

FCC 47 CFR PART 15 SUBPART C TEST REPORT

For

Product Name: Wireless Vibration & Temperature Sensor (916MHz Band)

Brand Name: MOONS'

Model No.: MS-WS100NA

Series Model.: N/A

FCC ID: 2ALUV-WS100NA

Test Report Number:

C180321R01-RPW

Issued for

Shanghai MOONS' Automation Control Co.,Ltd.

No.168 Mingjia Rd, Minhang District,Shanghai 201107

Issued by

Compliance Certification Services Inc.

Kun shan Laboratory

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	March 28, 2018	C180321R01-RPW	ALL	N/A
01	September 20, 2018	C180321R01-RPW	P4; P5; P8; P20; P34-P44	Add the average power; Update the photo of antenna; And update the data of radiated emissions.

1. TEST RESULT CERTIFICATION

Product Name:	Wireless Vibration & Temperature Sensor (916MHz Band)
Trade Name:	MOONS'
Model Name.:	MS-WS100NA
Series Model:	N/A
Applicant Discrepancy:	Initial
Device Category:	mobile unit
Date of Test:	March 23, 2018~March 28, 2018, and September 20, 2018
Applicant:	Shanghai MOONS' Automation Control Co.,Ltd. No.168 Mingjia Rd, Minhang District,Shanghai 201107
Manufacturer:	Shanghai MOONS' Automation Control Co.,Ltd. No.168 Mingjia Rd, Minhang District,Shanghai 201107
Application Type:	Certification

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 15 Subpart C	No non-compliance noted

We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10: 2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247.

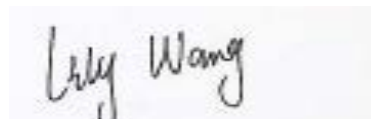
The test results of this report relate only to the tested sample EUT identified in this report.

Approved by:



Jeff.Fang
RF Manager
Compliance Certification Service Inc.

Tested by:



Lily.Wang
Test Engineer
Compliance Certification Service Inc.

2. EUT DESCRIPTION

Product Name:	Wireless Vibration & Temperature Sensor (916MHz Band)		
Brand Name:	MOONS'		
Model Name:	MS-WS100NA		
Series Model:	N/A		
Model Discrepancy:	N/A		
Power Adapter:	Battery: Output:3.6V		
Frequency Range:	902MHz to 928 MHz		
Max Peak Output Power:	9.23dBm		
Max Average Output Power:	9.01dBm		
Modulation Technique:	O-QPSK		
Number of Channels:	10 Channels		
Antenna type:	Dipole Antenna		
Antenna gain (Max):		Gain(dBi)	
	Antenna 1	2.55	
	Antenna 2	2.54	

Remark:

1.The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.

2.This submittal(s) (test report) is intended for **FCC ID: 2ALUV-WS100NA** filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10 2013 and FCC CFR 47 15.207, 15.209, 15.247 and KDB558074.

3.1.EUT CONFIGURATION

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

3.2.EUT EXERCISE

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3.GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10 2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

Under 1GHz

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.4 & 6.5 of ANSI C63.10:2013.

Above 1GHz

The EUT is placed on a turn table, which is 1.5 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.6 of ANSI C63.10:2013.

3.4.FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)
13.36 - 13.41			

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

3.5.DESCRPTION OF TEST MODES

Software used to control the EUT for staying in continuous transmitting and receiving mode is programmed. The worst-case data are determined to be as follows for each mode based on investigation by measuring the average power, peak power and PPSD across all channel, bandwidths, and modulations.

3.6.ANTENNA DESCRIPTION

According to FCC 47 CFR 15.203

“an intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached or an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section”

As the photo below, the EUT use a unique coupling to the intentional radiator attached antenna, so the EUT complies with the requirement of 15.203.



4. INSTRUMENT CALIBRATION

4.1.MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

Equipment Used for Emissions Measurement

Conducted Emissions Test Site					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Data	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY44020154	2017-9-4	2018-9-3
Spectrum Analyzer	RS	FSU26	200789	2017-7-20	2018-7-19
Power meter	Anritsu	ML2495A	1445010	2017-4-26	2018-4-25
Power sensor	Anritsu	MA2411B	1339220	2017-4-26	2018-4-25
Power SPLITTER	Mini-Circuits	ZN2PD-9G	SF078500430	N.C.R	N.C.R
DC Power Supply	AGILENT	E3632A	MY50340053	N.C.R	N.C.R
Temp. / Humidity Gauge	Anymetre	TH603	CCS007	2017-10-24	2018-10-23
Test Software			EZ-EMC		

Conducted Emission					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
EMI TEST RECEIVER	R&S	ESCI	100781	2018-2-26	2019-2-25
V (V-LISN)	SCHWARZBECK	NNLK 8129	8129-143	2017-10-29	2018-10-28
TWO-LINE V-NETWORK	R&S	ENV216	101604	2017-10-29	2018-10-28
Pulse LIMITER	R&S	ESH3-Z2	100524	2017-12-27	2018-12-26
Cable	Thermax	Cable-02	14	2017-12-27	2018-12-26
Test Software			EZ-EMC		

977 Chamber					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Data	Calibration Due
Spectrum Analyzer	RS	FSU26	200789	2018-7-13	2019-7-12
Signal Analyzer	R&S	FSV40	101493	2017-12-18	2018-12-17
EMI Test Receiver	R&S	ESCI	101378	2017-12-26	2018-12-25
Amplifier	COM-POWER	PAM-840A	461332	2017-11-29	2018-11-28
Amplifier	MITEQ	JS41-00101800-32-10P	1675713	2018-7-13	2019-7-12
Broad-Band Horn Antenna	SCHWARZBECK	BBHA 9170	9170-515	2018-2-27	2019-2-26
Bilog Antenna	Teseq	CBL 6112D	36996	2018-7-7	2019-7-6
Loop Antenna	COM-POWER	AL-130R	10160008	2018-5-8	2019-5-7
Horn-antenna	SCHWARZBECK	9120D	D:266	2018-2-26	2019-2-25
Horn-antenna	SCHWARZBECK	9120D	D:267	2017-11-5	2018-11-4
Turn Table	CT	CT123	4165	N.C.R	N.C.R
Antenna Tower	CT	CTERG23	3256	N.C.R	N.C.R
Controller	CT	CT100	95637	N.C.R	N.C.R
Cable	REBES MICROWAVE	Cable-93	N/A	2017-10-29	2018-10-28
Cable	REBES MICROWAVE	Cable-94	N/A	2017-10-29	2018-10-28
Cable	REBES MICROWAVE	Cable-95	N/A	2017-10-29	2018-10-28
Cable	N/A	Cable-03	N/A	2018-4-24	2019-4-23
Cable	N/A	Cable-04	N/A	2018-4-24	2019-4-23
0.9G Filter	N/A	N/A	N/A	2018-4-24	2019-4-23
Test Software			EZ-EMC		

Remark: The measurement uncertainty is less than +/- 2.81dB, which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.

Expanded Uncertainty (95% CONFIDENCE INTERVAL): K=2

4.2.MEASUREMENT UNCERTAINTY

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR 100 028-1 [2] and shall correspond to an expansion factor (coverage factor) $k = 1,96$ or $k = 2$ (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Table 6 is based on such expansion factors.

Table 6: Maximum measurement uncertainty

Parameter	Uncertainty
RF output power, conducted	$\pm 1.129\text{dB}$
Unwanted Emissions, conducted	$\pm 2.406\text{dB}$
RF Power density, conducted	$\pm 2.379\text{dB}$
Conducted emissions	$\pm 2.582\text{dB}$
All emissions, radiated (Below 1GHz)	$\pm 4.725\text{dB}$
All emissions, radiated (Above 1GHz)	$\pm 4.818\text{dB}$
Temperature	$\pm 0.3\text{dB}$
Supply voltages	$\pm 0.2\%$

5. FACILITIES AND ACCREDITATIONS

5.1.FACILITIES

All measurement facilities used to collect the measurement data are located at CCS China Kunshan Lab at 10#Weiye Rd, Innovation Park Eco. & Tec. Development Zone Kunshan city JiangSu, (215300), CHINA.

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 2013 and CISPR Publication 22.

5.2.EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."


5.3.LABORATORY ACCREDITATIONS AND LISTING

FCC –Designation Number: CN1172.

Compliance Certification Services Inc. Kun shan Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files and the Designation Number: CN1172.

5.4.TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	A2LA	<p>47 CFR FCC, Part 15,Subpart B (using ANSI 63.4 :2009 and ANSI C63.4:2014);ICES-003; 47 CFR FCC, Part 18(using MP-5:1986);ICES-001;VCCI - V3; VCCI-CISPR-32(up to 6GHz);VCCI 32-1;CNS 13438(up to 6GHz); CNS 13439; CNS 13803; CISPR 11; EN 55011; CISPR 13; EN 55013; CISPR 22; EN 55022; AS/NZS CISPR 22;CISPR32;EN55032; AS/NZS CISPR 32;EN55014-1(excluding clicks);CISPR 14-1(excluding clicks);EN55015;CISPR 15; IEC 61000-3-2; EN 61000-3-2; AS/NZS 61000.3.2 IEC 61000-3-3; EN 61000-3-3; AS/NZS 61000.3.3 IEC 61000-4-2; EN 61000-4-2; AS/NZS 61000.4.2 IEC 61000-4-3; EN 61000-4-3; AS/NZS 61000.4.3 IEC 61000-4-4; EN 61000-4-4; AS/NZS 61000.4.4 IEC 61000-4-5; EN 61000-4-5; AS/NZS 61000.4.5 IEC 61000-4-6; EN 61000-4-6; AS/NZS 61000.4.6 IEC 61000-4-8; EN 61000-4-8; AS/NZS 61000.4.8 IEC 61000-4-11; EN 61000-4-11; AS/NZS 61000.4.11 EN 61000-6-1; EN 61000-6-2; EN 61000-6-3 (excluding discontinuous interference); EN 61000-6-4; IEC 61000-6-1; IEC 61000-6-2; IEC 61000-6-3 (excluding discontinuous interference); IEC 61000-6-4; AS/NZS 61000.6.1; AS/NZS 61000.6.2; AS/NZS 61000.6.3 (excluding discontinuous interference); AS/NZS 61000.6.4; EN 55024; CISPR 24; AS/NZS CISPR 24; EN 61547; IEC 61547; EN 60601-1-2; IEC 60601-1-2; EN 50130-4; EN 55014-2; CISPR 14-2; EN 62040-2; IEC 62040-2; EN 61204-3; IEC 61204-3; EN 50121-1; EN 50121-3-2; EN 50121-4; EN 50121-5; EN 50155 (clauses 5.4 and 5.5); EN 61326-1; IEC 61326-1; EN 50083-2; EN 300 386; EN 301 489-1 (excluding Section 9.6); EN 301 489-3; EN 301 489-7; EN 301 489-17; EN 301 489-19; EN 301 489-24; EN 301 489-25; EN 301 489-34 FCC Part 15, Subparts 15C, 15E (KDB 905462 D03 (v01r02))(using ANSI C63.4:2009, ANSI C63.4:2014 and ANSI C63.10:2013) FCC Parts 22E, 24E (using ANSI/TIA-603-D) RSS-132; RSS-133; RSS-210; RSS-247 (excluding DFS testing)</p>	

		<p>EN 300 220-1; EN 300 220-2; EN 300 328; EN 300 330-1; EN 300 330-2; EN 300 440-1; EN 300 440-2; EN 301 893 (excluding DFS testing); EN 301 511(clauses 4.2.12 to 4.2.19, and 5.2.12 to 5.2.19); EN 301 908-1 (clauses 4.2.2, 4.2.3, 5.3.1, and 5.3.2); EN 301 908-2 (clauses 4.2.4, 4.2.10, 5.3.3, and 5.3.9) AS/NZS 4268 IEEE Std 1528:2013; EN 50360; EN 50566; EN 62479; EN 50383; EN 50385; EN 62311; IEC 62209-1; EN 62209-1; IEC 62209-2; EN 62209-2; CNS 14958-1; CNS 14959; RSS-102; ACMA Radio Communications (Electromagnetic Radiation – Human Exposure) Standard 2014</p>	
USA	FCC	3/10 meter Sites to perform FCC Part 15/18 measurements	 CN1172
Japan	VCCI	3/10 meter Sites and conducted test sites to perform radiated/conducted measurements	VCCI R-1600 C-1707 G-216

** No part of this report may be used to claim or imply product endorsement by A2LA or any agency of the US Government.*

6. SETUP OF EQUIPMENT UNDER TEST

6.1.SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

6.2.SUPPORT EQUIPMENT

No.	Device Type	Brand	Model	Series No.	FCC ID
N/A	N/A	N/A	N/A	N/A	N/A

Remark:

- 1.All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.*
- 2.Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.*

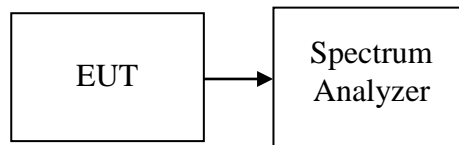
7. FCC PART 15.247 REQUIREMENTS

7.1.6DB BANDWIDTH

LIMIT

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 - 928 MHz, and 2400 - 2483.5 MHz bands, and 5725 - 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500kHz.

Test Configuration



TEST PROCEDURE

Set the spectrum analyzer as RBW = 100 kHz, VBW = 300 kHz, Sweep = auto couple.

