

FCC Test Report

Report No.: RF160512C16

FCC ID: E2K-DWRFID1602

Test Model: DWRFID1602

Received Date: May 12, 2016

Test Date: Oct. 13, 2016 ~ Oct. 26, 2016

Issued Date: Nov. 01, 2016

Applicant: Dell Inc.

Address: One Dell Way, Round Rock, TX 78682, USA

Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

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Release Control Record

Issue No.	Description	Date Issued
RF160512C16	Original Release	Nov. 01, 2016

1 Certificate of Conformity

Product: RFID 13.56MHz Wireless Module

Brand: DELL

Test Model: DWRFID1602

Sample Status: Identical Prototype

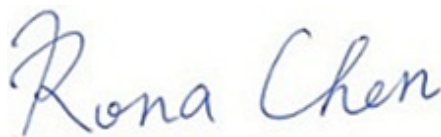
Applicant: Dell Inc.

Test Date: Oct. 13, 2016 ~ Oct. 26, 2016

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.225)
47 CFR FCC Part 15, Subpart C (Section 15.215)
ANSI C63.10:2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

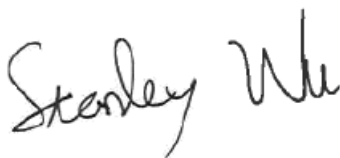
Prepared by :



, **Date:** Nov. 01, 2016

Rona Chen / Specialist

Approved by :



, **Date:** Nov. 01, 2016

Stanley Wu / Assistant Manager

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.225, 15.215)			
FCC Clause	Test Item	Result	Remarks
15.207	Conducted emission test	Pass	Meet the requirement of limit. Minimum passing margin is -8.78 dB at 13.56130 MHz.
15.225 (a)	The field strength of any emissions within the band 13.553-13.567 MHz	Pass	Meet the requirement of limit. Minimum passing margin is -79.11 dB at 13.561 MHz.
15.225 (b)	The field strength of any emissions within the bands 13.410-13.553 MHz and 13.567-13.710 MHz	Pass	Meet the requirement of limit.
15.225 (c)	The field strength of any emissions within the bands 13.110-13.410 MHz and 13.710-14.010 MHz	Pass	Meet the requirement of limit.
15.225 (d)	The field strength of any emissions appearing outside of the 13.110-14.010 MHz band	Pass	Meet the requirement of limit. Minimum passing margin is -2.23 dB at 40.67 MHz.
15.225 (e)	The frequency tolerance	Pass	Meet the requirement of limit.
15.215 (c)	20dB Bandwidth	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.44 dB
Radiated Emissions up to 1 GHz	30 MHz ~ 200 MHz	2.93 dB
	200 MHz ~ 1000 MHz	2.95 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	2.26 dB
	18 GHz ~ 40 GHz	1.94 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	RFID 13.56MHz Wireless Module
Brand	DELL
Test Model	DWRFID1602
Status of EUT	Identical Prototype
Power Supply Rating	20.0 Vdc (Adapter)
Modulation Type	ASK
Operating Frequency	13.56 MHz
Antenna Type	Loop Antenna
Accessory Device	Refer to Note
Data Cable Supplied	Refer to Note

Note:

1. The EUT is authorized for use in specific End-product. Please refer to below table for more details.

Item	Brand	Model
Portable Computer	DELL	P29S

2. The End-product contains following accessory devices.

Product	Brand	Model	Description
Adapter	DELL	LA45NM150	I/P: 100-240 Vac, 50/60 Hz, 1.3 A O/P: 5 Vdc, 2 A or 20 Vdc, 2.25 A 1.8m cable
Battery	Dell (Simplo)	71TG4	7.6 Vdc, 7500 mAh (45Wh)

3. The antenna vendors for this EUT is listed as below

Antenna 1: Acon

Antenna 2: Speedwire

4. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3.2 Description of Test Modes

One channel was provided to this EUT:

Channel	Frequency (MHz)
1	13.56

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To				Description
	RE	PLC	FS	EB	
A	√	√	√	√	EUT with Antenna 1
B	√	√	-	√	EUT with Antenna 2

Where

RE: Radiated Emission

PLC: Power Line Conducted Emission

FS: Frequency Stability

EB: 20 dB Bandwidth measurement

Radiated Emission Test:

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type
A, B	1	1	ASK

Power Line Conducted Emission Test:

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type
A, B	1	1	ASK

Frequency Stability:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type
A	1	1	ASK

20 dB Bandwidth:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type
A, B	1	1	ASK

