FCC 47 CFR PART 15 SUBPART C

TEST REPORT

For

NFC Door Handle Sensor

Model No.:
DHS HMC NFC DL3, DHS HMC NFC MQ4

Trade Name: Continental

Issued to

Continental Automotive GmbH
Siemensstrasse 12 SV C TS RBG EMC-Laboratory
Regensburg, 93055 Germany

Issued by

Compliance Certification Services Inc.
Wugu Laboratory
No.11, Wugong 6th Rd., Wugu Dist.,
New Taipei City 24891, Taiwan. (R.O.C.)
Issued Date: November 29, 2019

Revision History

Rev.		Issue Date		Revisions	Effect Page	Revised By
00		November 20, 2019		Initial Issue	ALL	Allison Chen
01		November 29, 2019		See the following note Rev.(01)	P.5, P.7, P.13-14	Allison Chen

Rev.(01)

1. Modify Model Discrepancy in section 2、section 3.3、test results and test plot.

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1. TEST RESULT CERTIFICATION

Applicant:	Continental Automotive GmbH Siemensstrasse 12 SV C TS RBG EMC-Laboratory Regensburg, 93055 Germany
Manufacturer:	Continental Automotive GmbH Siemensstrasse 12 SV C TS RBG EMC-Laboratory Regensburg, 93055 Germany
Factory:	Continental Automotive Electronics LLC. 74-7, Geumhoseonmal-gil, Bugang-myeon, Sejong-si, 339-942, South Korea
Equipment Under Test:	NFC Door Handle Sensor
Trade Name:	Continental
Model No.:	DHS HMC NFC DL3, DHS HMC NFC MQ4
Date of Test:	October 1 ~ November 29, 2019

APPLICABLE STANDARDS	
STANDARD	**TEST RESULT**
FCC 47 CFR Part 15 Subpart C	No non-compliance noted
Statements of Conformity	
Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.	

We hereby certify that:

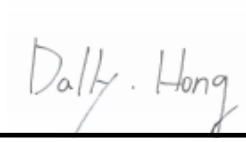
The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10: 2013 and the energy emitted by the sample tested as described in this report is in compliance with the requirements of FCC Rules Part 15.225.

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

Approved by:

Kevin Tsai
Deputy Manager
Compliance Certification Services Inc.

Tested by:



Dally Hong
Engineer
Compliance Certification Services Inc.

2. EUT DESCRIPTION

Product	NFC Door Handle Sensor
Model No.	DHS HMC NFC DL3, DHS HMC NFC MQ4
Model Discrepancy	The main differences between DHS HMC NFC DL3 and DHS HMC NFC MQ4 projects are mechanicals. Housing, cover, light guide are adapted to the Door handle shape (adaptation of the NFC foil design). They use the same PCB, software with few difference for tuning parameter (Capacitive and NFC).
Trade	Continental
Received Date	September 25, 2019
Power Supply	Power from power supply. (DC12V)
Frequency Range	13.56MHz
Modulation Technique	ASK
Number of Channels	1 Channel
Antenna Requirement	Antenna Brand: INPAQ Antenna model no.: Right version A2C19510600 / Left version A2C03261101 Antenna type: Antenna on Flex-PCB Antenna gain (max): -62.92dBi (DHS HMC NFC DL3) / -64.64dBi (DHS HMC NFC MQ4)

Remark:

1. *The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.*
2. *Left and right door handle is the same that we performed all the testing, the worst case was the right door handle of radiated emissions.*
3. *There are two models (DHS HMC NFC DL3, DHS HMC NFC MQ4). After verification, the worst case is DHS HMC NFC DL3, all tests were carried out with the worst case test modes as shown below.*

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10: 2013 and FCC CFR 47 Part 15.207, 15.209, 15.225.

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 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

(a) 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 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	([2])
13.36 - 13.41	322 - 335.4		

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2] Above 38.6

(b) 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.

3.3 DESCRIPTION OF TEST MODES

The EUT had been tested under engineering test mode condition and the EUT staying in continuous transmitting mode.

All modes and data rates were investigated and it was determined that ISO 14443A and ISO 18092 Type y, 106/212/424/848 kbps.

All data rates were investigated and it was determined that 106 Kbps was considered worst-case. Therefore, all testing was performed in 106 Kbps mode.

3.4.1 The worst mode of measurement

Radiated Emission Measurement Above 1G	
Test Condition	**Radiated Emission Above 1G**
Power supply Mode	**Mode 1: EUT power by Power supply (DC 12V)**
Worst Mode	☒ **Mode 1** ☐ **Mode 2** ☐ **Mode 3** ☐ **Mode 4**
Worst Position	☐ **Placed in fixed position.** ☐ **Placed in fixed position at X-Plane (E2-Plane)** ☒ **Placed in fixed position at Y-Plane (E1-Plane)** ☐ **Placed in fixed position at Z-Plane (H-Plane)**

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

Remark:
1. The worst mode was record in this test report.
2. EUT pre-scanned in three axis ,X,Y, Z for radiated measurement. The worst case(Y-Plane) were recorded in this report

4. TEST SUMMARY

FCC Standard Sec.	Chapter	Test Item	Result
15.203	2	Antenna Requirement	Pass
15.215	8.1	Occupied Bandwidth (99%) and 20dB Bandwidth	Pass
15.209	8.2	Radiated Emissions	Pass
15.225	8.3	Frequency Stability	Pass
15.207	8.4	AC Power-line Conducted Emission	N/A

5. INSTRUMENT CALIBRATION

5.1 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.

5.2 MEASUREMENT EQUIPMENT USED

Equipment Used for Emissions Measurement

Conducted Emissions Test Site					
Name of Equipment	**Manufacturer**	**Model**	**S/N**	**Calibration Date**	**Calibration Due**
Coaxial Cable	Woken	WC12	CC003	06/28/2019	06/27/2020
Signal Analyzer	R&S	FSV 40	101073	09/25/2019	09/24/2020
Thermostatic/Humidity Chamber	GWINSTEK	GTC-288MH-CC	TH160402	05/16/2019	05/15/2020
Software	N/A				

Wugu 966 Chamber A					
Name of Equipment	**Manufacturer**	**Model**	**S/N**	**Calibration Date**	**Calibration Due**
Bilog Antenna	Sunol Sciences	JB3	A030105	07/26/2019	07/25/2020
Cable	HUBER SUHNER	SUCOFLEX 104PEA	20995	02/26/2019	02/25/2020
Digital Thermo-Hygro Meter	WISEWIND	1206	D07	01/30/2019	01/29/2020
Loop Ant	COM-POWER	AL-130	121051	03/22/2019	03/21/2020
Pre-Amplifier	EMEC	EM330	060609	02/26/2019	02/25/2020
PSA Series Spectrum Analyzer	Agilent	E4446A	MY46180323	05/29/2019	05/28/2020
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R
Software	e3 6.11-20180413				

AC Conducted Emissions Test Site					
Name of Equipment	**Manufacturer**	**Model**	**S/N**	**Calibration Date**	**Calibration Due**
N/A					

Remark: *Each piece of equipment is scheduled for calibration once a year*

5.3 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	+/- 1.2575
Emission bandwidth, 20dB bandwidth	+/- 0.0014
RF output power, conducted	+/- 1.14
Power density, conducted	+/- 1.40
3M Semi Anechoic Chamber / 30M~200M	+/- 4.12
3M Semi Anechoic Chamber / 200M~1000M	+/- 4.68
3M Semi Anechoic Chamber / 1G~8G	+/- 5.18
3M Semi Anechoic Chamber / 8G~18G	+/- 5.47
3M Semi Anechoic Chamber / 18G~26G	+/- 3.81
3M Semi Anechoic Chamber / 26G~40G	+/- 3.87

Remark:
1.This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2
2. ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report.

6. FACILITIES AND ACCREDITATIONS

6.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

☐ No.199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.
Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029

☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.)
Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045

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

6.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, bucolical, 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.”

7. SETUP OF EQUIPMENT UNDER TEST

7.1 SETUP CONFIGURATION OF EUT

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

7.2 SUPPORT EQUIPMENT

No.	Device Type	Brand	Model	Series No.	FCC ID	Cable length & Type Describe
	N/A					

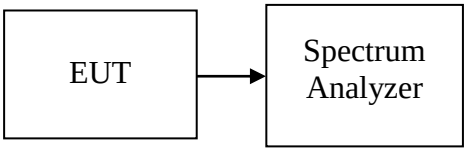
Remark:

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.*

8. FCC PART 15.225 REQUIREMENTS

8.1 OCCUPIED BANDWIDTH (99%) AND 20 dB BANDWIDTH

TEST CONFIGURATION



TEST PROCEDURE

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW=10kHz, VBW = 30kHz, Span = 5MHz, Sweep = auto.
4. Record the max. reading.