TEST RESULTS

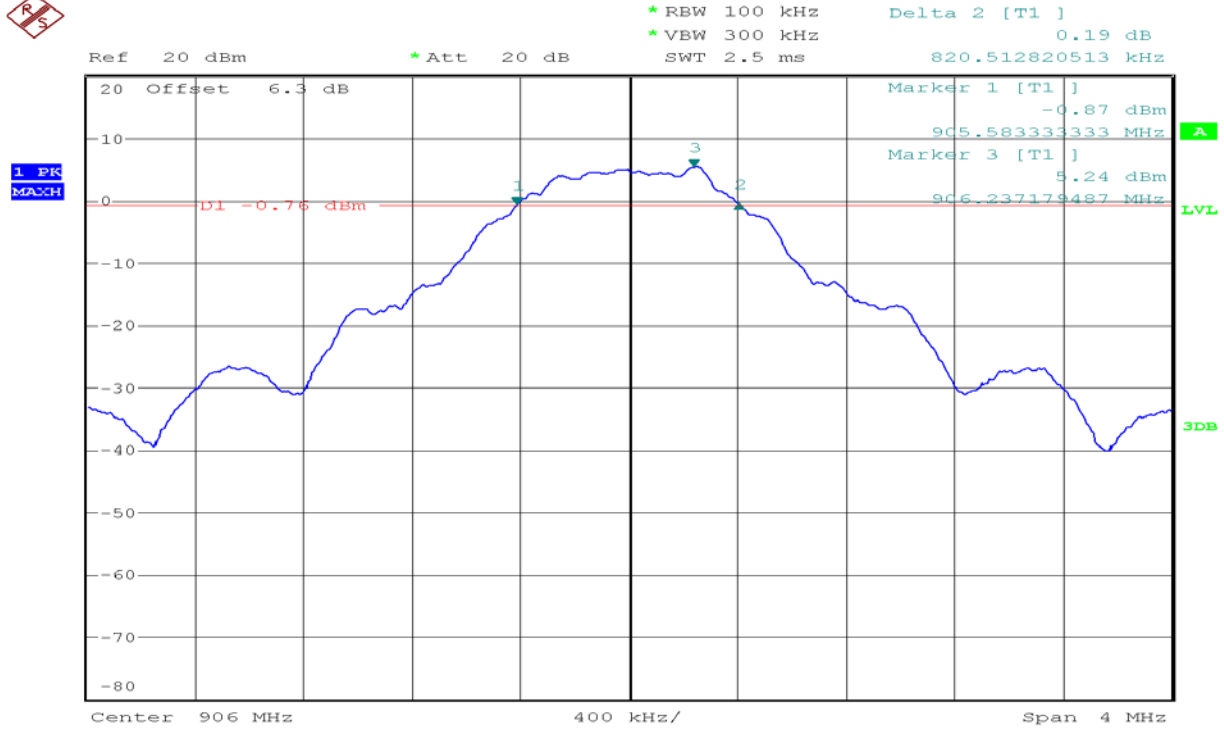
No non-compliance noted

Test Data

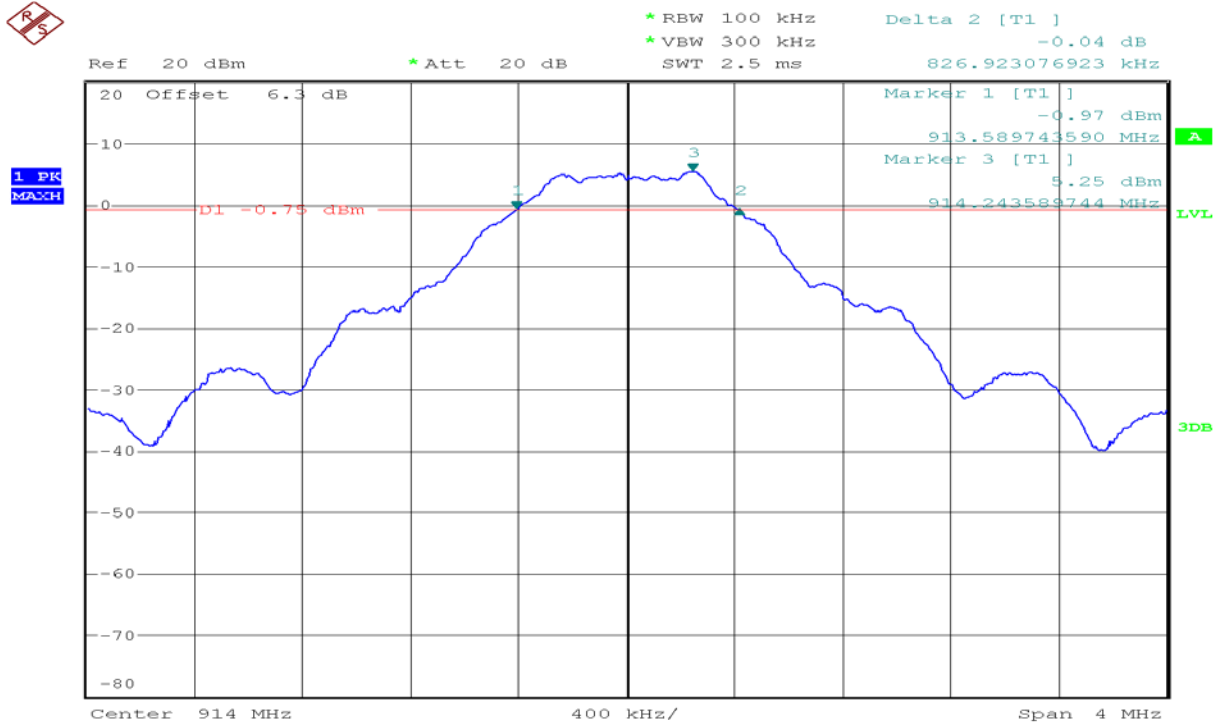
Channel	Frequency (MHz)	Bandwidth (MHz)	Limit (kHz)	Result
Low	906	0.821	>500	PASS
Mid	914	0.827		PASS
High	924	0.821		PASS

Test Plot

6dB Bandwidth (CH Low)



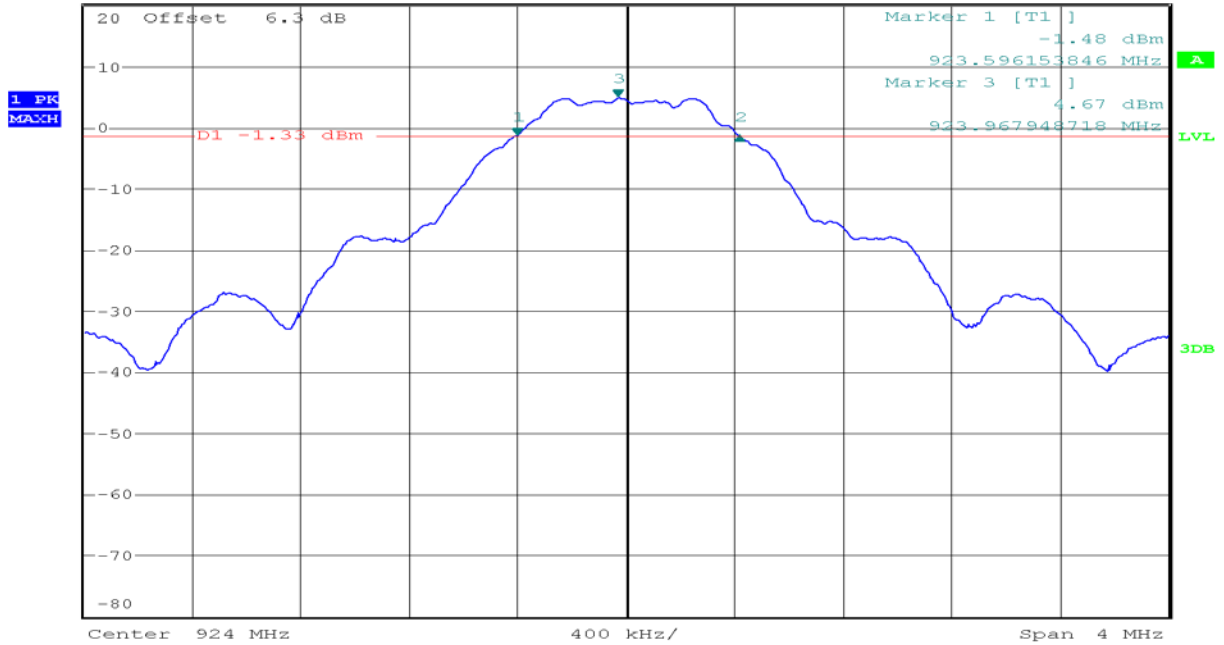
6dB Bandwidth (CH Mid)



6dB Bandwidth (CH High)



Ref 20 dBm * Att 20 dB * RBW 100 kHz Delta 2 [T1] 0.04 dB
 * VBW 300 kHz 820.512820512 kHz
 SWT 2.5 ms



7.2. PEAK POWER

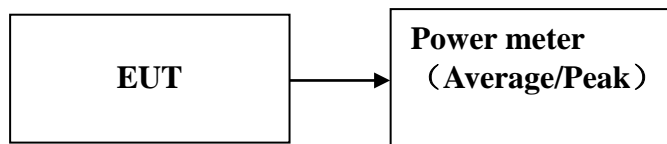
LIMIT

The maximum peak output power of the intentional radiator shall not exceed the following:

1. According to §15.247(b)(3), for systems using digital modulation in the bands of 902-928 MHz, and 2400-2483.5 MHz: 1 Watt.
2. According to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6dBi.

$$\text{Directional Gain} = G_{\text{ANT}} = 2.55 \text{dBi} < 6 \text{dBi}$$

Test Configuration



TEST PROCEDURE

1. The EUT transmitter output is connected to the Power meter.
The Power meter is set to the peak power detection.
2. The testing follows the Measurement Procedure FCC KDB No. 558074 D01 DTS Meas. Guidance v04. 9.1.3 PKPM1 Peak-reading power meter method.

TEST RESULTS

No non-compliance noted

Test Data

Channel	Frequency (MHz)	peak Output Power (dBm)	Limit (dBm)
Low	906	9.23	30
Mid	914	9.05	30
High	924	8.82	30

Channel	Frequency (MHz)	Average Output Power (dBm)
Low	906	9.01
Mid	914	8.79
High	924	8.51

Remark: Duty factor has been offset with cable loss

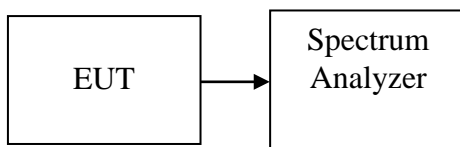
7.3. PEAK POWER SPECTRAL DENSITY

LIMIT

1. According to §15.247(e), 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.
2. According to §15.247(f), the digital modulation operation of the hybrid system, with the frequency hopping turned off, shall comply with the power density requirements of paragraph (d) of this section.

Directional Gain = $G_{ANT} = 2.55 \text{ dBi} < 6 \text{ dBi}$

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set the spectrum analyzer as RBW = 3 kHz, VBW = 10 kHz, Span = 1.5 times the DTS bandwidth, Sweep = auto
3. Record the max reading.
4. Repeat the above procedure until the measurements for all frequencies are completed.

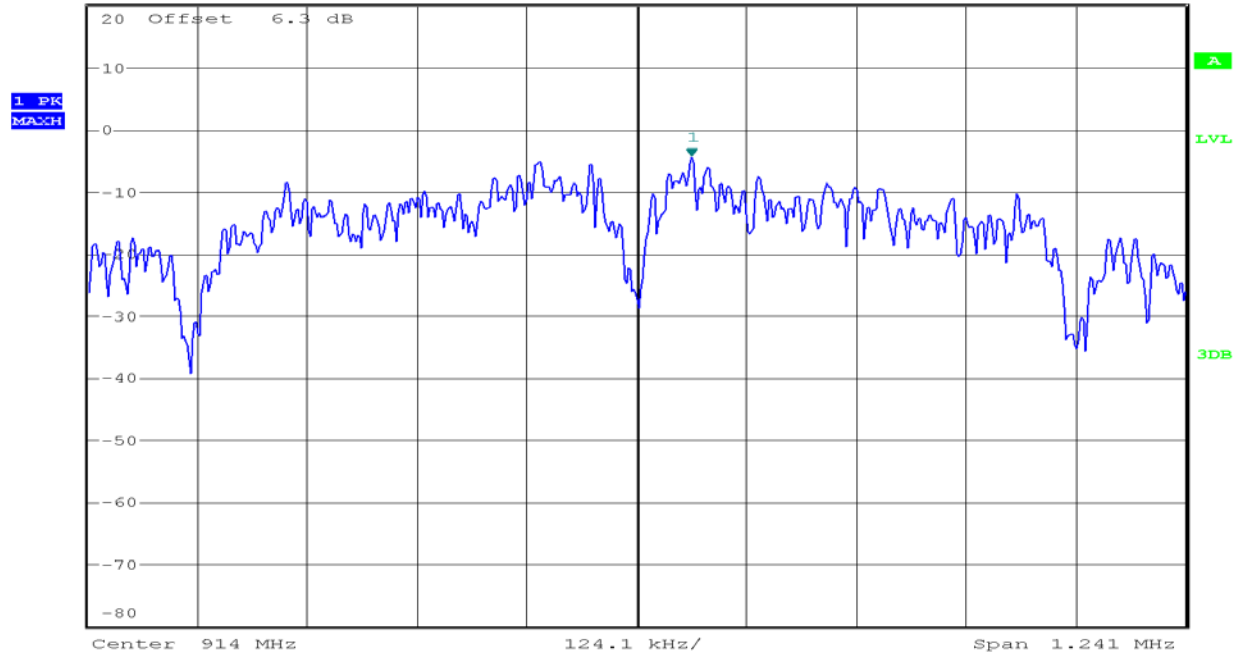
TEST RESULTS

No non-compliance noted

PPSD(CH Mid)