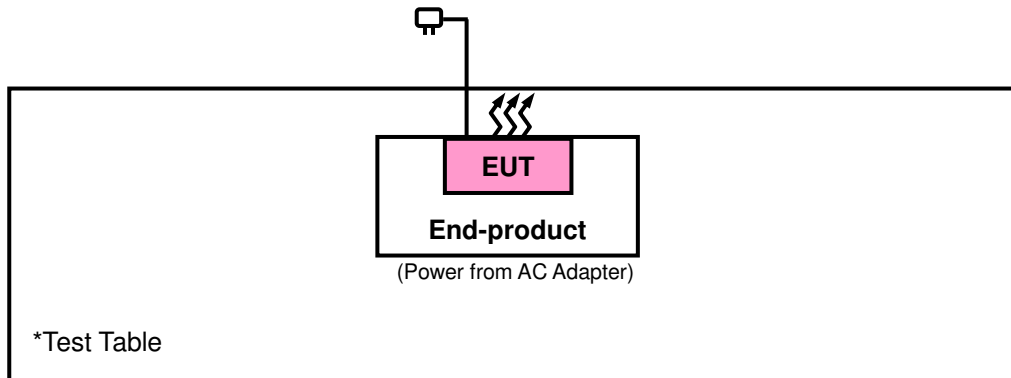
Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested By
RE	25 deg. C, 65 % RH	120 Vac, 60 Hz	Getaz Yang
FS	25 deg. C, 65 % RH	20.0 Vdc	Taylor Liu
PLC	25 deg. C, 65 % RH	120 Vac, 60 Hz	Toby Tian
EB	25 deg. C, 68 % RH	20.0 Vdc	Luke Chen

3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units.

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (15.225)

FCC Part 15, Subpart C (15.215)

ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

NOTE: The EUT has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC).
The test report has been issued separately.

4 Test Types and Results

4.1 Radiated Emission Measurement

4.1.1 Limits of Radiated Emission Measurement

The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

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

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent	N9038A	MY51210203	Jan. 21, 2016	Jan. 20, 2017
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Dec. 17, 2015	Dec. 16, 2016
BILOG Antenna SCHWARZBECK	VULB9168	9168-472	Jan. 07, 2016	Jan. 06, 2017
Loop Antenna	EM-6879	269	Aug. 11, 2016	Aug. 10, 2017
Preamplifier EMCI	EMC 330H	980112	Dec. 28, 2015	Dec. 27, 2016
Preamplifier EMCI	EMC001340	980201	Nov. 03, 2015	Nov. 02, 2016
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	309219/4 2950114	Oct. 11, 2016	Oct. 10, 2017
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	250130/4	Oct. 11, 2016	Oct. 10, 2017
RF Coaxial Cable Worken	8D-FB	Cable-Ch10-01	Oct. 11, 2016	Oct. 10, 2017
Software BV ADT	E3 6.120103	NA	NA	NA
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower & Turn Table Controller MF	MF-7802	NA	NA	NA

- Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 10.
3. The horn antenna and preamplifier (model: EMC 184045) are used only for the measurement of emission frequency above 1 GHz if tested.
4. The FCC Site Registration No. is 690701.
5. The IC Site Registration No. is IC7450F-10.

4.1.3 Test Procedures

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Height of receiving antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

NOTE:

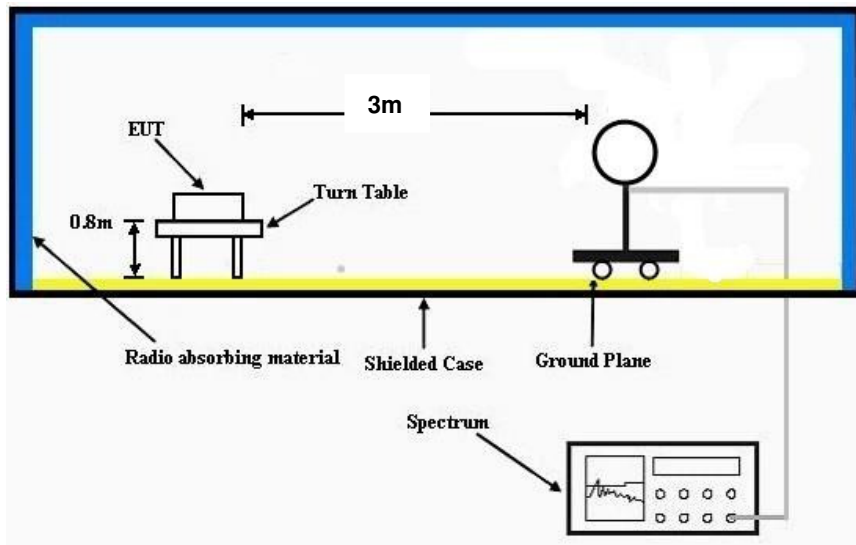
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is $\geq 1/T$ (Duty cycle $< 98\%$) or 10 Hz (Duty cycle $> 98\%$) for Average detection (AV) at frequency above 1 GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