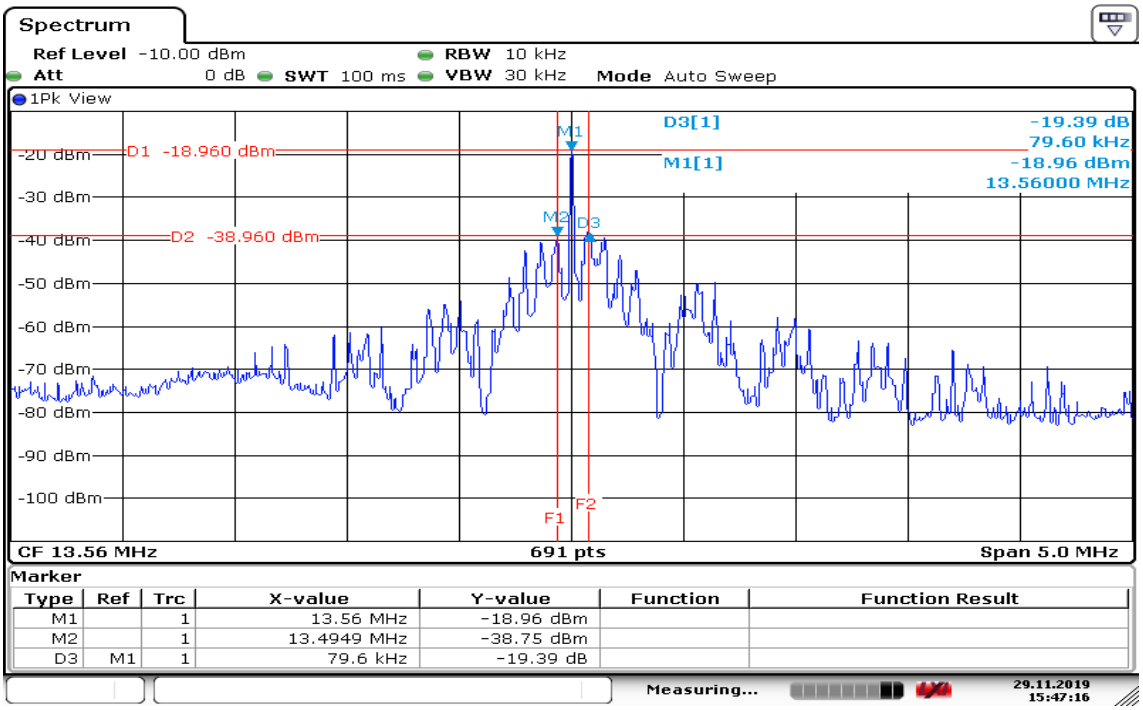
TEST RESULTS

No non-compliance noted

Test Condition	Frequency(MHz)	Occupied Bandwidth 99% (kHz)	20 dB Bandwidth (kHz)
NFC	13.56	492.0405	79.6

Test Plot

20dB Bandwidth



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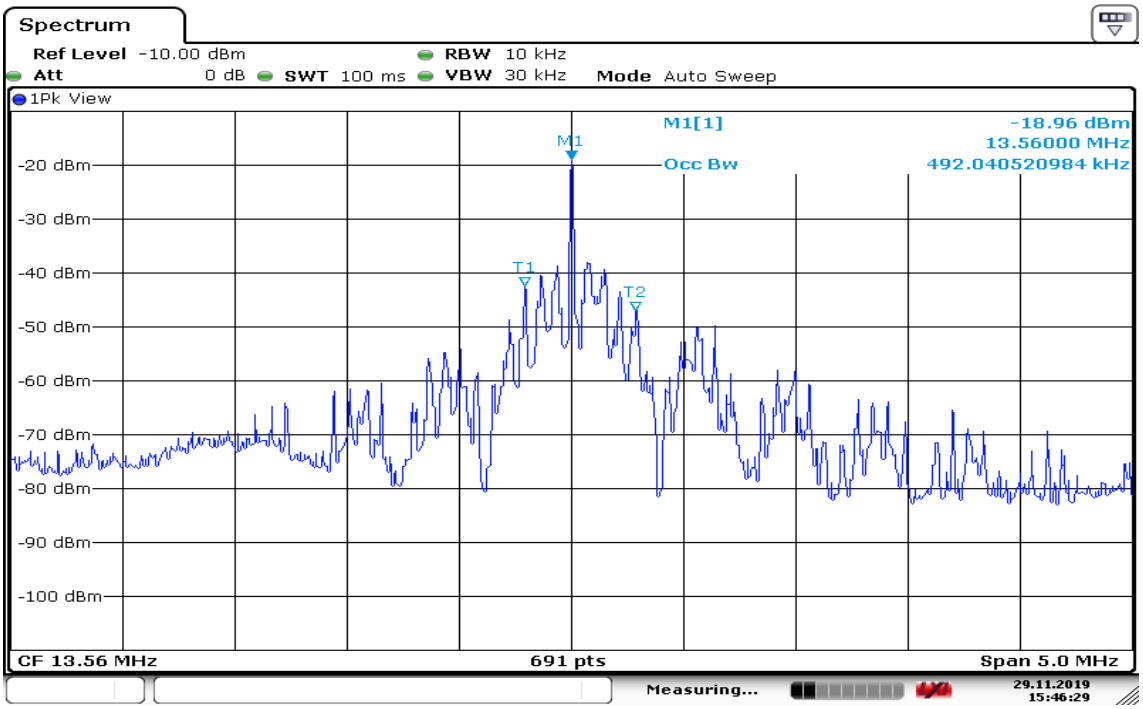
99% Bandwidth



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8.2 RADIATED EMISSIONS

LIMIT

According to §15.225

(a) The field strength of any emissions within the band 13.553 – 13.567 MHz shall not exceed 15,848 microvolts / meter at 30 meters.
(b) Within the bands 13.410 – 13.553 MHz and 13.567 -13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts / meter at 30 meters.
(c) Within the bands 13.110 – 13.410 MHz and 13.710 – 14.010 MHz the field strength of any emissions shall not exceed 106 microvolts / meter at 30 meters.
(d) The field strength of any emissions appearing outside of the 13.110 – 14.010 MHz and shall not exceed the general radiated emission limits in §15.209.

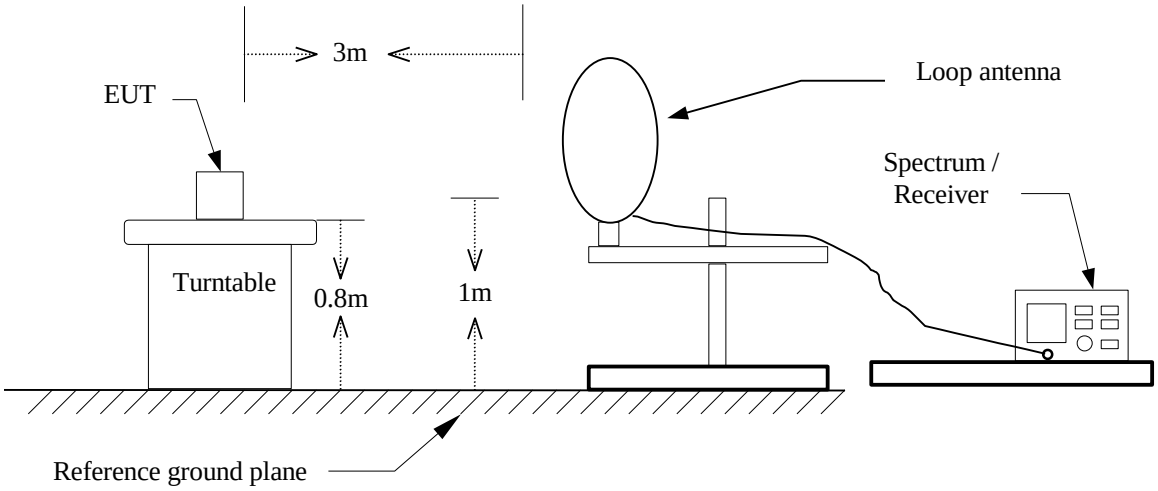
According to §15.225, except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m at meter)	Measurement Distance (meter)
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