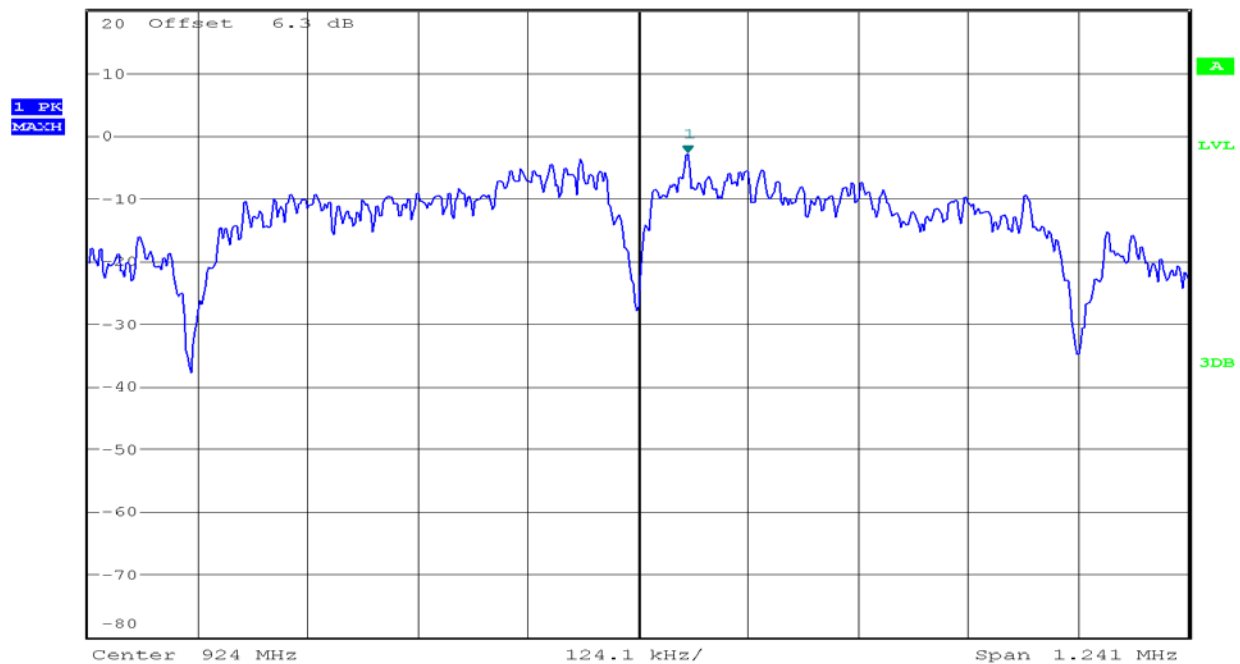
Ref 20 dBm *Att 20 dB *RBW 3 kHz Marker 1 [T1] -4.50 dBm
 *VBW 10 kHz SWT 140 ms 914.062050000 MHz



PPSD (CH High)



Ref 20 dBm *Att 20 dB *RBW 3 kHz Marker 1 [T1] -2.95 dBm
 *VBW 10 kHz SWT 140 ms 924.055845000 MHz



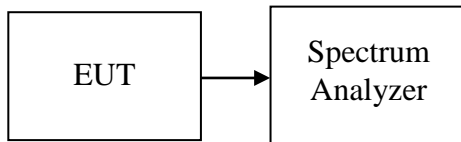
7.4.SPURIOUS EMISSIONS

Conducted Measurement

LIMIT

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)).

Test Configuration



TEST PROCEDURE

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

Measurements are made over the 30MHz to 10GHz range with the transmitter set to the lowest, middle, and highest channels.

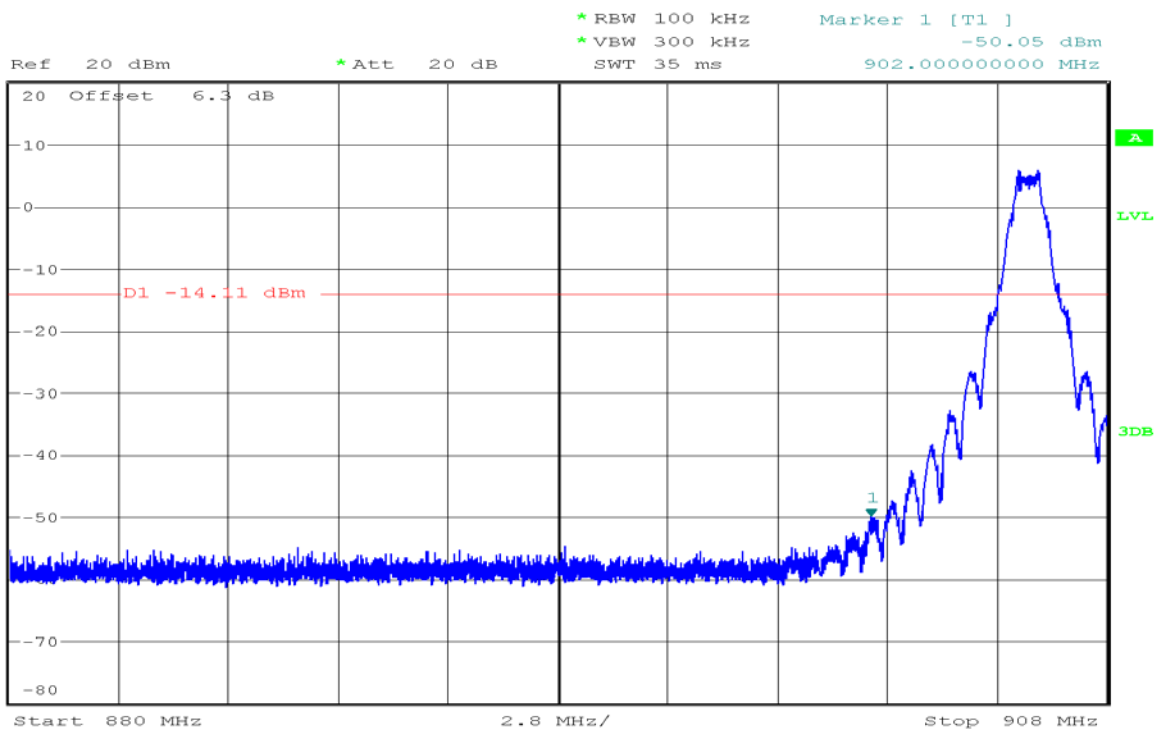
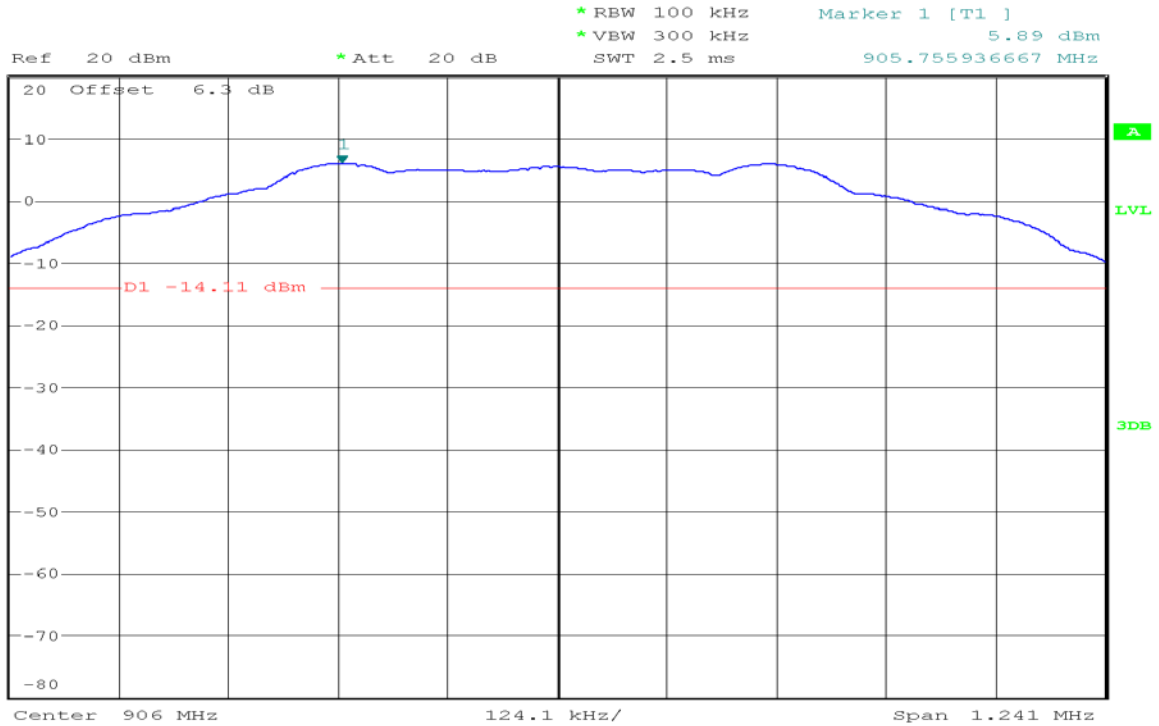
TEST RESULTS

No non-compliance noted

Test Plot

OUT-OF-BAND SPURIOUS EMISSIONS-CONDUCTED MEASUREMENT

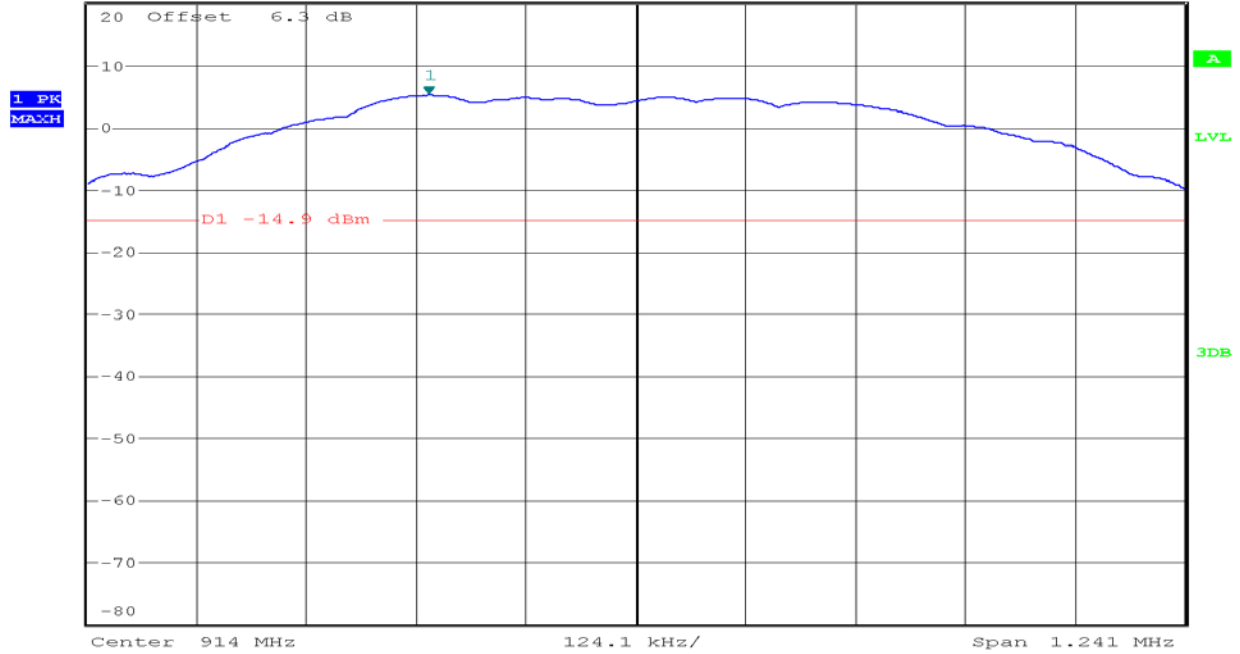
CH Low



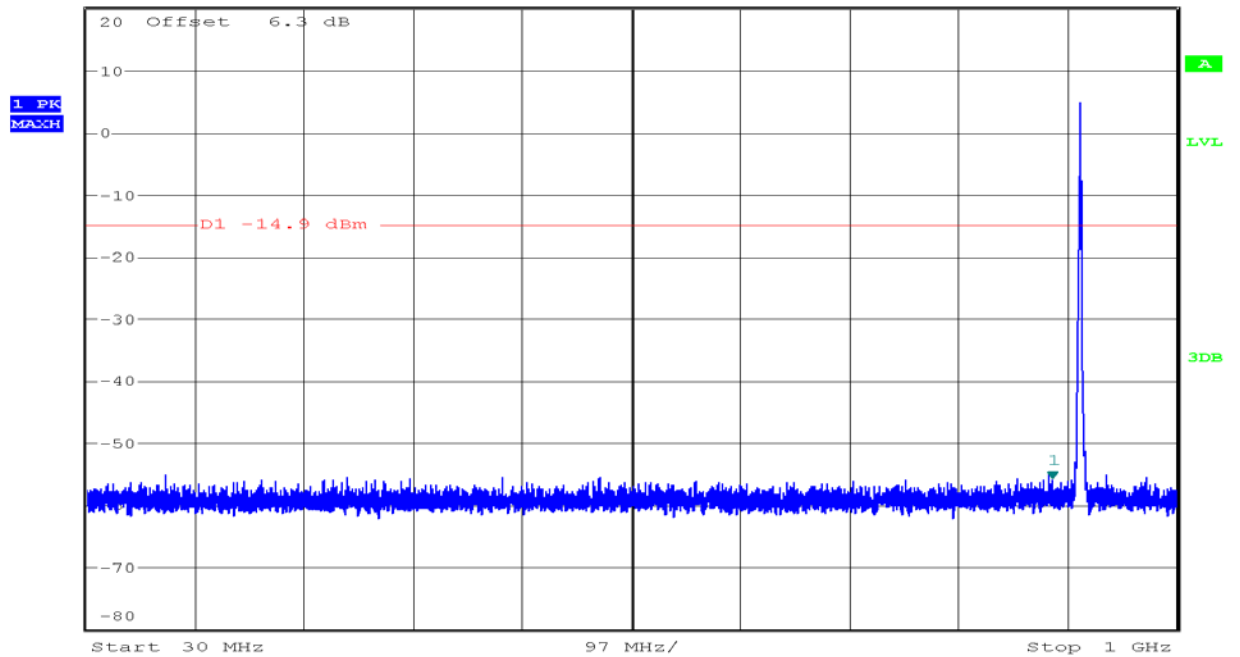
CH Mid



Ref 20 dBm *Att 20 dB *RBW 100 kHz Marker 1 [T1] 5.10 dBm
*VBW 300 kHz 913.766278333 MHz
SWT 2.5 ms

