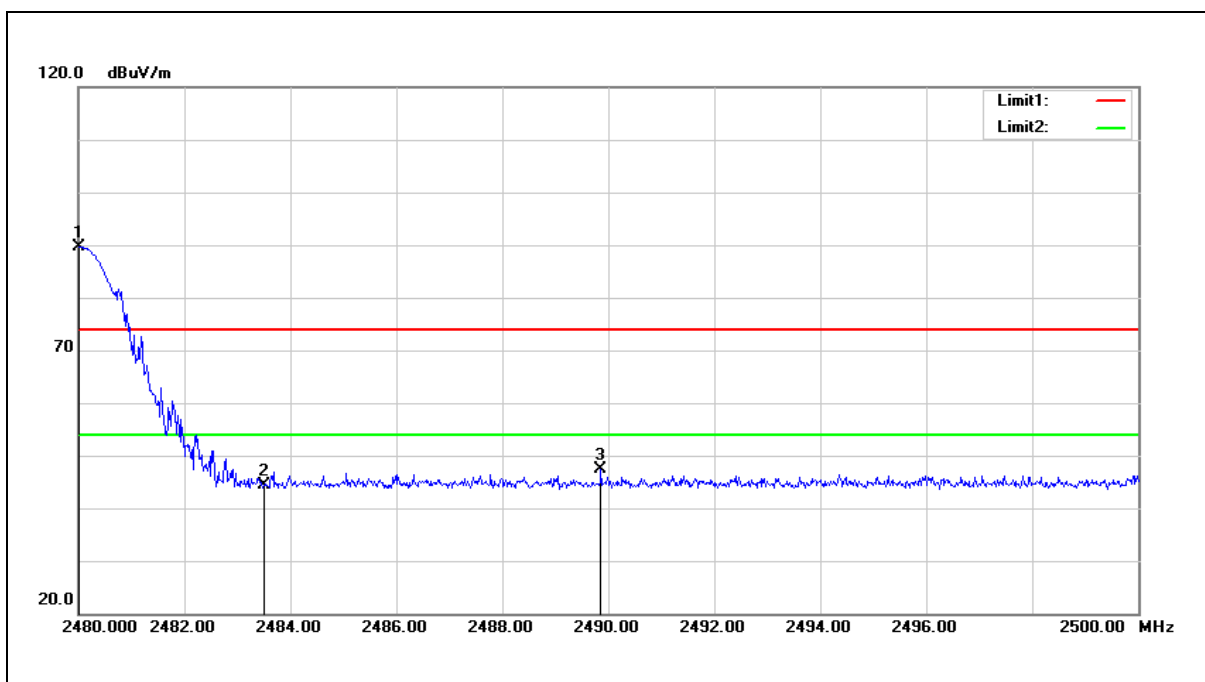
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2480.020	103.78	-10.66	93.12	---	---	peak
2	2483.500	57.97	-10.65	47.32	74.00	-26.68	peak
3	2484.080	60.55	-10.65	49.90	74.00	-24.10	peak

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:	Band edge	Power:	AC 120 V/60 Hz
Frequency:	2480 MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60 %RH
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	100.25	-10.66	89.59	---	---	peak
2	2483.500	54.98	-10.65	44.33	74.00	-29.67	peak
3	2489.860	57.92	-10.64	47.28	74.00	-26.72	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.