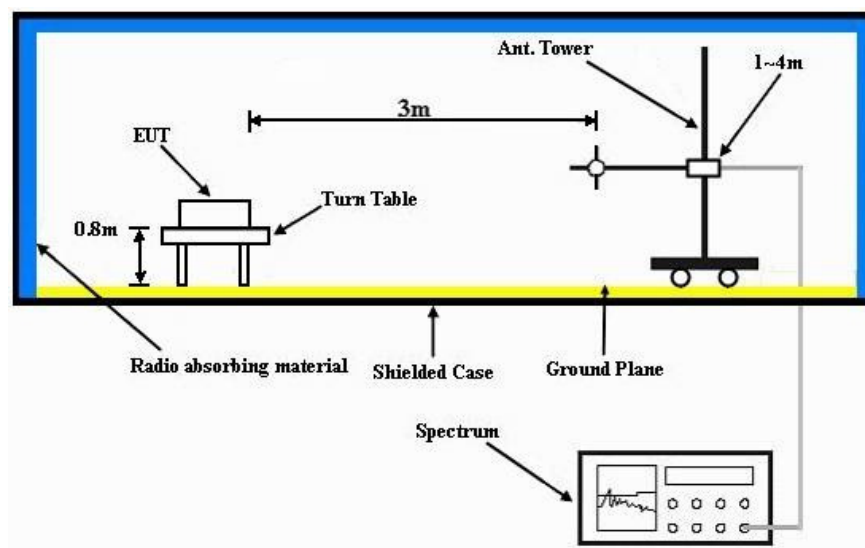
No deviation.

4.1.5 Test Set Up

Frequency range 9k~30MHz:



Frequency range 30~1000MHz:



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT Operating Conditions

- Placed the EUT on the testing table.
- Set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

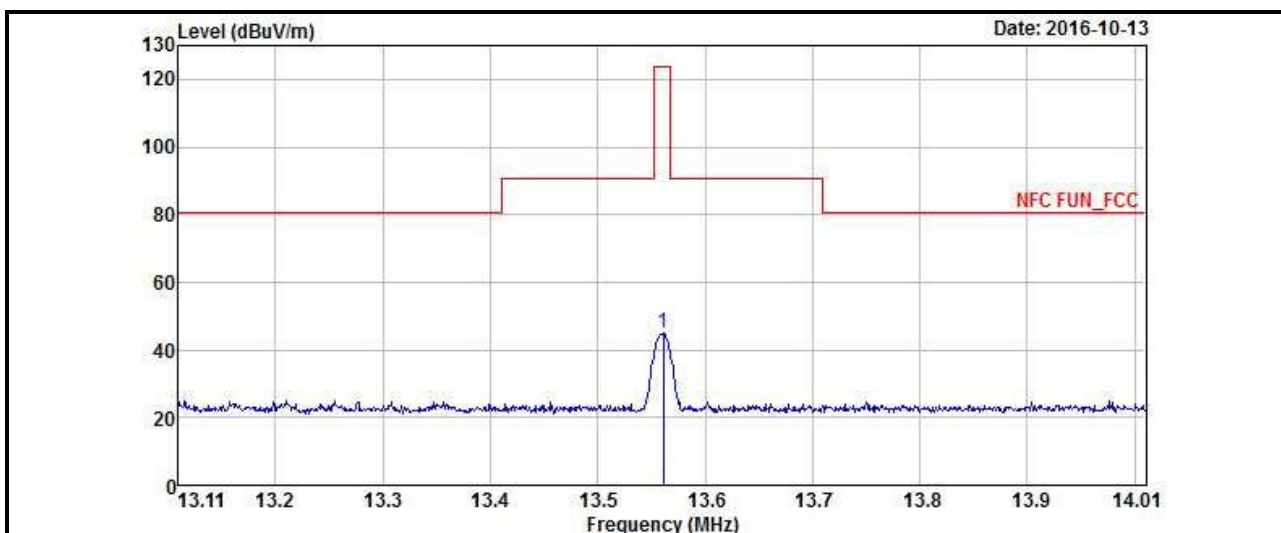
No non-compliance noted:

KDB 937606 OATS and Chamber Correlation Justification

- Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.
- OATs and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

Mode A

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	13.553 ~ 13.567 MHz
Input Power	120 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Getaz Yang



Antenna Polarity & Test Distance: Loop Antenna Open at 3M										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
13.561	44.89	48.27	124	-79.11	37.67	0.31	41.36	100	360	Peak