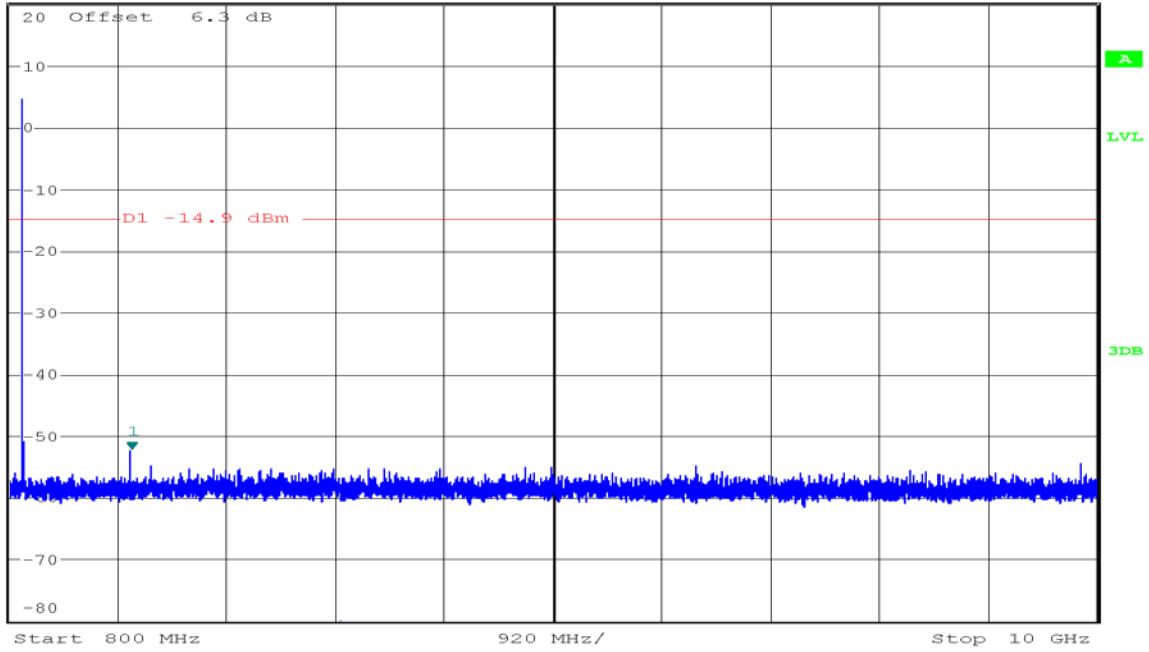


Ref 20 dBm *Att 20 dB *RBW 100 kHz Marker 1 [T1] -55.97 dBm
*VBW 300 kHz 889.514634146 MHz
SWT 100 ms





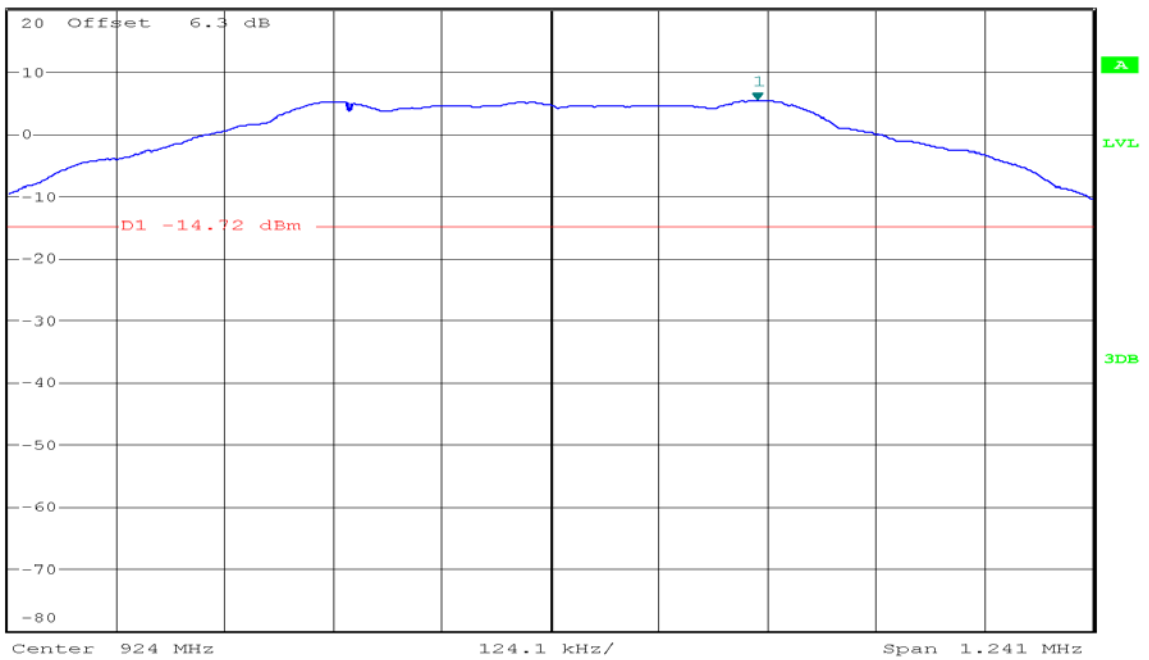
Ref 20 dBm * Att 20 dB * RBW 100 kHz Marker 1 [T1] -52.43 dBm
* VBW 300 kHz SWT 920 ms 1.827707317 GHz



CH High



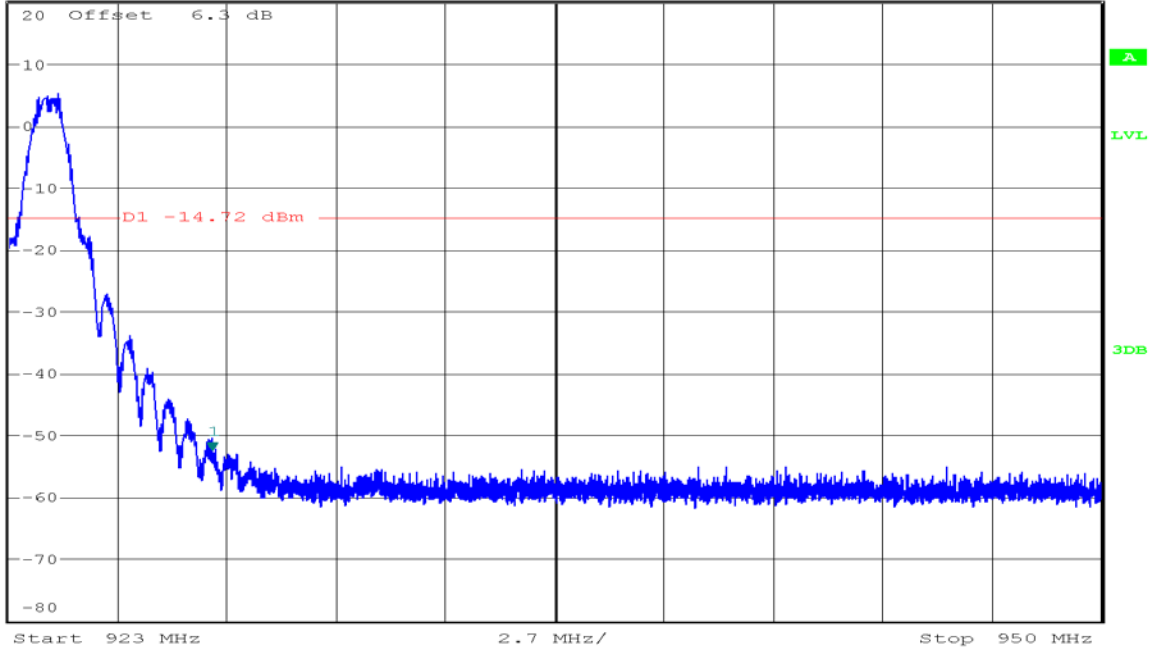
Ref 20 dBm * Att 20 dB * RBW 100 kHz Marker 1 [T1] 5.28 dBm
* VBW 300 kHz SWT 2.5 ms 924.236665064 MHz





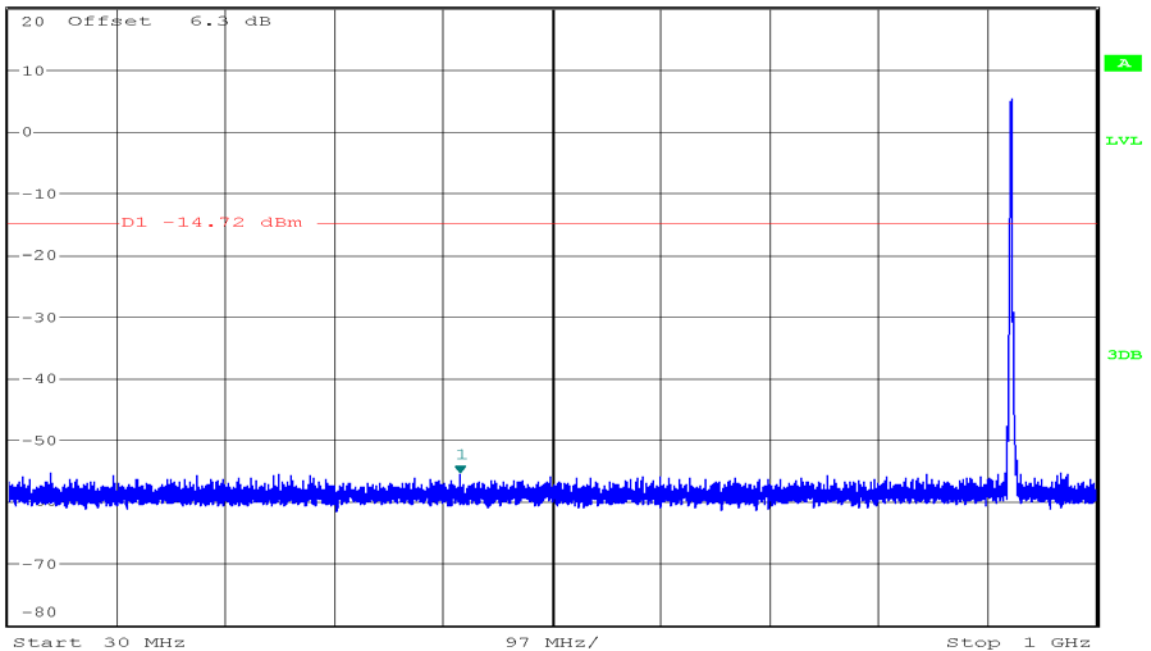
Ref 20 dBm * Att 20 dB * RBW 100 kHz Marker 1 [T1] -52.50 dBm
* VBW 300 kHz SWT 35 ms 928.000000000 MHz

1 PK
MAXH



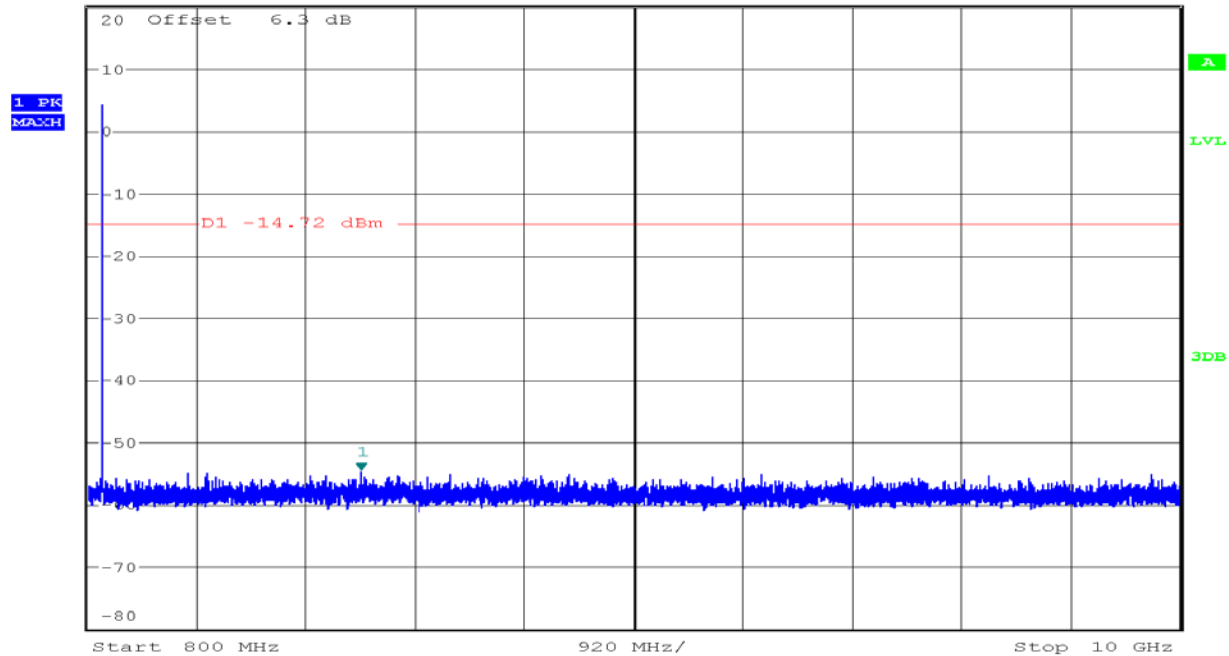
Ref 20 dBm * Att 20 dB * RBW 100 kHz Marker 1 [T1] -55.45 dBm
* VBW 300 kHz SWT 100 ms 432.786585366 MHz