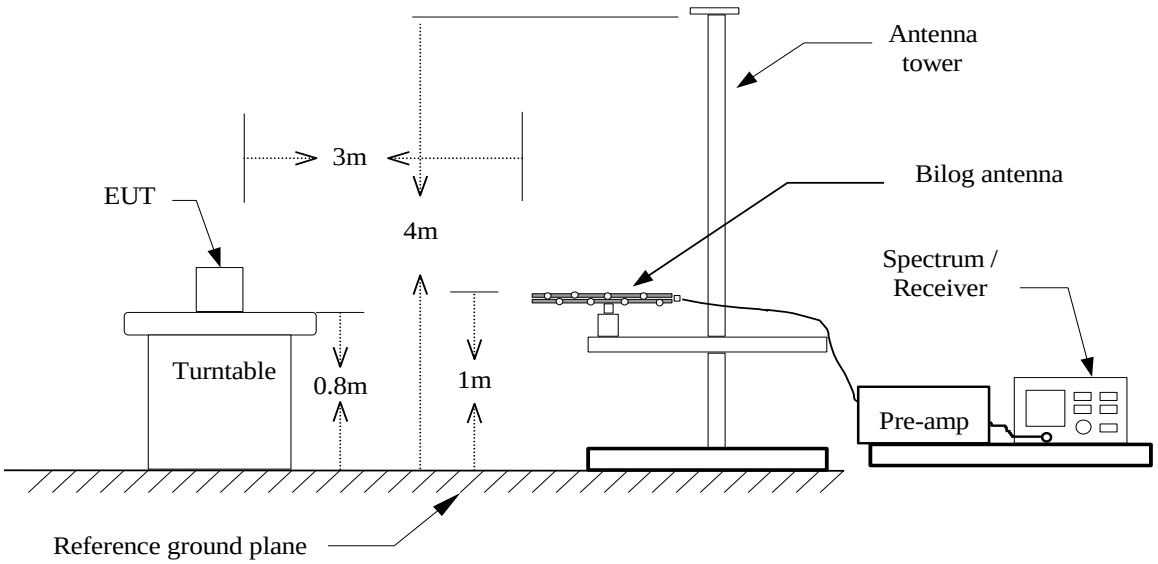
*** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this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

Test Configuration

9kHz ~ 30MHz



30MHz ~ 1GHz



TEST PROCEDURE

For 9kHz ~ 30MHz

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, The center of the loop shall be 1 m above the ground then to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. Set the spectrum analyzer in the following setting as:
   9KHz-490KHz : RBW=200Hz / VBW=1kHz / Sweep=AUTO
   490KHz-30MHz : RBW=10kHz / VBW=30kHz / Sweep=AUTO
6. Repeat above procedures until the measurements for all frequencies are complete.

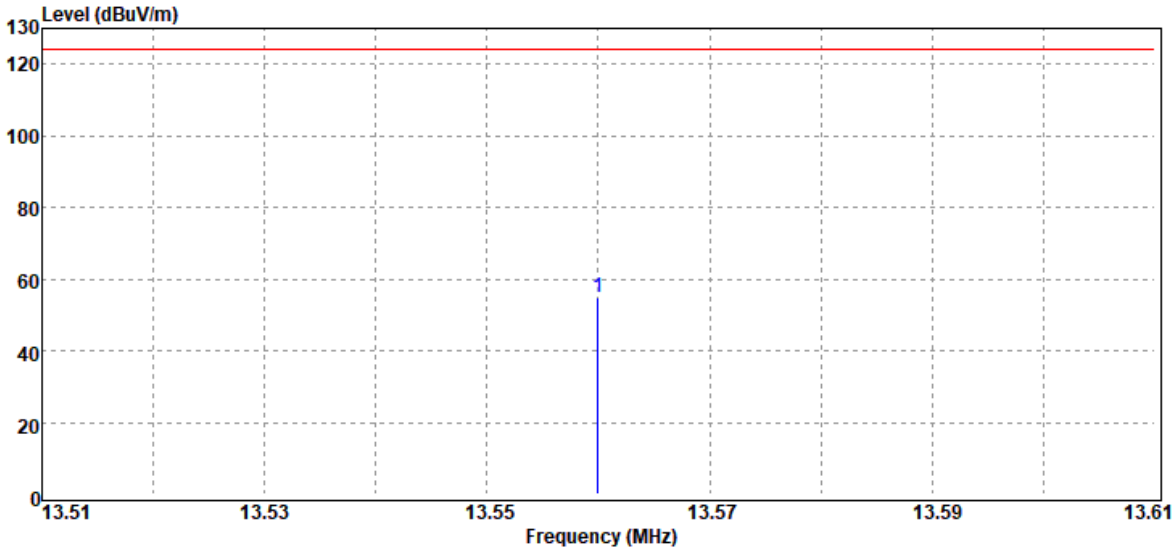
For 30MHz ~ 1GHz

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 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:
   RBW=100kHz / VBW=300kHz / Sweep=AUTO
7. Repeat above procedures until the measurements for all frequencies are complete.

Remark :
Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

For Right door handle (The worst case)

Operation Mode:	TX mode	**Test Date:**	October 3, 2019
Temperature:	27.6℃	**Tested by:**	Dally Hong
Humidity:	58% RH	**Polarity:**	Ver.

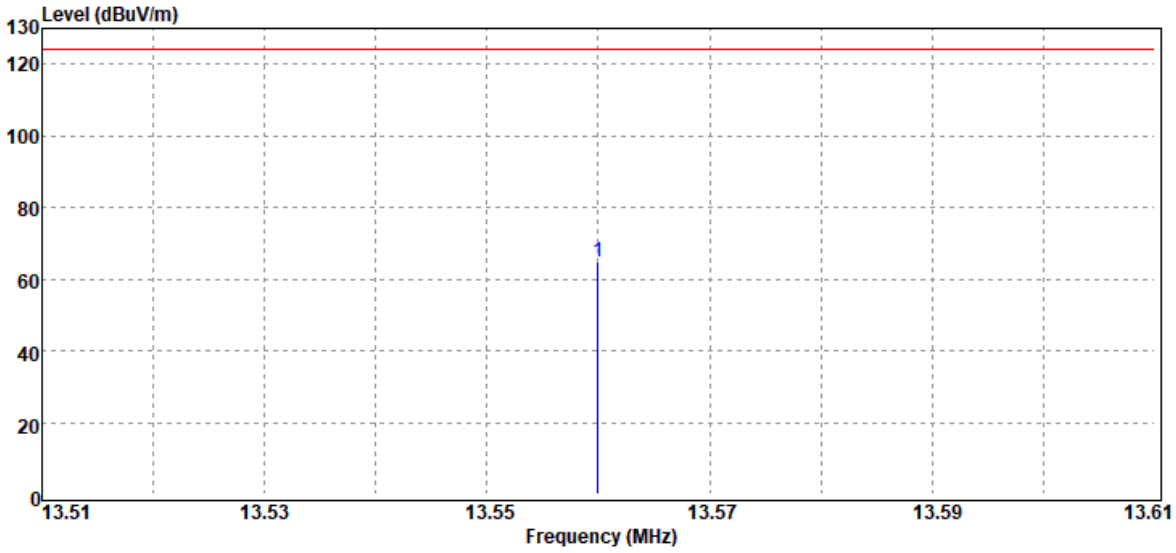


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	13.56	38.99	15.91	54.90	124.00	-69.10	Peak

Remark:

1. *Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.*
2. *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.*
3. *Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).*

Operation Mode:	TX mode	**Test Date:**	October 3, 2019
Temperature:	27.6℃	**Tested by:**	Dally Hong
Humidity:	58% RH	**Polarity:**	Hor.