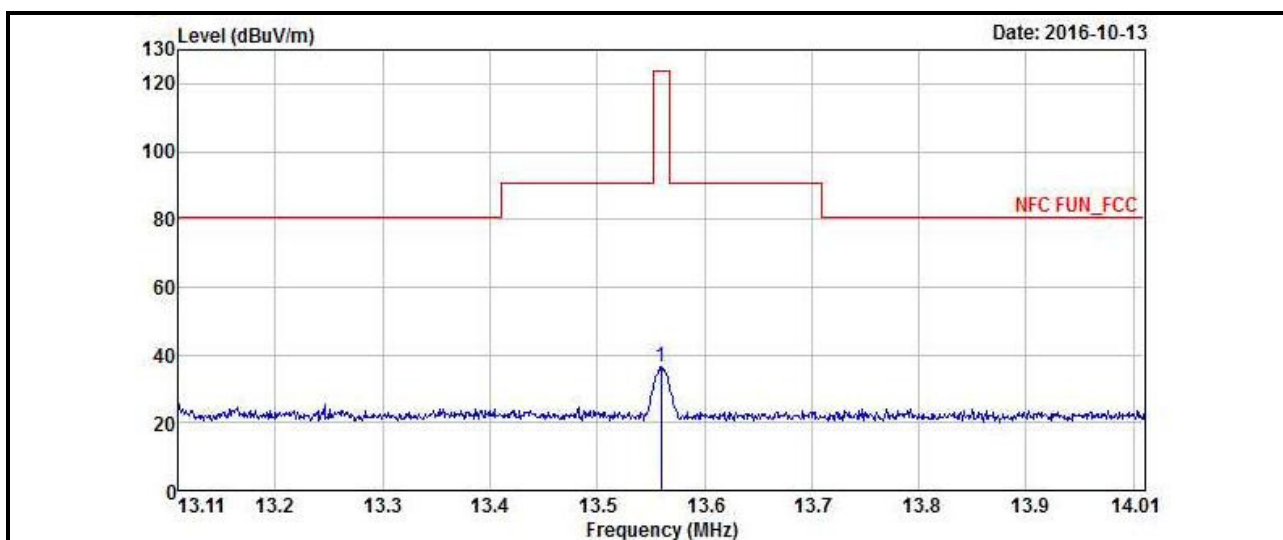
- REMARKS:**
1. Emission level(dBuV/m)=Raw Value(dBuV) + Correction Factor(dB/m)
 2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor(dB)
 3. The other emission levels were very low against the limit.
 4. Margin value = Emission level – Limit value.
 5. Above limits have been translated by the formula

The measured field strength was extrapolated to distance 30 meters, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)

Example:

$$\begin{aligned}
 13.56 \text{ MHz} &= 15848 \text{ uV/m} & 30\text{m} \\
 &= 84 \text{ dBuV/m} & 30\text{m} \\
 &= 84+20\log(30/3)^2 & 3\text{m} \\
 &= 124 \text{ dBuV/m}
 \end{aligned}$$

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	13.553 ~ 13.567 MHz
Input Power	120 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Getaz Yang



Antenna Polarity & Test Distance: Loop Antenna Close at 3M										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
13.56	36.48	39.86	124	-87.52	37.67	0.31	41.36	100	0	Peak

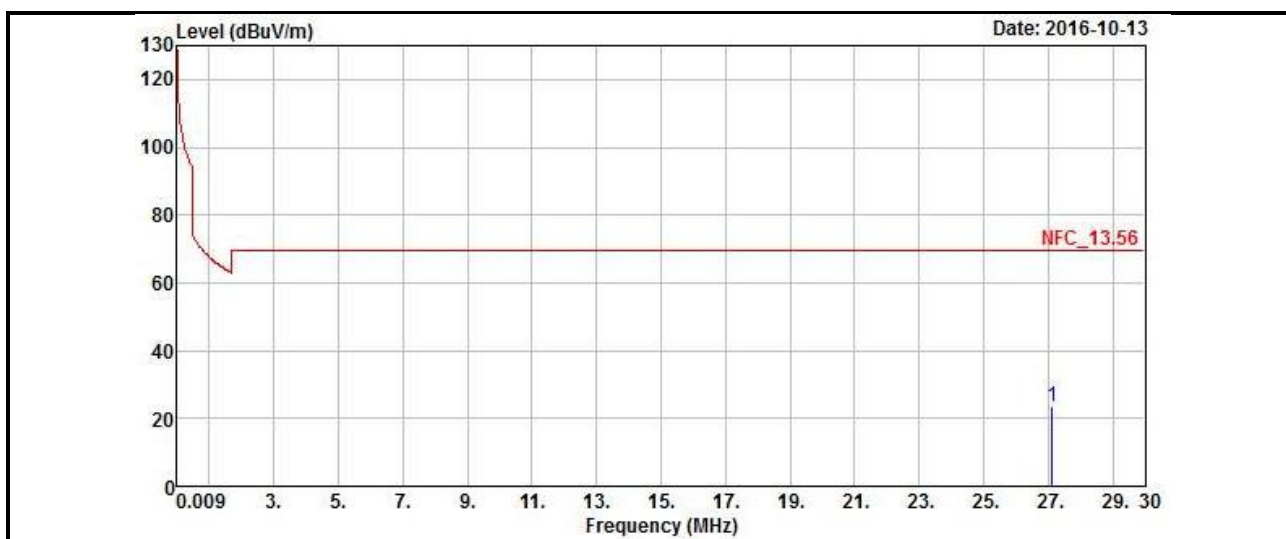
- REMARKS:**
1. Emission level(dBuV/m)=Raw Value(dBuV) + Correction Factor(dB/m)
 2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor(dB)
 3. The other emission levels were very low against the limit.
 4. Margin value = Emission level – Limit value.
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 &= 84 \text{ dBuV/m} & 30\text{m} \\
 &= 84 + 20\log(30/3)^2 & 3\text{m} \\
 &= 124 \text{ dBuV/m}
 \end{aligned}$$