1 PK
MAXH





Ref 20 dBm * Att 20 dB * RBW 100 kHz Marker 1 [T1] -54.63 dBm
* VBW 300 kHz SWT 920 ms 3.103365854 GHz



7.5. RADIATED EMISSIONS

LIMIT

Radiated emissions from 9 kHz to 10 GHz were measured according to the methods defines in ANSI C63.10-2013. The EUT was placed above the ground plane, 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz. The interface cables and equipment positions were varied within limits of reasonable applications to determine the positions producing maximum radiated emissions

1. 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:

FREQUENCIES(MHz)	FIELD STRENGTH (microvolts/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

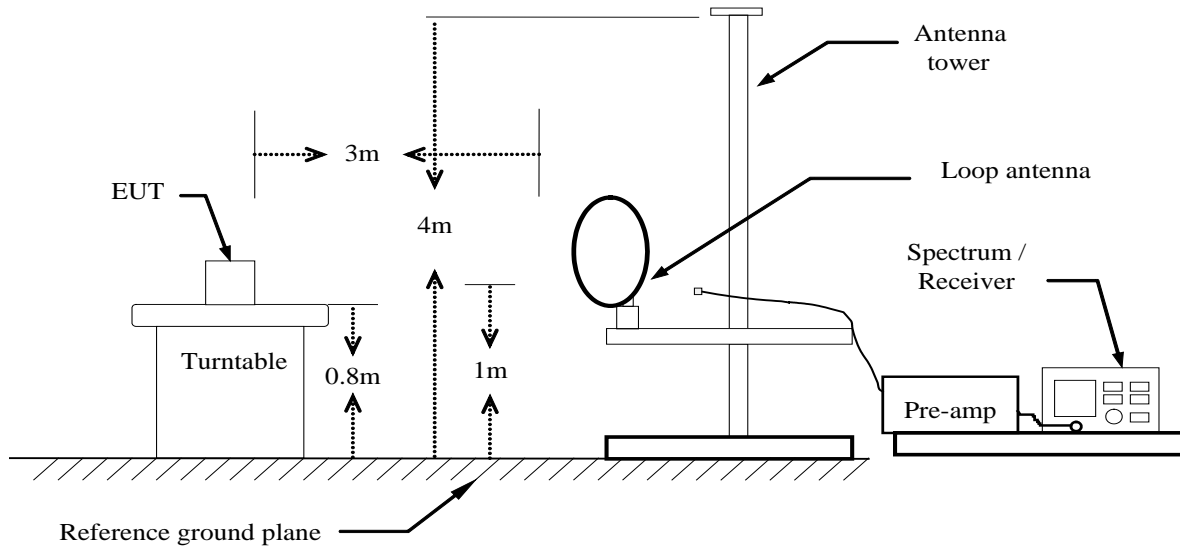
Remark: Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of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

2. In the emission table above, the tighter limit applies at the band edges.

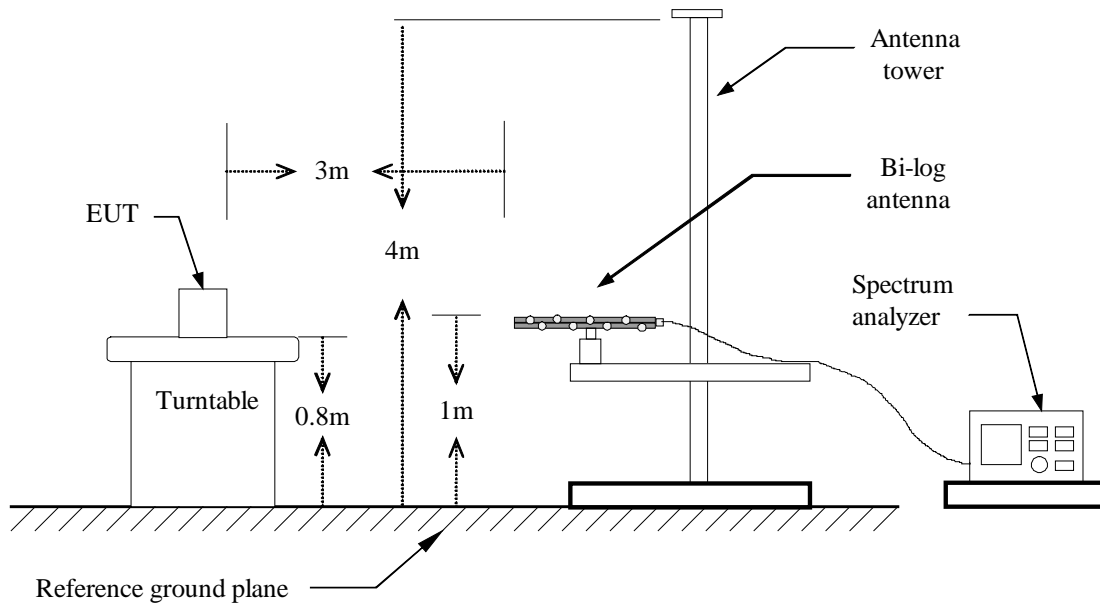
Frequency (MHz)	Field Strength (μ V/m at 3-meter)	Field Strength (dB μ V/m at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

Test Configuration

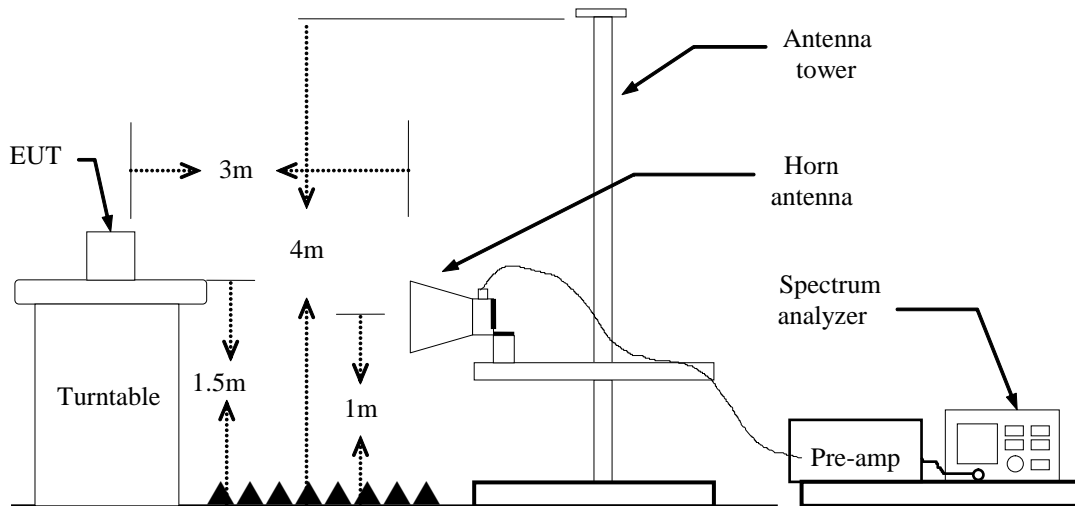
Below 30MHz



Below 1 GHz



Above 1 GHz



TEST PROCEDURE

1. The EUT is placed on a turntable above ground plane, which is 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz.
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:

PEAK: RBW=VBW=1MHz / Sweep=AUTO

AVERAGE: RBW=1MHz / Sweep=AUTO

VBW=10Hz,when duty cycle is no less than 98 percent.

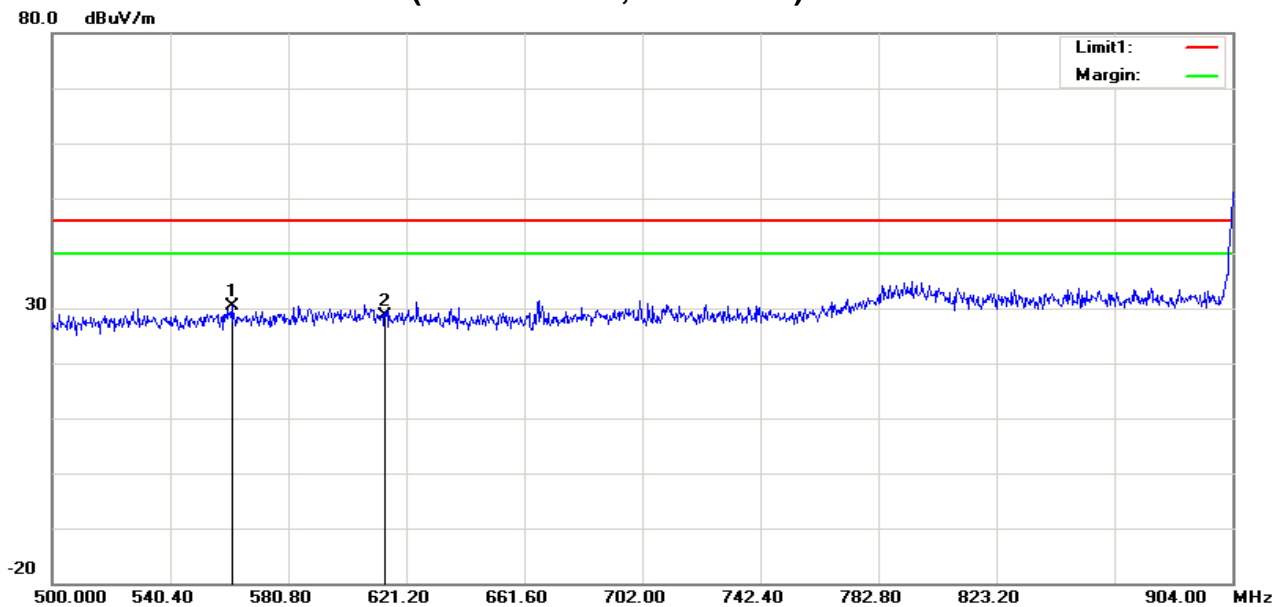
VBW $\geq 1/T$,when duty cycle is less than 98 percent,where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

Band	Duty Cycle(%)	T(s)	1/T(kHz)	VBW Setting
O-QPSK	100	-	-	10Hz

7. Repeat above procedures until the measurements for all frequencies are complete.

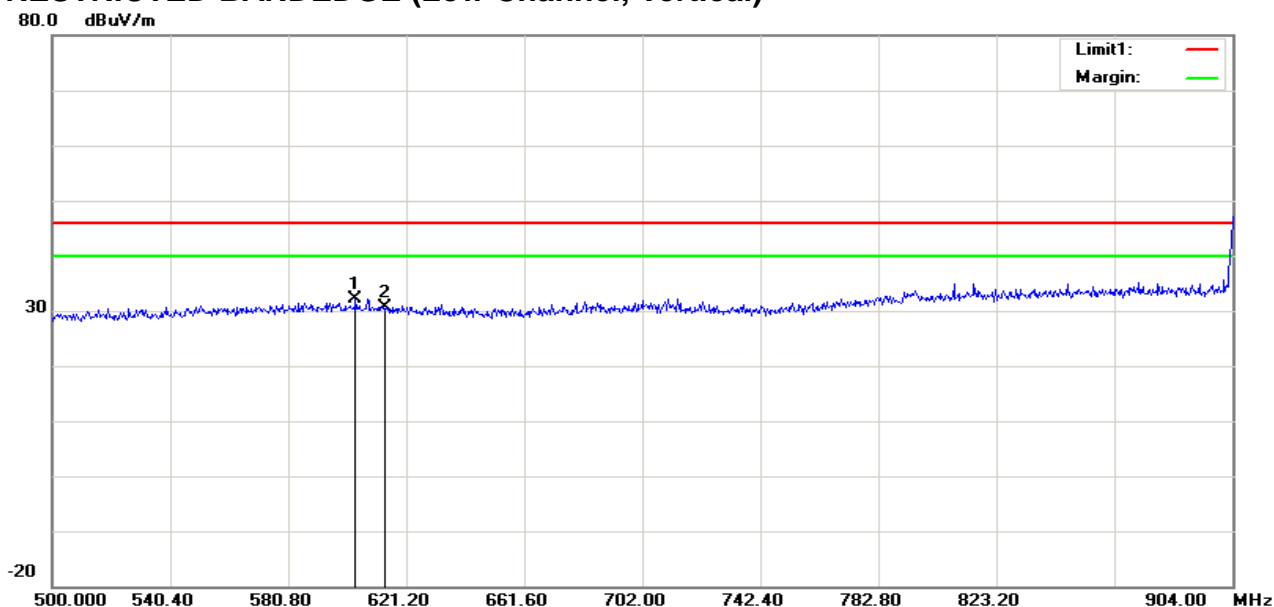
TEST RESULTS

RESTRICTED BANDEDGE (Low Channel, Horizontal)