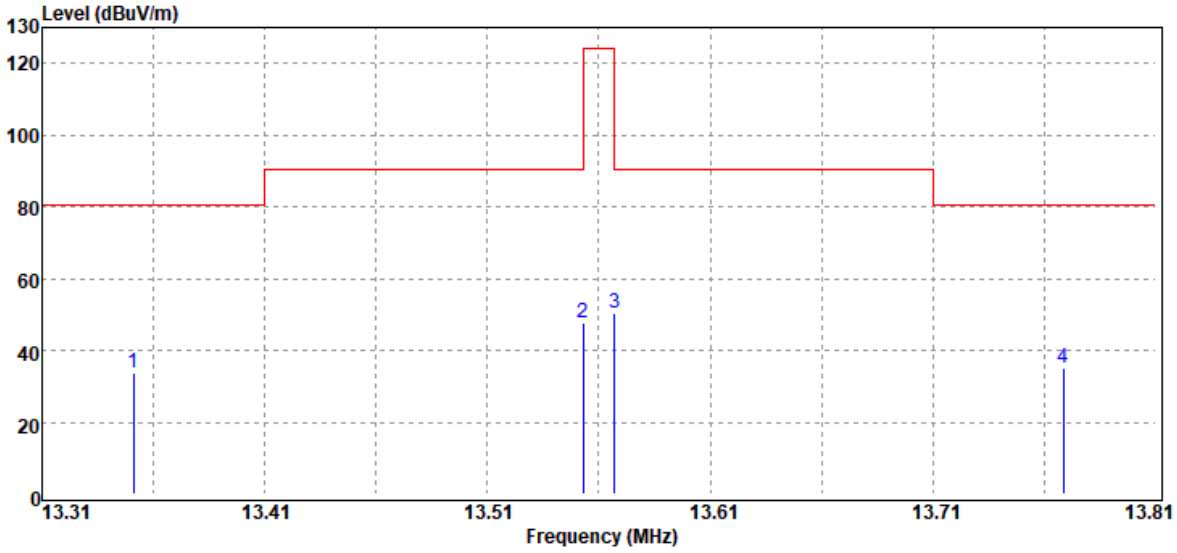


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	13.56	48.68	15.91	64.59	124.00	-59.41	Peak

Remark:

1. *Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.*
2. *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.*
3. *Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).*

Operation Mode:	TX mode	**Test Date:**	October 3, 2019
Temperature:	27.6℃	**Tested by:**	Dally Hong
Humidity:	58% RH	**Polarity:**	Ver.

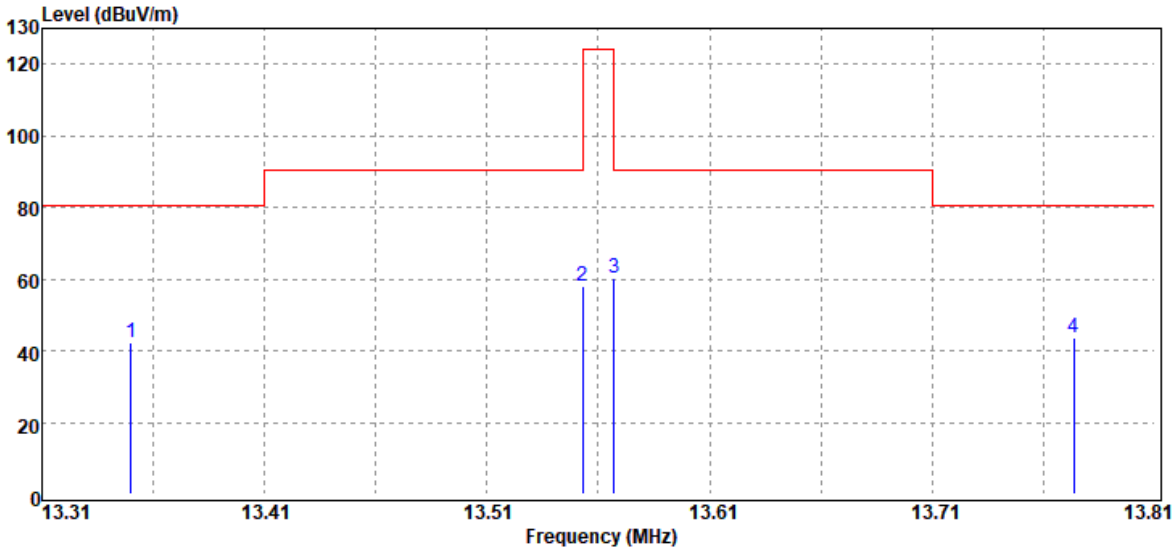


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	13.35	17.81	15.92	33.73	80.54	-46.81	Peak
2	13.55	31.96	15.91	47.87	90.47	-42.60	Peak
3	13.57	34.45	15.91	50.36	90.47	-40.11	Peak
4	13.77	19.33	15.90	35.23	80.50	-45.27	Peak

Remark:

1. *Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.*
2. *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.*
3. *Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).*

Operation Mode:	TX mode	**Test Date:**	October 3, 2019
Temperature:	27.6℃	**Tested by:**	Dally Hong
Humidity:	58% RH	**Polarity:**	Hor.



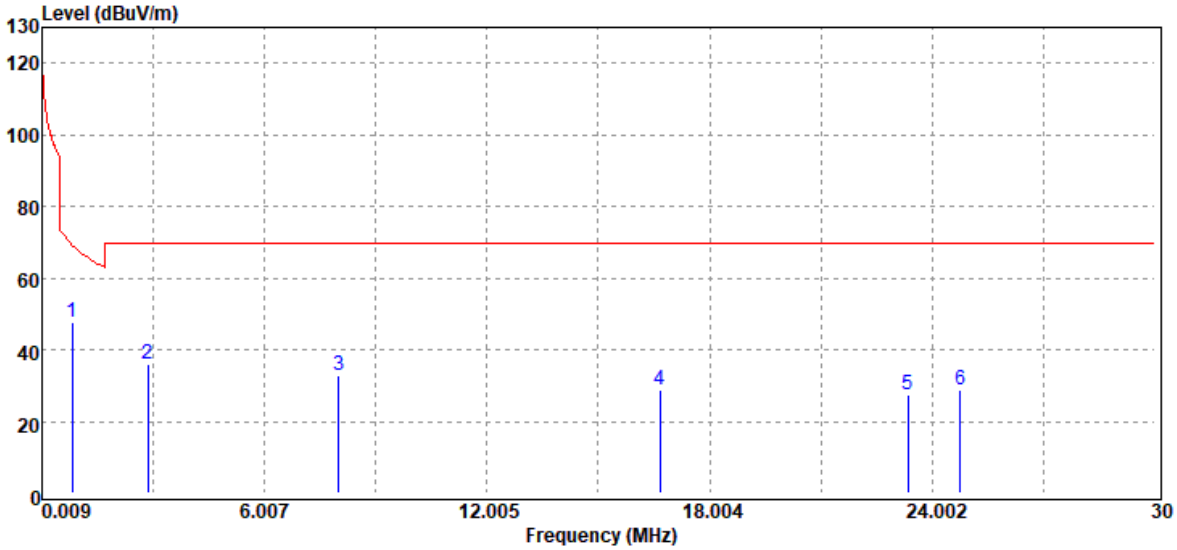
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	13.35	26.51	15.92	42.43	80.54	-38.11	Peak
2	13.55	42.22	15.91	58.13	90.47	-32.34	Peak
3	13.57	44.57	15.91	60.48	90.47	-29.99	Peak
4	13.77	27.77	15.90	43.67	80.50	-36.83	Peak

Remark:

1. *Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.*
2. *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.*
3. *Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).*

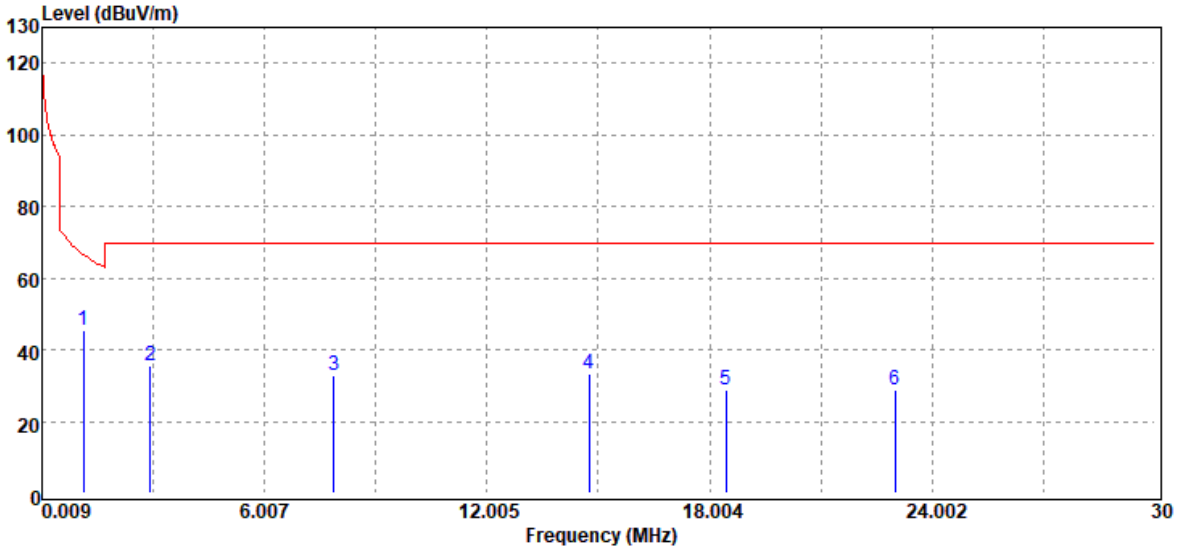
9kHz ~ 30MHz

Operation Mode:	TX mode	**Test Date:**	October 3, 2019
Temperature:	27.6℃	**Tested by:**	Dally Hong
Humidity:	58% RH	**Polarity:**	Ver.