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 30 MHz
Input Power	120 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Getaz Yang

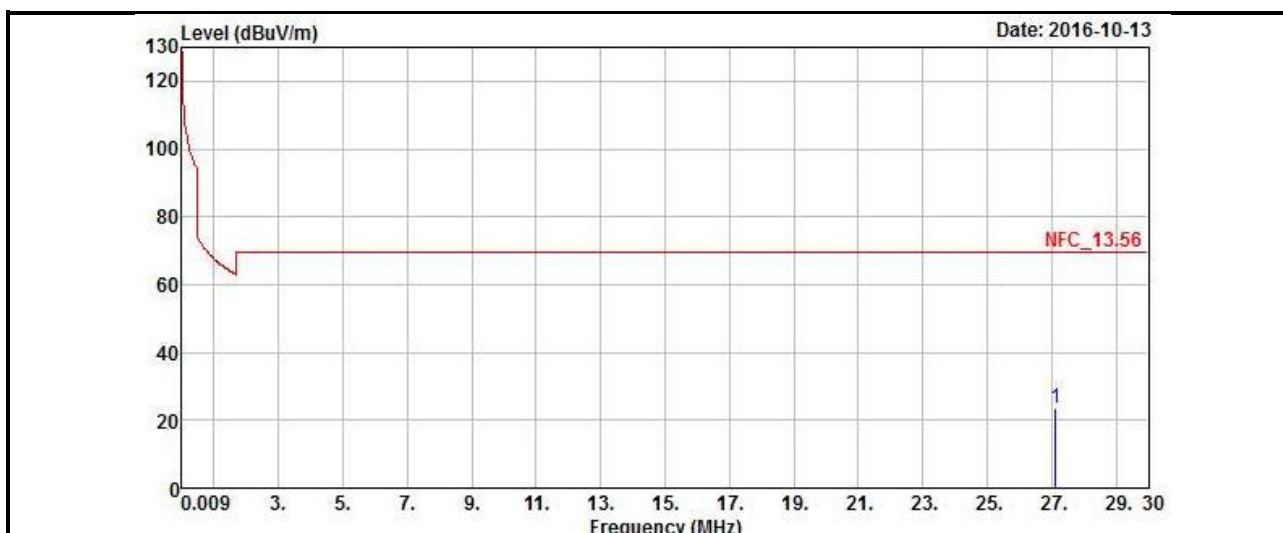


Antenna Polarity & Test Distance: Loop Antenna Open at 3M										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
27.12	23.38	28.78	69.54	-46.16	35.55	0.38	41.33	100	0	Peak

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
– Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 30 MHz
Input Power	120 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Getaz Yang