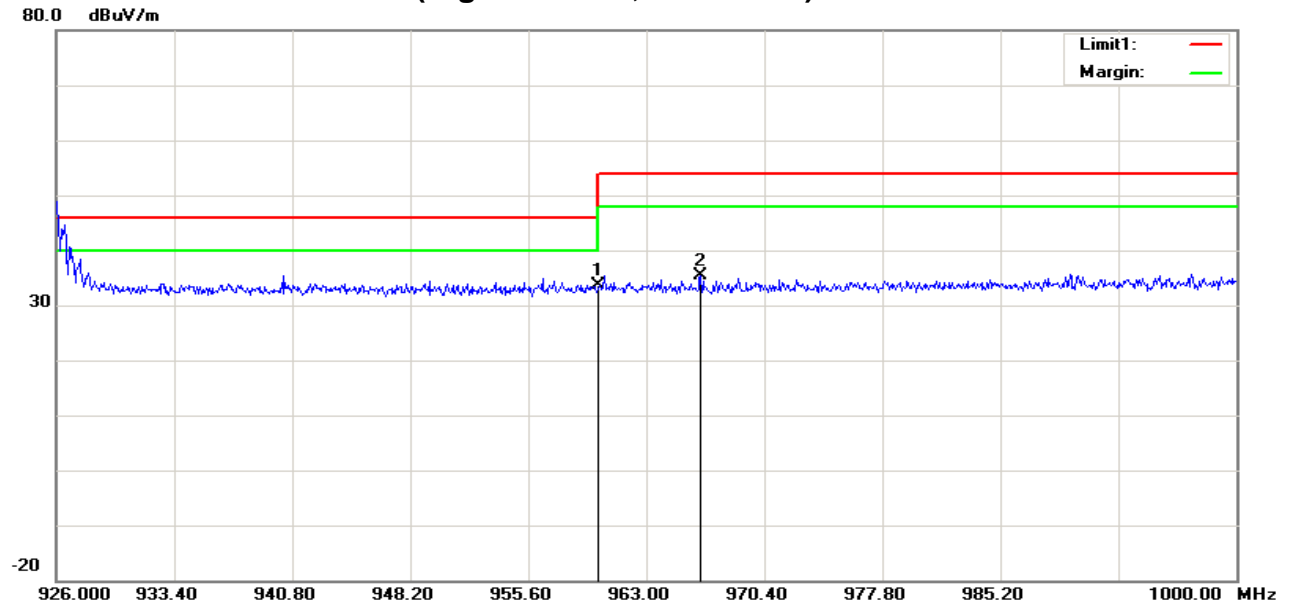
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	561.4080	5.08	25.40	30.48	46.00	-15.52	100	125	peak
2	614.0000	2.94	25.66	28.60	46.00	-17.40	100	360	peak

RESTRICTED BANDEDGE (Low Channel, Vertical)



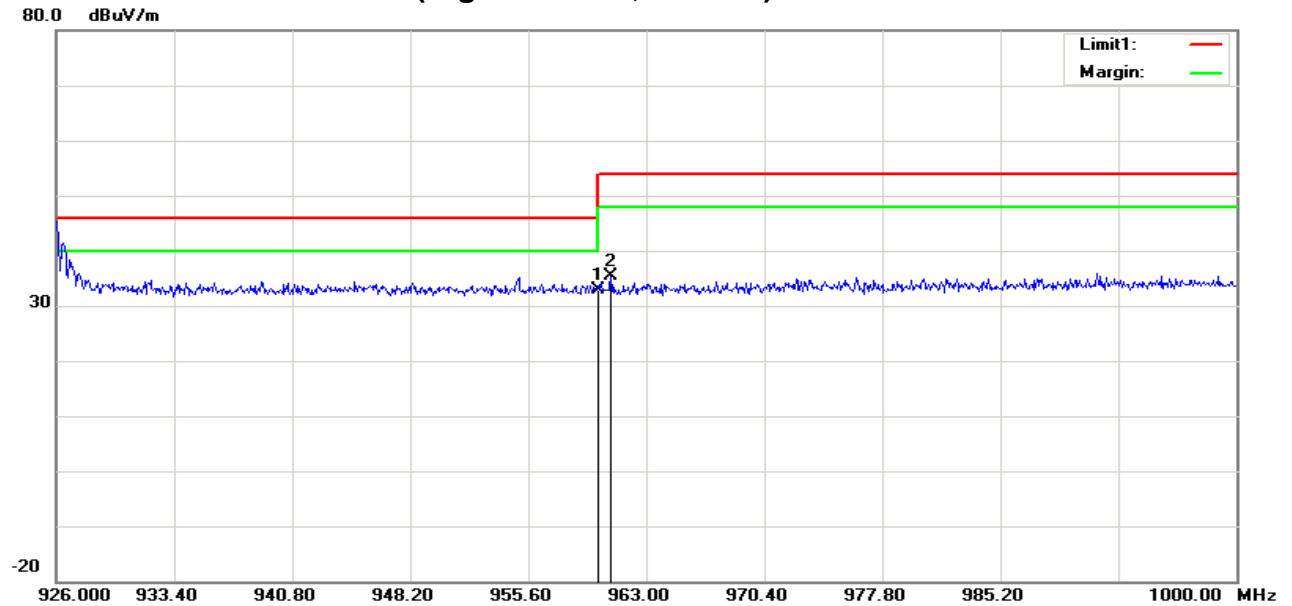
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	603.8280	6.28	25.88	32.16	46.00	-13.84	100	215	peak
2	614.0000	4.92	25.66	30.58	46.00	-15.42	100	36	peak

RESTRICTED BANDEDGE (High Channel, Horizontal)



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	960.0000	4.78	28.92	33.70	46.00	-12.30	100	260	peak
2	966.4040	6.40	29.09	35.49	54.00	-18.51	100	34	peak

RESTRICTED BANDEDGE (High Channel, Vertical)



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	960.0000	3.95	28.92	32.87	46.00	-13.13	100	221	peak
2	960.7800	6.46	28.94	35.40	54.00	-18.60	100	360	peak

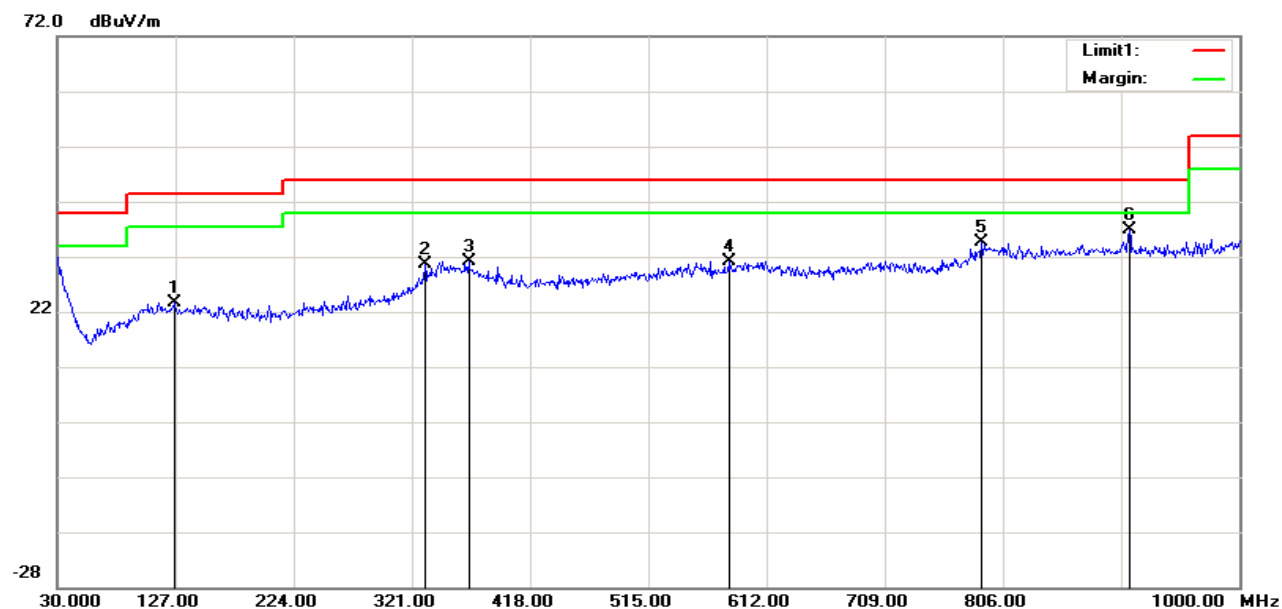
Test Result of Radiated Emission

Below 30MHz

The interference of the frequency value is lower than the limit below 20 db, measured as the background noise values and will not be recorded.

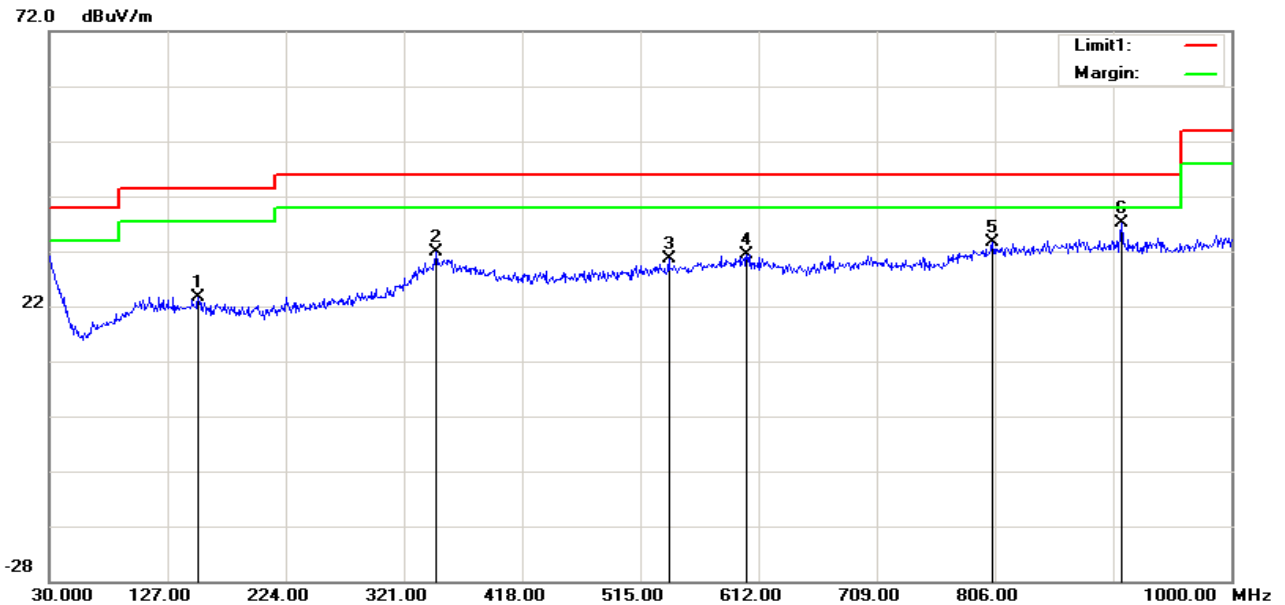
30MHz-1GHz

Operation Mode:	Low Channel	Test Date:	2018-9-20
Temperature:	25°C	Tested by:	Lily.Wang
Humidity:	48% RH	Polarity:	Hor.



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	126.0300	5.67	17.88	23.55	43.50	-19.95	100	206	peak
2	331.6700	6.61	24.06	30.67	46.00	-15.33	200	344	peak
3	367.5600	5.69	25.47	31.16	46.00	-14.84	200	85	peak
4	580.9600	5.48	25.68	31.16	46.00	-14.84	100	143	peak
5	788.5400	7.54	27.07	34.61	46.00	-11.39	100	347	peak
6	909.7900	7.86	28.91	36.77	46.00	-9.23	100	0	peak

Operation Mode:	Low Channel	Test Date:	2018-9-20
Temperature:	25°C	Tested by:	Lily.Wang
Humidity:	48% RH	Polarity:	Ver.

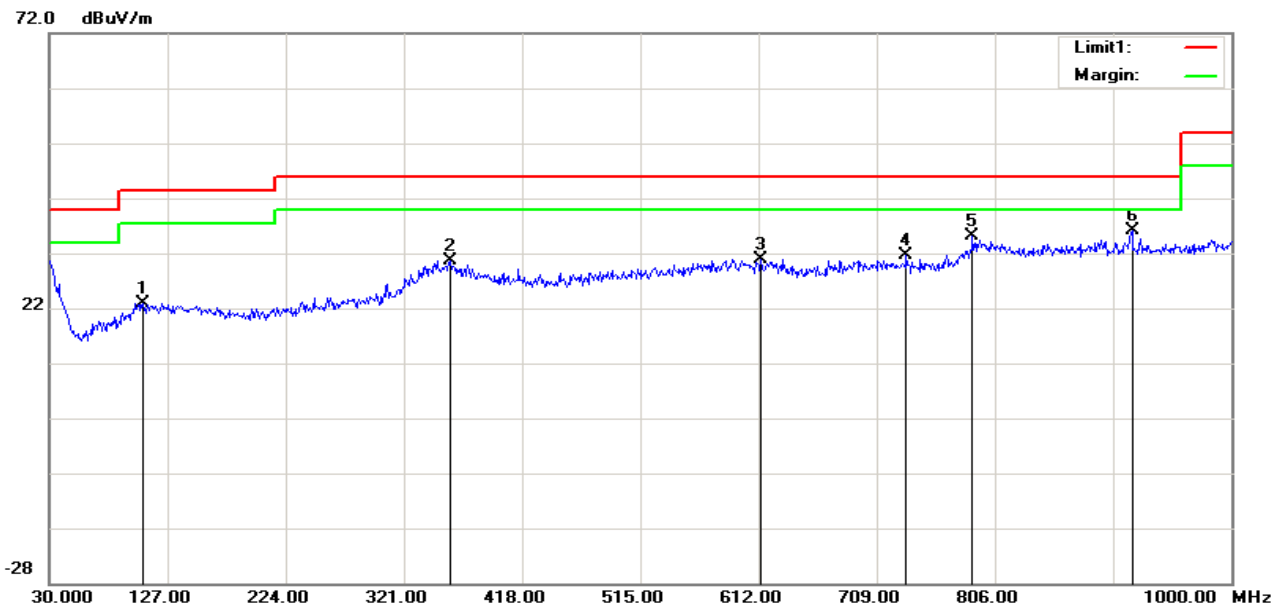


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	152.2200	5.90	17.81	23.71	43.50	-19.79	200	360	peak
2	347.1900	5.99	25.96	31.95	46.00	-14.05	100	360	peak
3	538.2800	5.62	25.05	30.67	46.00	-15.33	100	220	peak
4	602.3000	5.52	25.91	31.43	46.00	-14.57	100	165	peak
5	804.0600	5.98	27.65	33.63	46.00	-12.37	100	254	peak
6	909.7900	8.20	28.91	37.11	46.00	-8.89	100	360	peak

Remark:

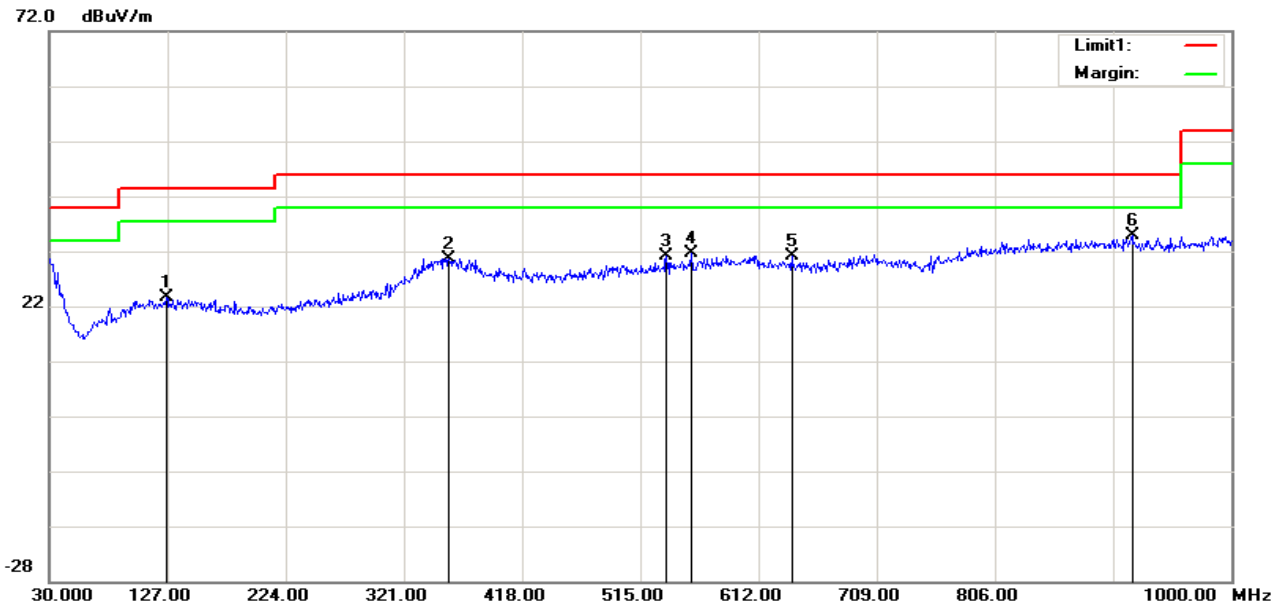
- 1.Measuring frequencies from 30 MHz to the 1GHz (No emission found between lowest internal used/generated frequency to 30 MHz).
- 2.Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.
- 3.Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
- 4.Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).

Operation Mode:	Mid Channel	Test Date:	2018-9-20
Temperature:	25°C	Tested by:	Lily.Wang
Humidity:	48% RH	Polarity:	Hor.



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	106.6300	5.00	17.92	22.92	43.50	-20.58	100	84	peak
2	358.8300	4.75	25.88	30.63	46.00	-15.37	100	0	peak
3	613.9400	5.24	25.66	30.90	46.00	-15.10	100	8	peak
4	733.2500	6.01	25.51	31.52	46.00	-14.48	100	328	peak
5	787.5700	8.18	27.03	35.21	46.00	-10.79	100	0	peak
6	918.5200	7.24	28.86	36.10	46.00	-9.90	100	221	peak

Operation Mode:	Mid Channel	Test Date:	2018-9-20
Temperature:	25°C	Tested by:	Lily.Wang
Humidity:	48% RH	Polarity:	Ver.

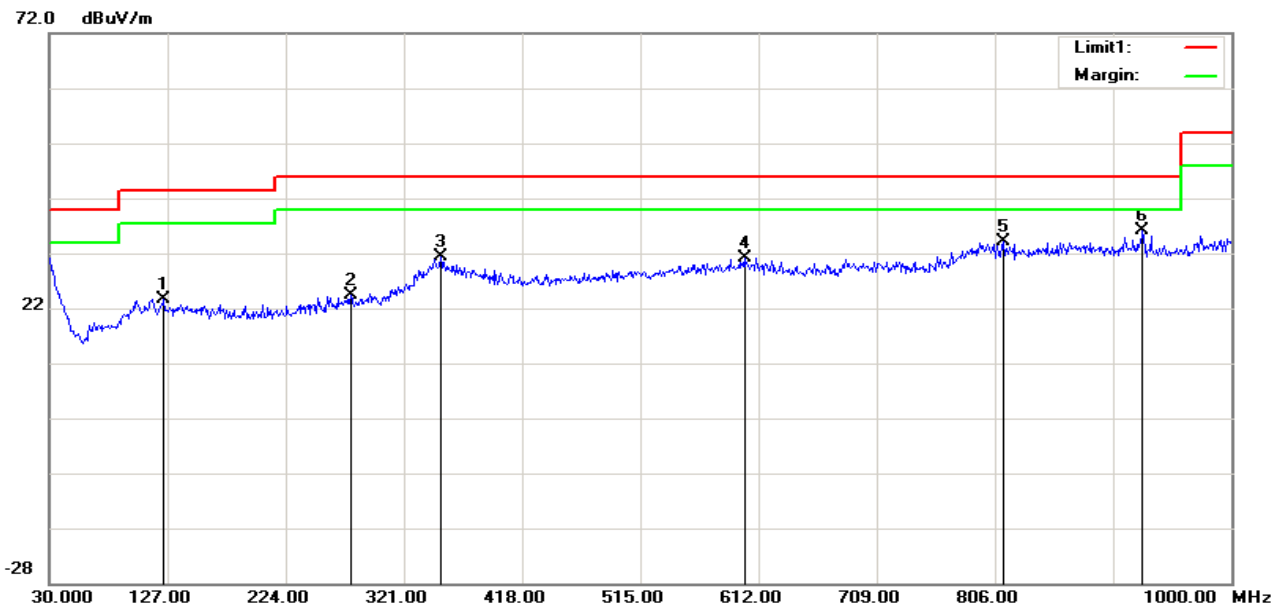


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	126.0300	5.82	17.88	23.70	43.50	-19.80	100	94	peak
2	357.8600	4.79	25.93	30.72	46.00	-15.28	200	198	peak
3	536.3400	6.12	25.02	31.14	46.00	-14.86	100	111	peak
4	556.7100	6.26	25.33	31.59	46.00	-14.41	200	360	peak
5	639.1600	6.07	25.11	31.18	46.00	-14.82	200	97	peak
6	918.5200	6.12	28.86	34.98	46.00	-11.02	200	343	peak

Remark:

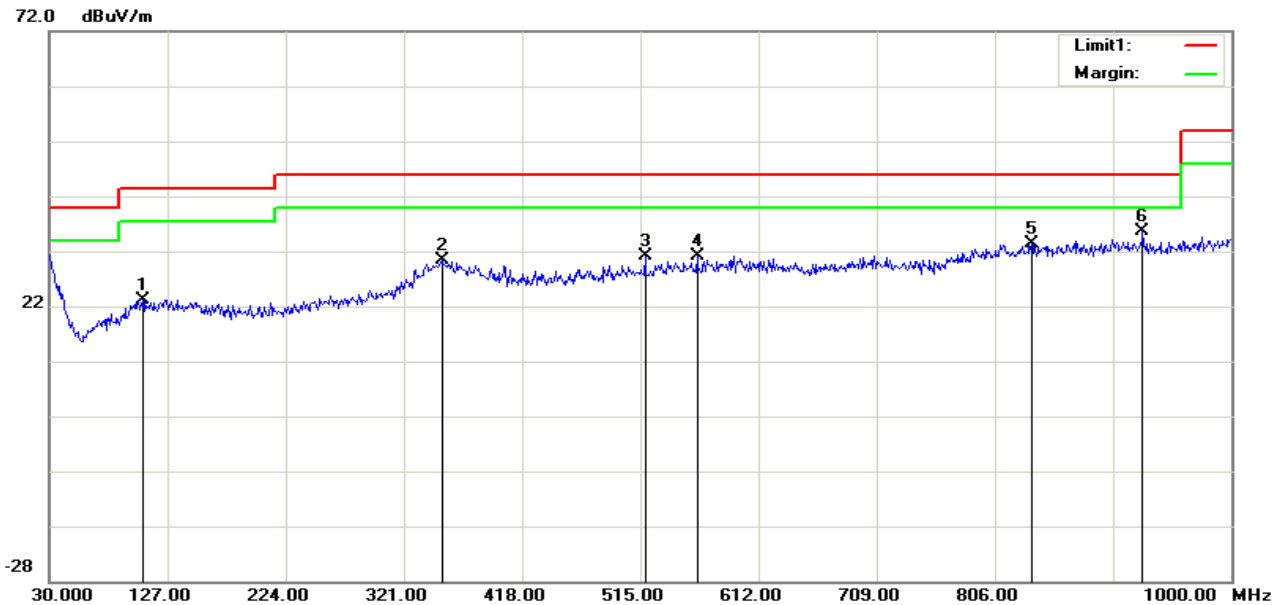
- 1.Measuring frequencies from 30 MHz to the 1GHz (No emission found between lowest internal used/generated frequency to 30 MHz).
- 2.Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.
- 3.Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
- 4.Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).

Operation Mode:	High Channel	Test Date:	2018-9-20
Temperature:	25°C	Tested by:	Lily.Wang
Humidity:	48% RH	Polarity:	Hor.



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	124.0900	5.74	17.89	23.63	43.50	-19.87	100	281	peak
2	277.3500	4.84	19.48	24.32	46.00	-21.68	100	174	peak
3	351.0700	5.12	26.25	31.37	46.00	-14.63	100	241	peak
4	600.3600	5.16	25.95	31.11	46.00	-14.89	100	0	peak
5	812.7900	6.23	27.81	34.04	46.00	-11.96	100	222	peak
6	927.2500	7.24	28.80	36.04	46.00	-9.96	100	48	peak

Operation Mode:	High Channel	Test Date:	2018-9-20
Temperature:	25°C	Tested by:	Lily.Wang
Humidity:	48% RH	Polarity:	Ver.



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	106.6300	5.21	17.92	23.13	43.50	-20.37	100	114	peak
2	352.0400	4.13	26.20	30.33	46.00	-15.67	100	354	peak
3	518.8800	6.38	24.76	31.14	46.00	-14.86	100	272	peak
4	561.5600	5.72	25.40	31.12	46.00	-14.88	100	307	peak
5	836.0700	5.14	28.23	33.37	46.00	-12.63	100	169	peak
6	927.2500	6.80	28.80	35.60	46.00	-10.40	100	351	peak

Remark:

1.Measuring frequencies from 30 MHz to the 1GHz (No emission found between lowest internal used/generated frequency to 30 MHz).

2.Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.

3.Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.

4.Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).