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
0.82	Peak	33.22	14.60	47.82	69.34	-21.52
2.86	Peak	21.09	15.05	36.14	69.54	-33.40
8.02	Peak	17.04	15.91	32.95	69.54	-36.59
16.65	Peak	13.07	15.73	28.80	69.54	-40.74
23.34	Peak	12.74	14.86	27.60	69.54	-41.94
24.75	Peak	14.16	14.59	28.75	69.54	-40.79

Operation Mode:	TX mode	**Test Date:**	October 3, 2019
Temperature:	27.6℃	**Tested by:**	Dally Hong
Humidity:	58% RH	**Polarity:**	Hor.



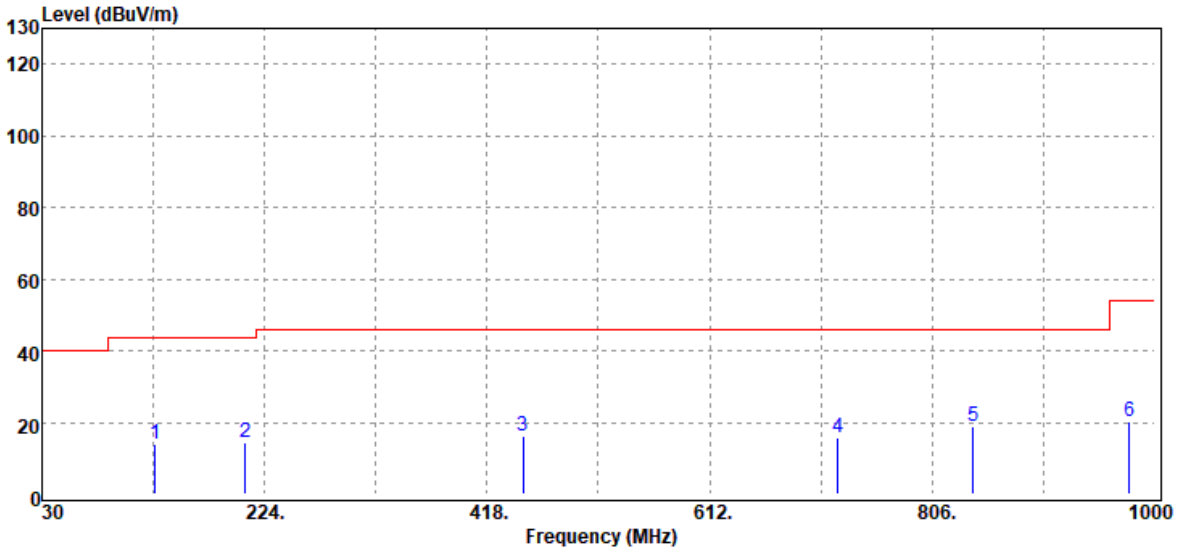
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
1.12	Peak	30.63	14.73	45.36	66.63	-21.27
2.92	Peak	20.63	15.06	35.69	69.54	-33.85
7.87	Peak	16.89	15.89	32.78	69.54	-36.76
14.77	Peak	17.50	15.84	33.34	69.54	-36.20
18.45	Peak	13.16	15.64	28.80	69.54	-40.74
23.01	Peak	13.68	14.93	28.61	69.54	-40.93

30MHz ~ 1GHz

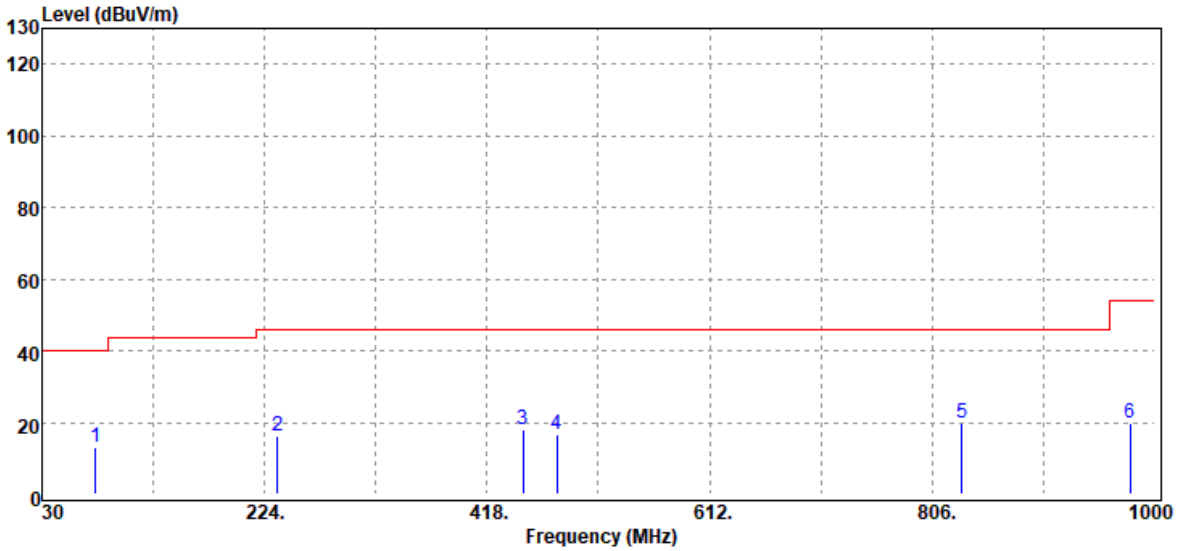
Operation Mode: TX mode
Temperature: 27.6℃
Humidity: 58% RH
Test Date: October 3, 2019
Tested by: Dally Hong

Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB	Polarity (V/H)
128.94	Peak	22.75	-8.95	13.80	43.50	-29.70	V
207.51	Peak	25.95	-11.47	14.48	43.50	-29.02	V
449.04	Peak	19.97	-3.88	16.09	46.00	-29.91	V
723.55	Peak	14.82	0.86	15.68	46.00	-30.32	V
841.89	Peak	15.49	3.50	18.99	46.00	-27.01	V
977.69	Peak	14.53	5.53	20.06	54.00	-33.94	V
76.56	Peak	28.03	-14.89	13.14	40.00	-26.86	H
235.64	Peak	26.57	-10.56	16.01	46.00	-29.99	H
449.04	Peak	21.75	-3.88	17.87	46.00	-28.13	H
479.11	Peak	19.53	-2.98	16.55	46.00	-29.45	H
832.19	Peak	16.35	3.45	19.80	46.00	-26.20	H
978.66	Peak	13.99	5.60	19.59	54.00	-34.41	H

Vertical

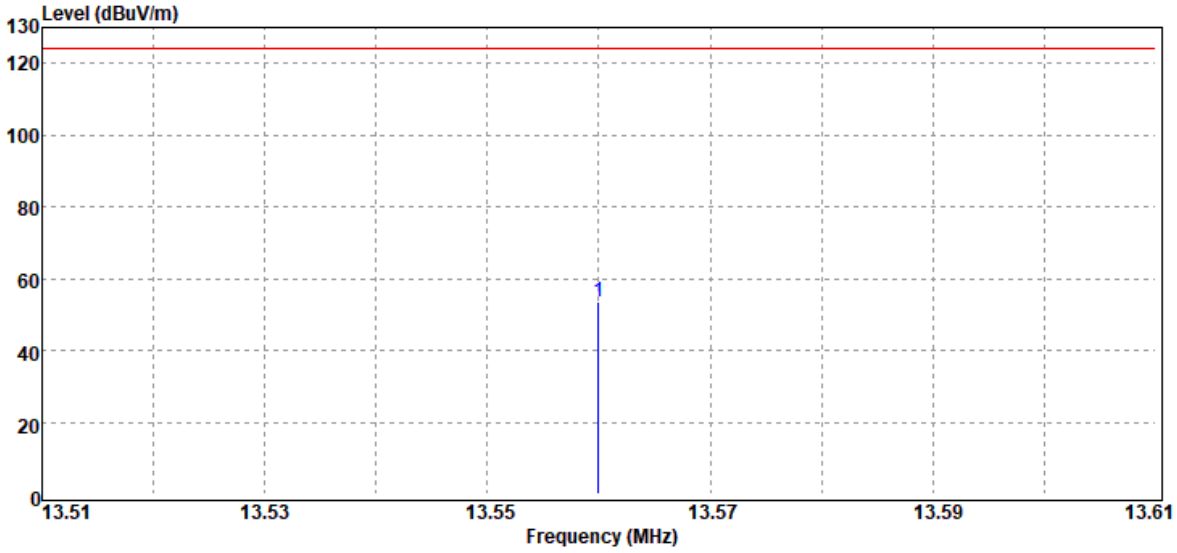


Horizontal



For Left door handle

Operation Mode:	TX mode	**Test Date:**	October 3, 2019
Temperature:	27.6℃	**Tested by:**	Dally Hong
Humidity:	58% RH	**Polarity:**	Ver.