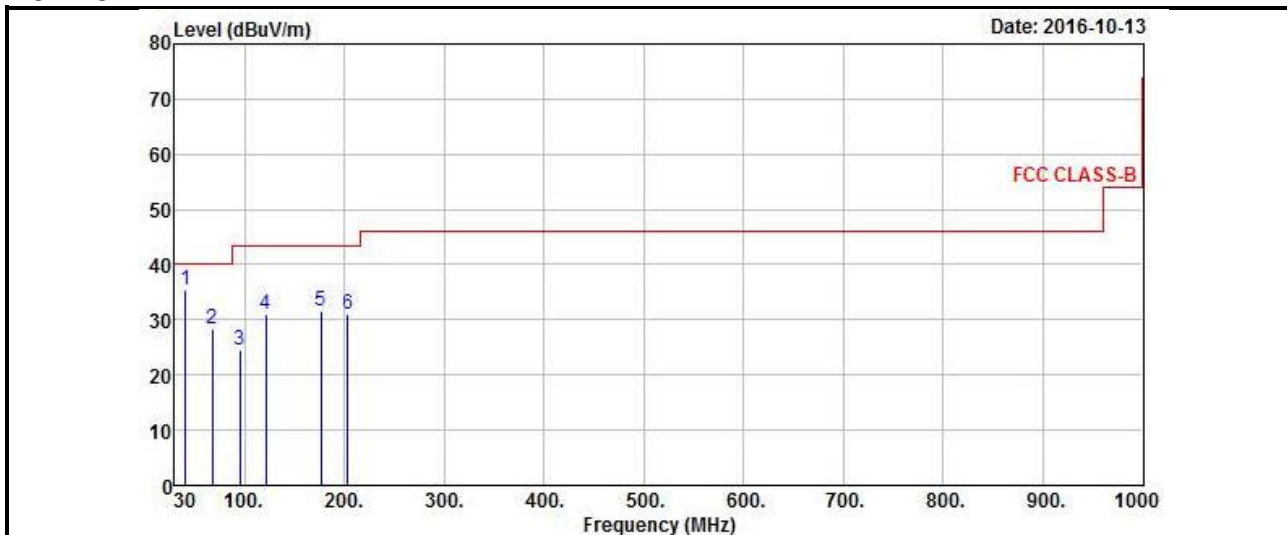
Antenna Polarity & Test Distance: Loop Antenna Close at 3M										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
27.12	23.66	29.06	69.54	-45.88	35.55	0.38	41.33	100	360	Peak

REMARKS:

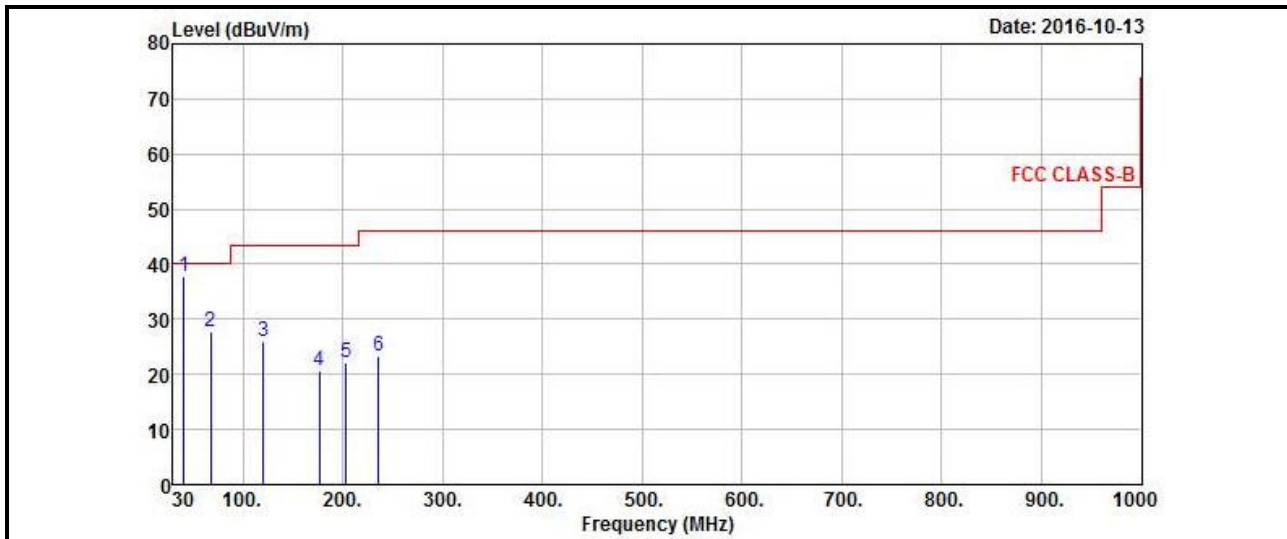
1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
– Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 1000 MHz
Input Power	120 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Getaz Yang