Above 1 GHz

Operation Mode: TX / CH Low

Test Date: 2018-9-20

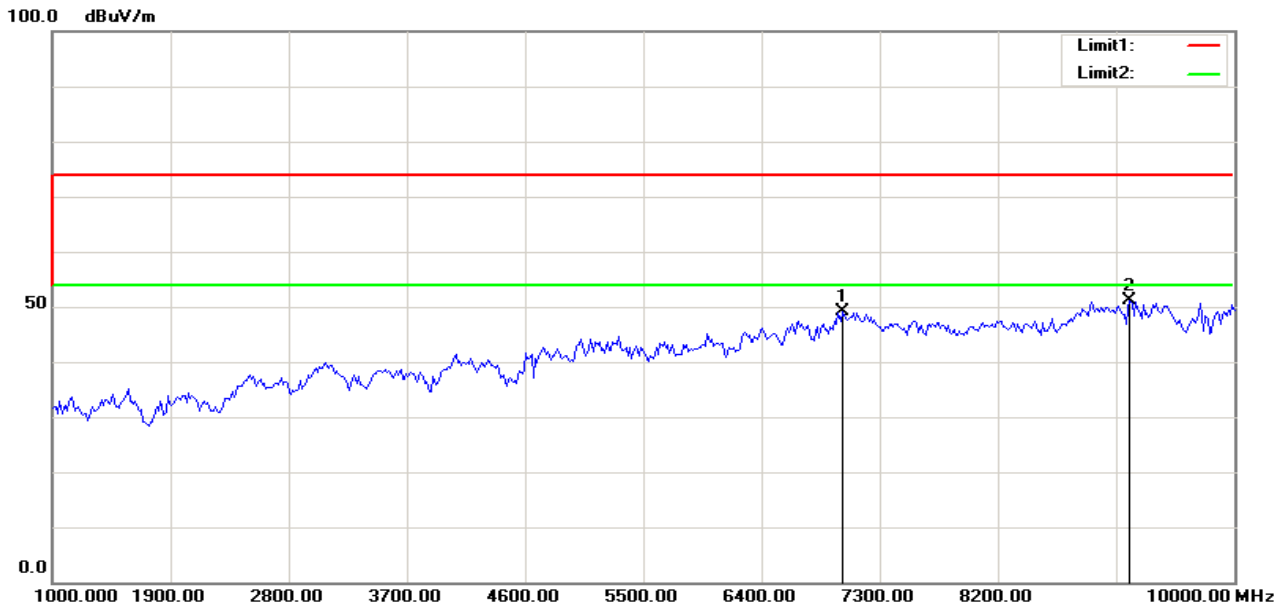
Temperature: 24°C

Tested by: Lily.Wang

Humidity: 48 % RH

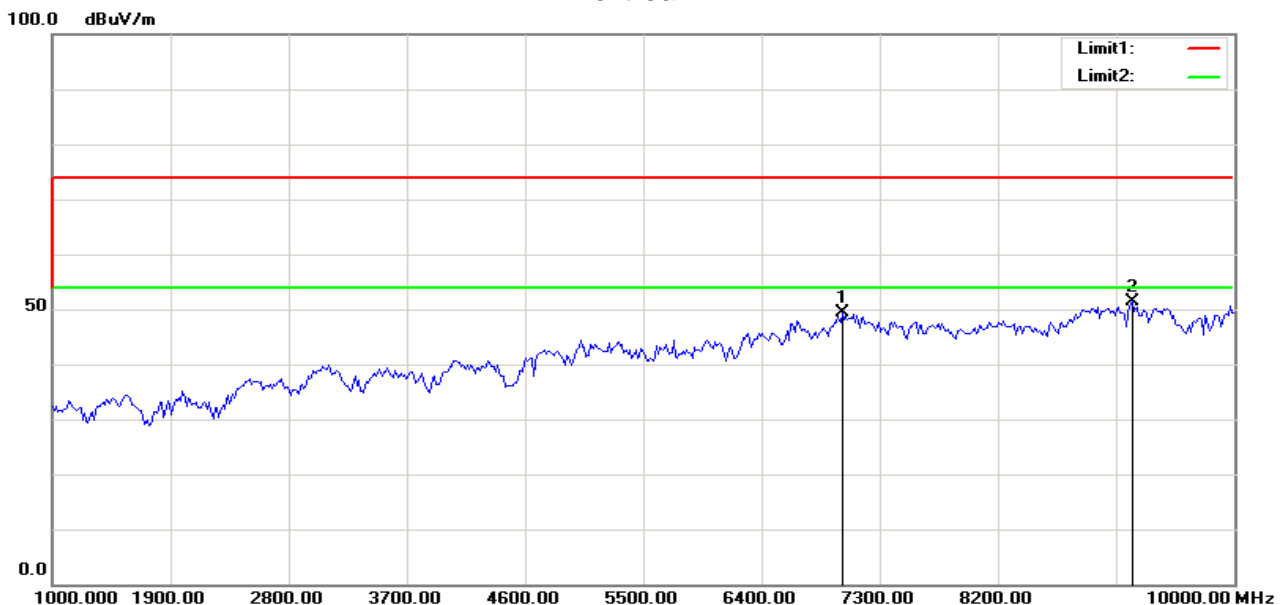
Polarity: Ver. / Hor.

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	7014.423	42.38	6.87	49.25	74.00	-24.75	100	171	peak
2	9206.731	41.98	9.04	51.02	74.00	-22.98	100	150	peak

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	7014.423	42.42	6.87	49.29	74.00	-24.71	100	61	peak
2	9221.154	42.46	9.04	51.50	74.00	-22.50	100	360	peak

Operation Mode: TX / CH Mid

Test Date: 2018-9-20

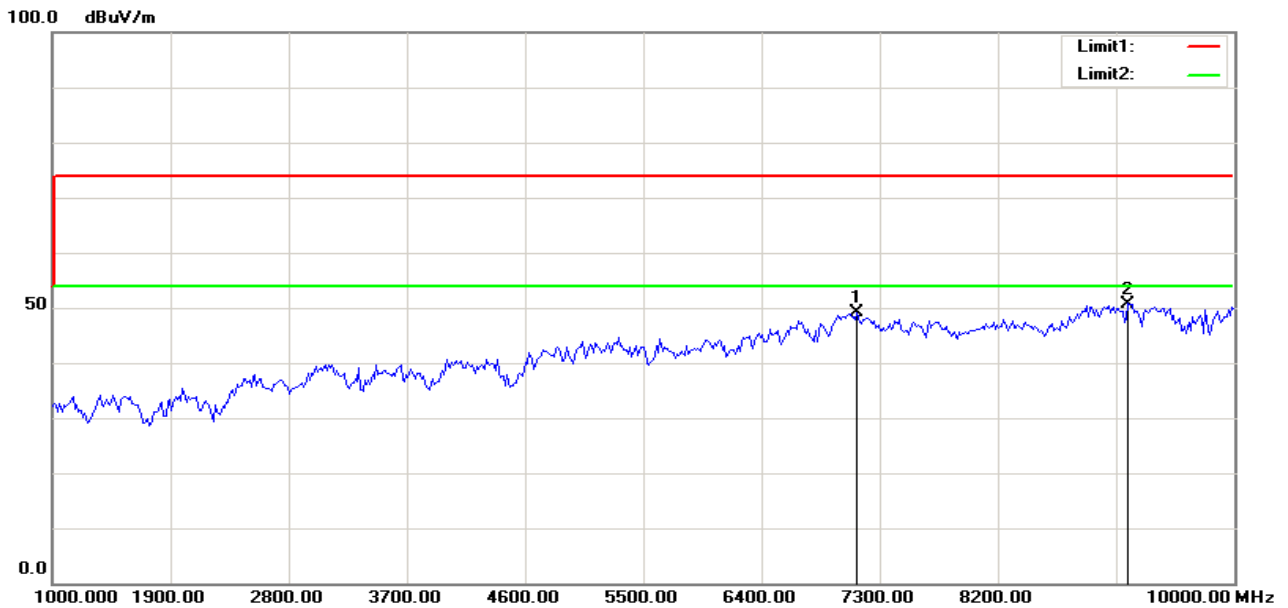
Temperature: 24°C

Tested by: Lily.Wang

Humidity: 48 % RH

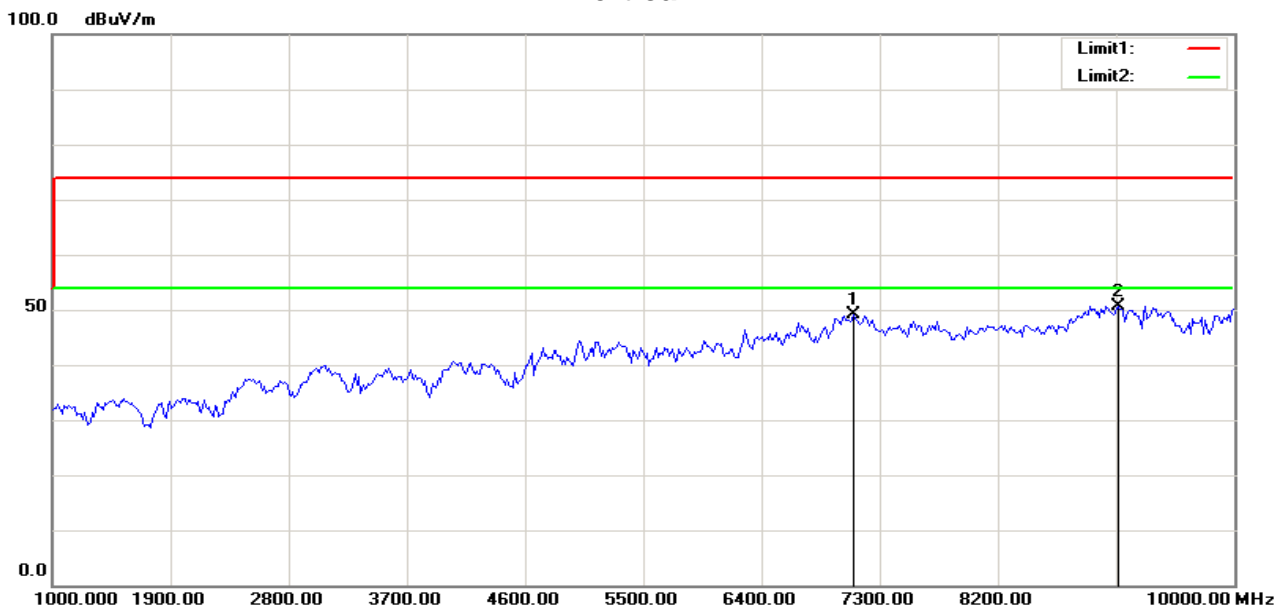
Polarity: Ver. / Hor.

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	7129.808	42.55	6.67	49.22	74.00	-24.78	200	76	peak
2	9192.308	41.71	9.04	50.75	74.00	-23.25	100	0	peak

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	7100.962	42.51	6.72	49.23	74.00	-24.77	100	0	peak
2	9120.192	41.67	9.03	50.70	74.00	-23.30	200	0	peak

Operation Mode: TX / CH High

Test Date: 2018-9-20

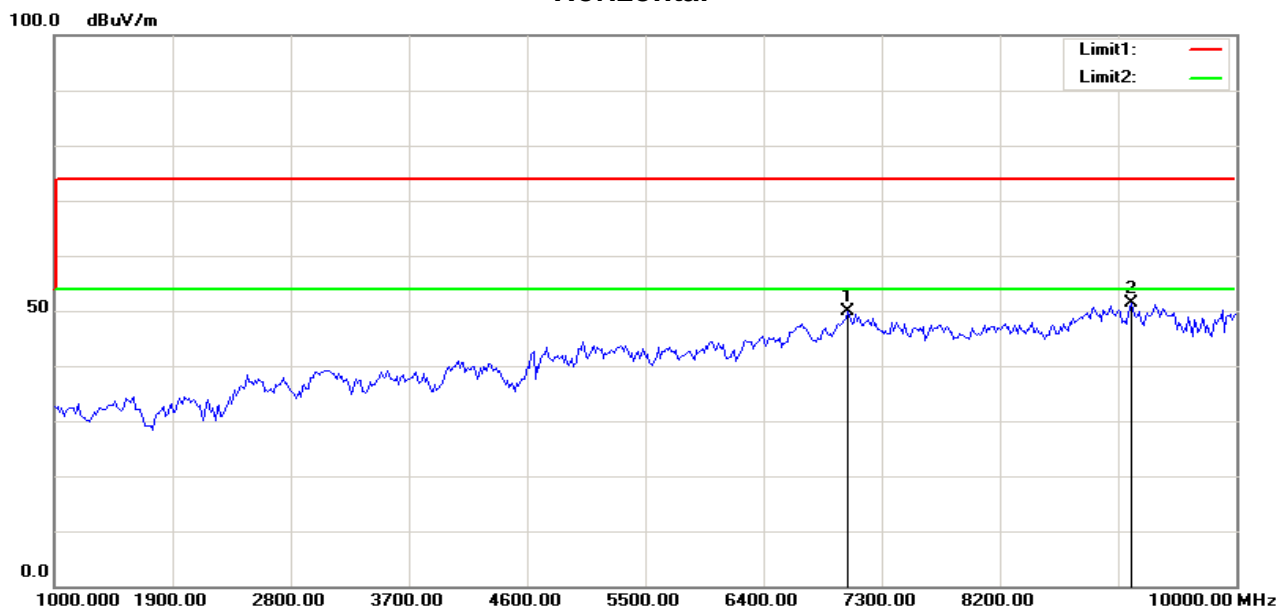
Temperature: 24°C

Tested by: Lily.Wang

Humidity: 48 % RH

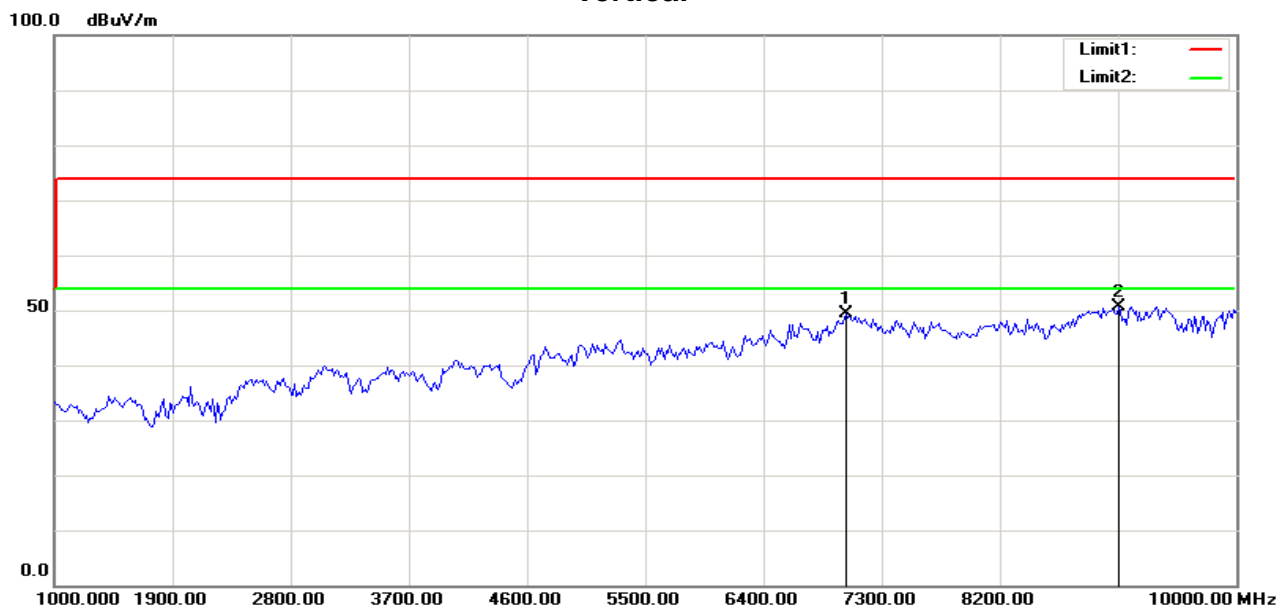
Polarity: Ver. / Hor.

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	7043.269	42.95	6.82	49.77	74.00	-24.23	200	360	peak
2	9206.731	42.46	9.04	51.50	74.00	-22.50	200	0	peak

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	7028.846	42.49	6.85	49.34	74.00	-24.66	100	0	peak
2	9105.769	41.59	9.03	50.62	74.00	-23.38	100	335	peak

7.6.POWERLINE CONDUCTED EMISSIONS

LIMIT

According to §15.207(a), except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency Range (MHz)	Limits (dB μ V)	
	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.

Test Configuration

See test photographs attached in Setup photo for the actual connections between EUT and support equipment.

TEST PROCEDURE

- 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.

TEST RESULTS

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

TEST DATA

Note: EUT is battery powered, test is not applicable.

END OF REPORT