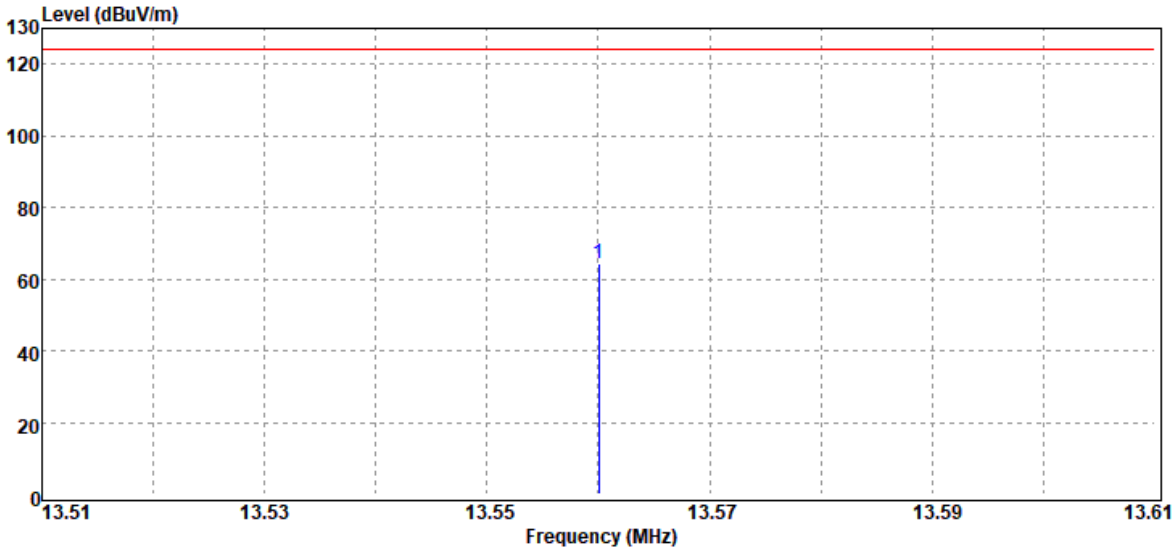


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	13.56	37.82	15.91	53.73	124.00	-70.27	Peak

Remark:

1. *Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.*
2. *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.*
3. *Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).*

Operation Mode:	TX mode	**Test Date:**	October 3, 2019
Temperature:	27.6℃	**Tested by:**	Dally Hong
Humidity:	58% RH	**Polarity:**	Hor.

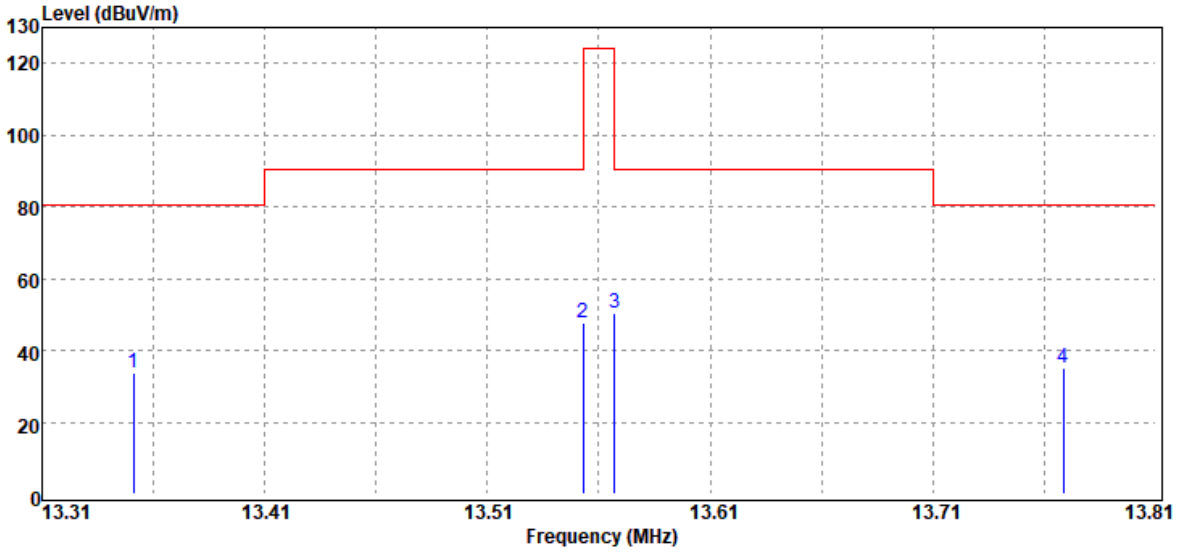


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	13.56	48.54	15.91	64.45	124.00	-59.55	Peak

Remark:

1. *Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.*
2. *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.*
3. *Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).*

Operation Mode:	TX mode	**Test Date:**	October 3, 2019
Temperature:	27.6℃	**Tested by:**	Dally Hong
Humidity:	58% RH	**Polarity:**	Ver.

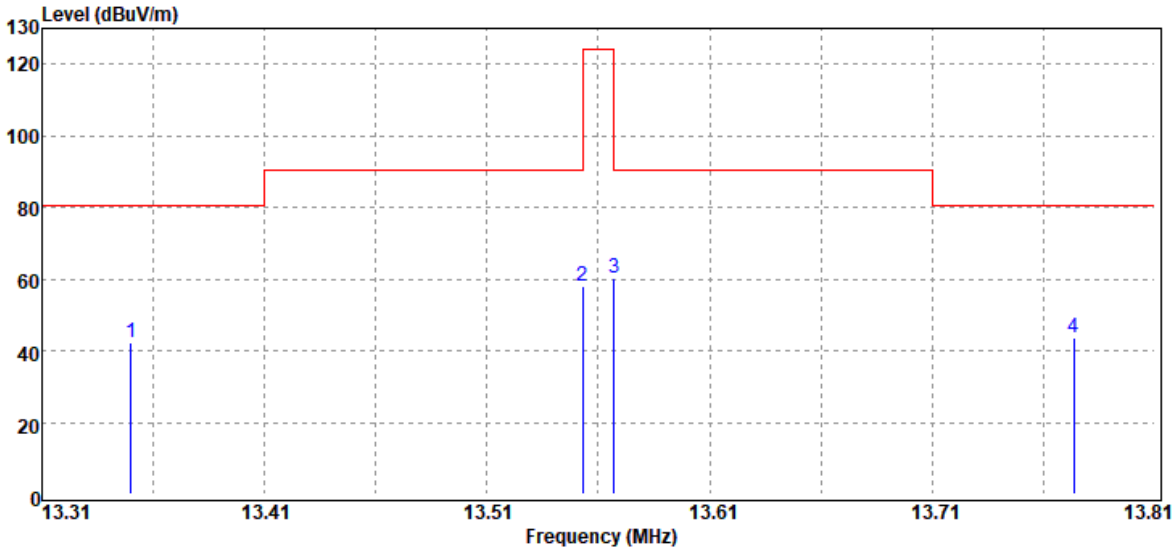


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	13.35	17.81	15.92	33.73	80.54	-46.81	Peak
2	13.55	31.96	15.91	47.87	90.47	-42.60	Peak
3	13.57	34.45	15.91	50.36	90.47	-40.11	Peak
4	13.77	19.33	15.90	35.23	80.50	-45.27	Peak

Remark:

1. *Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.*
2. *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.*
3. *Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).*

Operation Mode:	TX mode	**Test Date:**	October 3, 2019
Temperature:	27.6℃	**Tested by:**	Dally Hong
Humidity:	58% RH	**Polarity:**	Hor.