HORIZONTAL



VERTICAL



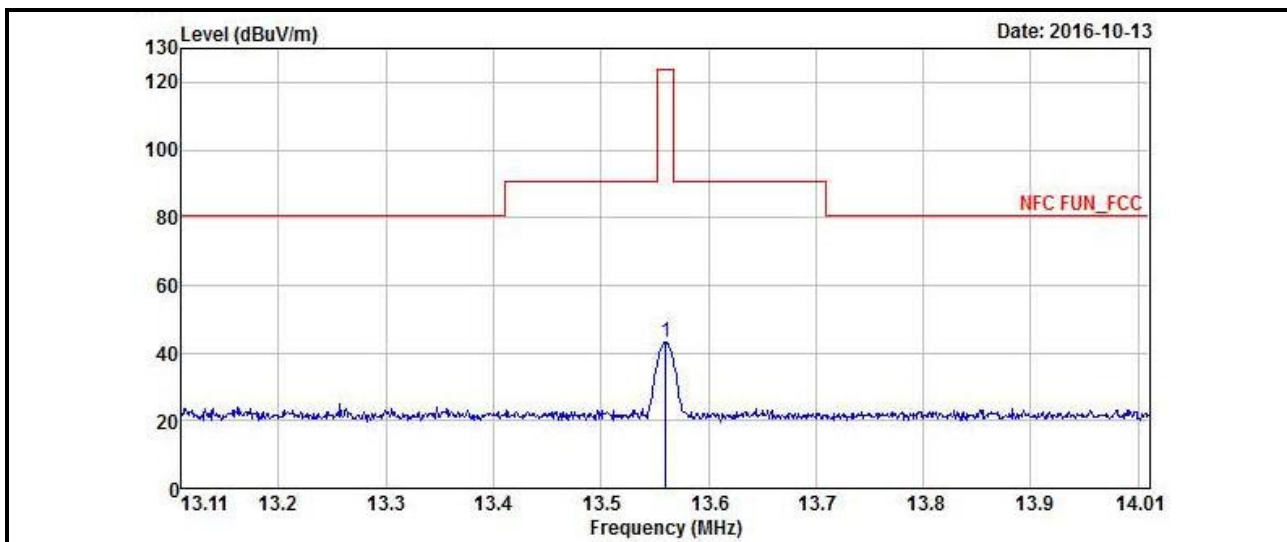
Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
40.67	35.48	52.3	40	-4.52	13.55	0.65	31.02	112	239	Peak
67.83	28.23	48.11	40	-11.77	11	0.85	31.73	139	243	Peak
94.99	24.38	46.64	43.5	-19.12	8.68	1.02	31.96	100	211	Peak
121.18	31.04	50.69	43.5	-12.46	11.09	1.16	31.9	104	150	Peak
176.47	31.47	51	43.5	-12.03	11.1	1.17	31.8	131	101	Peak
203.63	31.14	52.01	43.5	-12.36	9.52	1.31	31.7	108	198	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
40.67	37.77	54.59	40	-2.23	13.55	0.65	31.02	122	48	QP
67.83	27.85	47.73	40	-12.15	11	0.85	31.73	136	167	Peak
120.21	26.01	45.73	43.5	-17.49	11.02	1.16	31.9	103	182	Peak
176.47	20.67	40.2	43.5	-22.83	11.1	1.17	31.8	116	121	Peak
203.63	22.22	43.09	43.5	-21.28	9.52	1.31	31.7	117	51	Peak
235.64	23.31	42.81	46	-22.69	10.87	1.44	31.81	117	254	Peak

REMARKS:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value.

Mode B

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	13.553 ~ 13.567 MHz
Input Power	120 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Getaz Yang



Antenna Polarity & Test Distance: Loop Antenna Open at 3M										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
13.56	43.21	46.59	124	-80.79	37.67	0.31	41.36	100	0	Peak

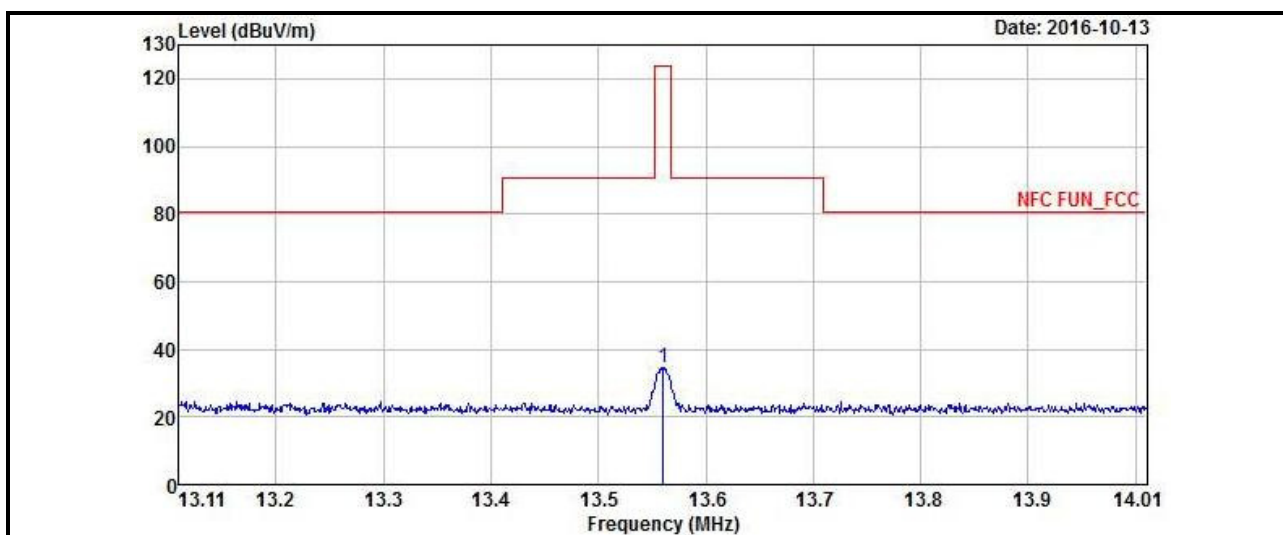
- REMARKS:**
1. Emission level(dBuV/m)=Raw Value(dBuV) + Correction Factor(dB/m)
 2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor(dB)
 3. The other emission levels were very low against the limit.
 4. Margin value = Emission level – Limit value.
 5. Above limits have been translated by the formula