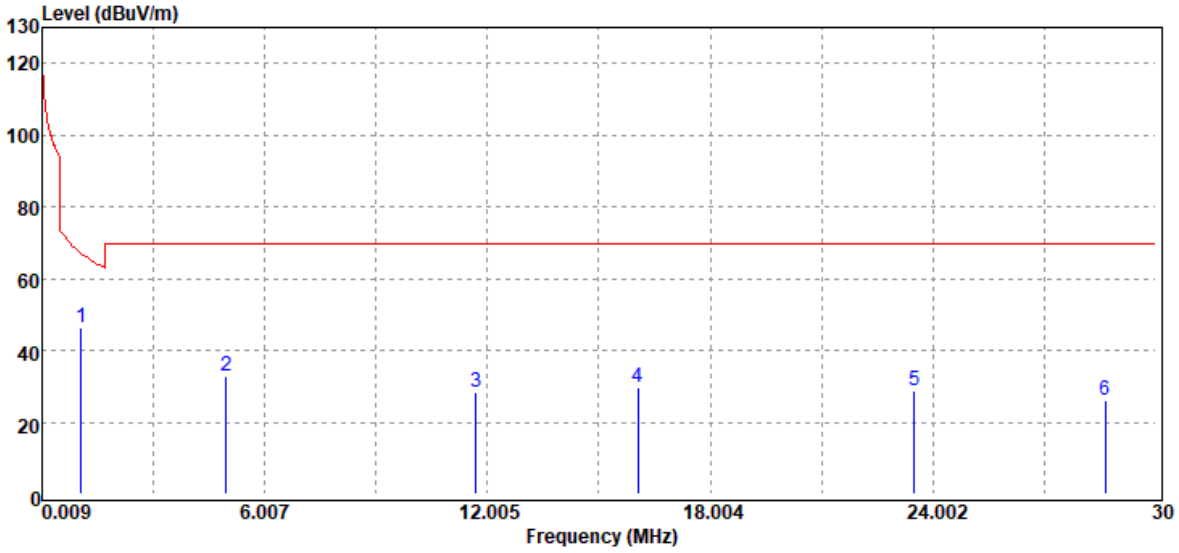
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	13.35	26.51	15.92	42.43	80.54	-38.11	Peak
2	13.55	42.22	15.91	58.13	90.47	-32.34	Peak
3	13.57	44.57	15.91	60.48	90.47	-29.99	Peak
4	13.77	27.77	15.90	43.67	80.50	-36.83	Peak

Remark:

1. *Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.*
2. *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.*
3. *Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).*

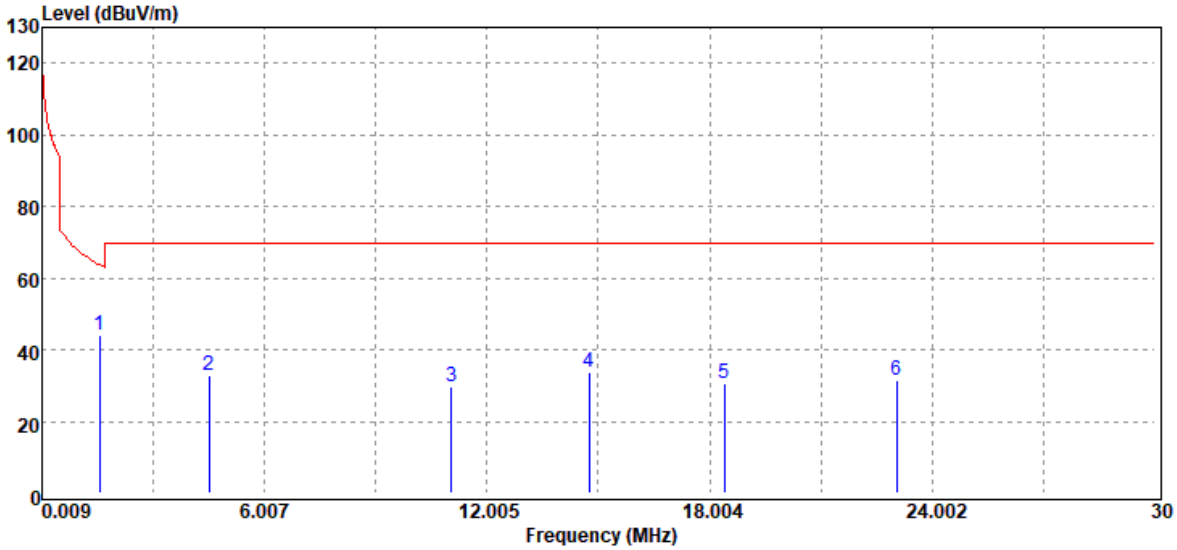
9kHz ~ 30MHz

Operation Mode:	TX mode	**Test Date:**	October 3, 2019
Temperature:	27.6℃	**Tested by:**	Dally Hong
Humidity:	58% RH	**Polarity:**	Ver.



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
1.06	Peak	31.54	14.71	46.25	67.11	-20.86
4.96	Peak	17.49	15.35	32.84	69.54	-36.70
11.71	Peak	12.43	16.03	28.46	69.54	-41.08
16.05	Peak	14.09	15.76	29.85	69.54	-39.69
23.49	Peak	14.01	14.83	28.84	69.54	-40.70
28.65	Peak	12.37	13.91	26.28	69.54	-43.26

Operation Mode:	TX mode	**Test Date:**	October 3, 2019
Temperature:	27.6℃	**Tested by:**	Dally Hong
Humidity:	58% RH	**Polarity:**	Hor.



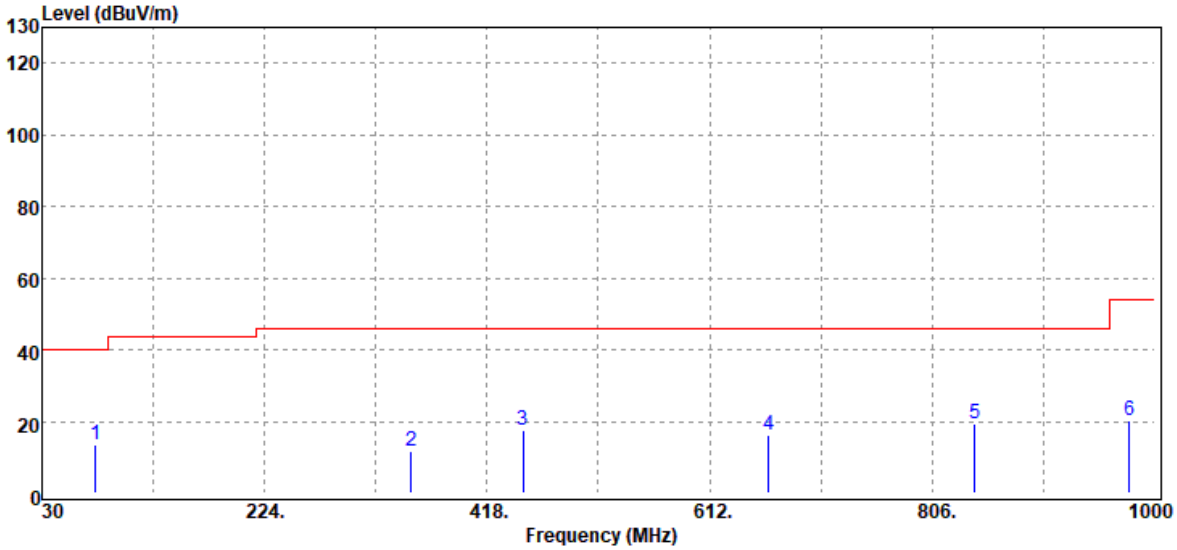
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
1.57	Peak	29.27	14.84	44.11	63.70	-19.59
4.51	Peak	17.61	15.30	32.91	69.54	-36.63
11.05	Peak	13.50	16.08	29.58	69.54	-39.96
14.77	Peak	17.99	15.84	33.83	69.54	-35.71
18.39	Peak	15.06	15.64	30.70	69.54	-38.84
23.04	Peak	16.50	14.92	31.42	69.54	-38.12

30MHz ~ 1GHz

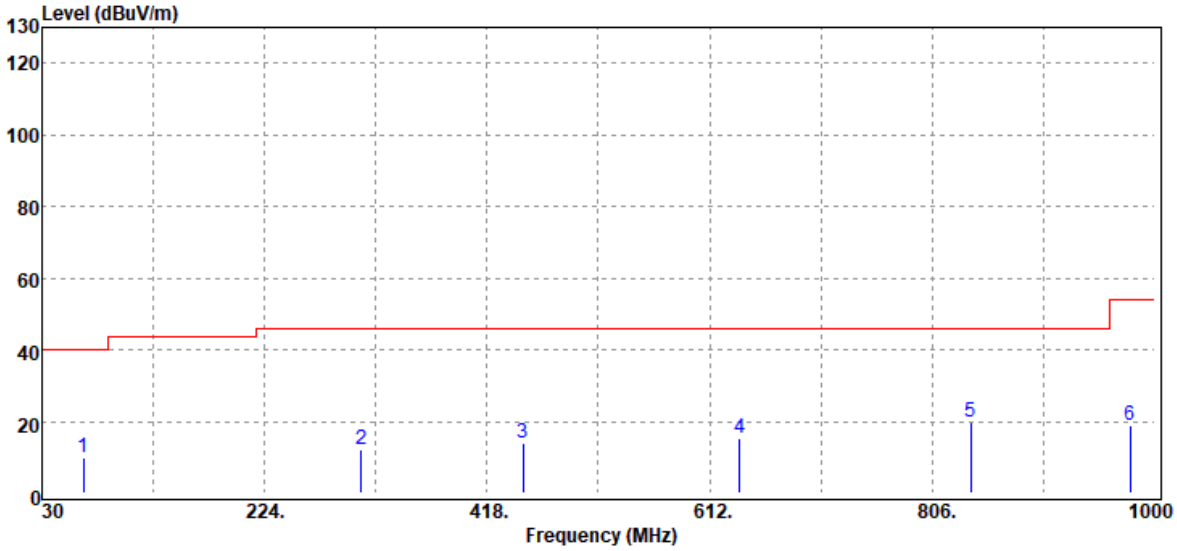
Operation Mode: TX mode
Temperature: 27.6℃
Humidity: 58% RH
Test Date: October 3, 2019
Tested by: Dally Hong

Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB	Polarity (V/H)
76.56	Peak	28.44	-14.89	13.55	40.00	-26.45	V
352.04	Peak	18.74	-6.87	11.87	46.00	-34.13	V
449.04	Peak	21.53	-3.88	17.65	46.00	-28.35	V
663.41	Peak	16.12	0.05	16.17	46.00	-29.83	V
842.86	Peak	16.04	3.35	19.39	46.00	-26.61	V
977.69	Peak	14.86	5.53	20.39	54.00	-33.61	V
65.89	Peak	25.44	-15.35	10.09	40.00	-29.91	H
308.39	Peak	19.93	-7.97	11.96	46.00	-34.04	H
449.04	Peak	18.04	-3.88	14.16	46.00	-31.84	H
638.19	Peak	15.59	-0.37	15.22	46.00	-30.78	H
839.95	Peak	16.37	3.58	19.95	46.00	-26.05	H
978.66	Peak	13.47	5.60	19.07	54.00	-34.93	H

Vertical



Horizontal



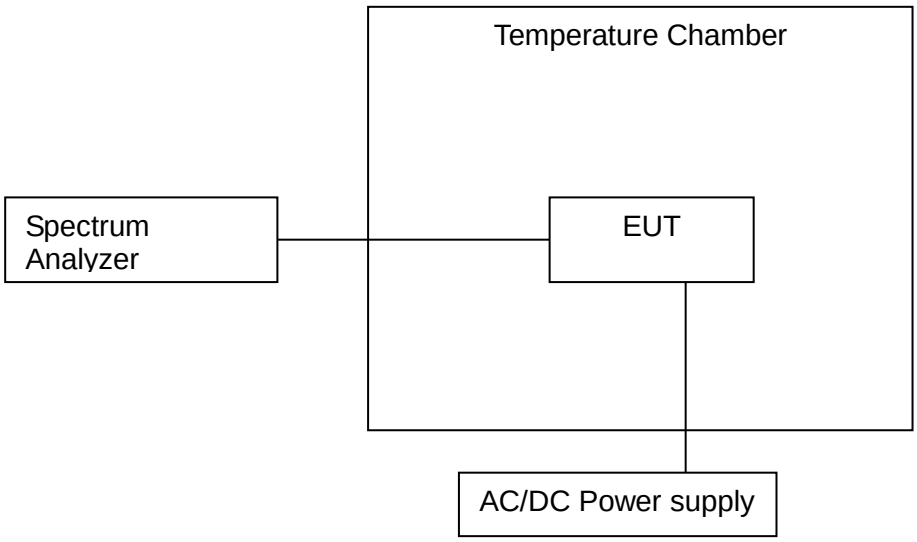
8.3 FREQUENCY STABILITY

LIMIT

According to §15.225(e),
The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of –40 degrees to +75 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

Test Configuration

Temperature and Voltage Measurement (under normal and extreme test conditions)



TEST PROCEDURE

1. Turn the EUT off, and place it inside the environmental temperature chamber.
2. Set the temperature control on the chamber to the highest specified in the regulatory requirements for the type of device and allow the oscillator heater and the chamber temperature to stabilize.
3. Set the spectrum analyzer as RBW=1kHz, VBW = RBW, Span = 200kHz, Sweep = auto.
4. Turn the EUT on and record the operating frequency at startup and two, five, and ten minutes after the EUT is energized.
5. Switch off the EUT and Lower the chamber temperature by not more than 10 °C and allow the temperature inside the chamber to stabilize.
6. Mark the peak frequency and measure the frequency tolerance using frequency counter function.
7. Repeat step 4 through step 6 down to the lowest specified temperature.

TEST RESULTS

No non-compliance noted.

TEST DATA

Condition			Frequency Error (ppm)									
Temperature	Modulation Mode	Test Freq.	0 min	2 min	5 min	10 min	0 min	2 min	5 min	10 min	Limit (ppm)	Result
			Normal									
$T_{20°C}$Vmax	CW	13.56	13.560724	13.560738	13.560724	13.560724	53.39	54.42	53.39	53.39	100	Pass
$T_{20°C}$Vmin	CW	13.56	13.560753	13.560738	13.560738	13.560738	55.53	54.42	54.42	54.42		Pass
			Extreme									
$T_{75°C}$Vnom	CW	13.56	13.560535	13.560550	13.560550	13.560535	39.45	40.56	40.56	39.45	100	Pass
$T_{70°C}$Vnom	CW	13.56	13.560550	13.560550	13.560550	13.560550	40.56	40.56	40.56	40.56		Pass
$T_{60°C}$Vnom	CW	13.56	13.560593	13.560593	13.560579	13.560579	43.73	43.73	42.70	42.70		Pass
$T_{50°C}$Vnom	CW	13.56	13.560622	13.560622	13.560622	13.560608	45.87	45.87	45.87	44.84		Pass
$T_{40°C}$Vnom	CW	13.56	13.560637	13.560637	13.560622	13.560637	46.98	46.98	45.87	46.98		Pass
$T_{30°C}$Vnom	CW	13.56	13.560724	13.560709	13.560709	13.560709	53.39	52.29	52.29	52.29		Pass
$T_{20°C}$Vnom	CW	13.56	13.560753	13.560753	13.560753	13.560753	55.53	55.53	55.53	55.53		Pass
$T_{10°C}$Vnom	CW	13.56	13.560796	13.560781	13.560796	13.560781	58.70	57.60	58.70	57.60		Pass
$T_{0°C}$Vnom	CW	13.56	13.560781	13.560781	13.560781	13.560781	57.60	57.60	57.60	57.60		Pass
$T_{-10°C}$Vnom	CW	13.56	13.560767	13.560767	13.560767	13.560767	56.56	56.56	56.56	56.56		Pass
$T_{-20°C}$Vnom	CW	13.56	13.560738	13.560753	13.560753	13.560753	54.42	55.53	55.53	55.53		Pass
$T_{-30°C}$Vnom	CW	13.56	13.560724	13.560724	13.560738	13.560738	53.39	53.39	54.42	54.42		Pass
$T_{-40°C}$Vnom	CW	13.56	13.560753	13.560738	13.560753	13.560738	55.53	54.42	55.53	54.42		Pass

Remark: Vnom: 12
Vmax: 13.2
Vmin: 10.8

8.4 POWERLINE CONDUCTED EMISSIONS

LIMIT

According to §15.207(a), 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 μH/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 (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

***** *Decreases with the logarithm of the frequency.*

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

Not applicable, because EUT not connect to AC Main Source direct.

- End of Test Report -