The measured field strength was extrapolated to distance 30 meters, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)

Example:

$$\begin{aligned}
 13.56 \text{ MHz} &= 15848 \text{ uV/m} & 30\text{m} \\
 &= 84 \text{ dBuV/m} & 30\text{m} \\
 &= 84 + 20\log(30/3)^2 & 3\text{m} \\
 &= 124 \text{ dBuV/m}
 \end{aligned}$$

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	13.553 ~ 13.567 MHz
Input Power	120 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Getaz Yang



Antenna Polarity & Test Distance: Loop Antenna Close at 3M										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
13.56	34.41	37.79	124	-89.59	37.67	0.31	41.36	100	360	Peak

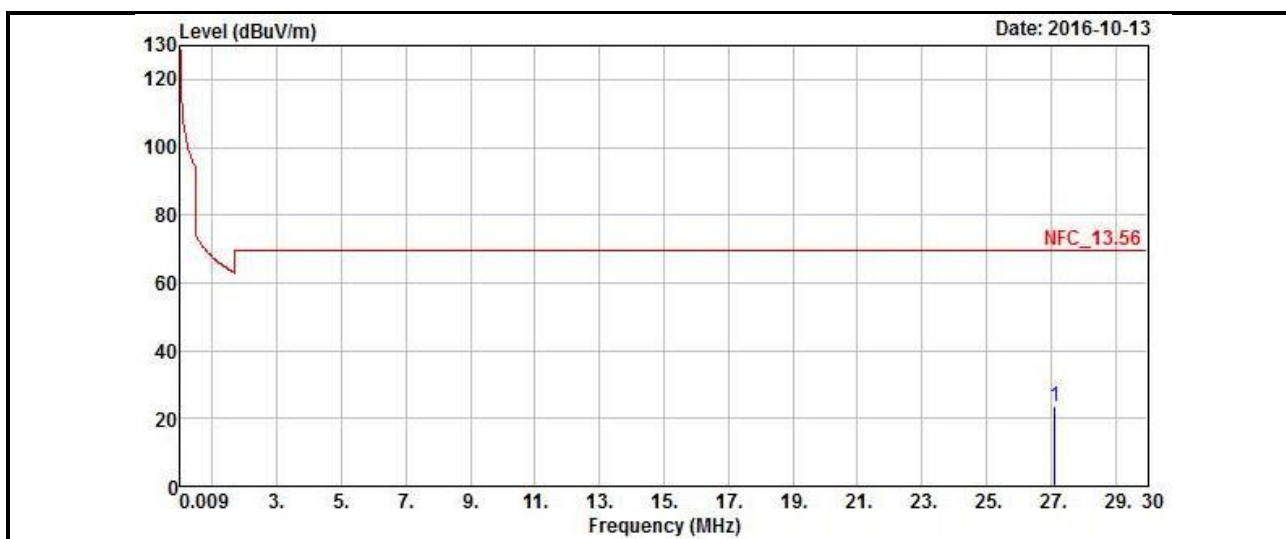
- REMARKS:**
1. Emission level(dBuV/m)=Raw Value(dBuV) + Correction Factor(dB/m)
 2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor(dB)
 3. The other emission levels were very low against the limit.
 4. Margin value = Emission level – Limit value.
 5. Above limits have been translated by the formula

The measured field strength was extrapolated to distance 30 meters, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)

Example:

$$\begin{aligned}
 13.56 \text{ MHz} &= 15848 \text{ uV/m} && 30\text{m} \\
 &= 84 \text{ dBuV/m} && 30\text{m} \\
 &= 84+20\log(30/3)^2 && 3\text{m} \\
 &= 124 \text{ dBuV/m}
 \end{aligned}$$

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 30 MHz
Input Power	120 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Getaz Yang

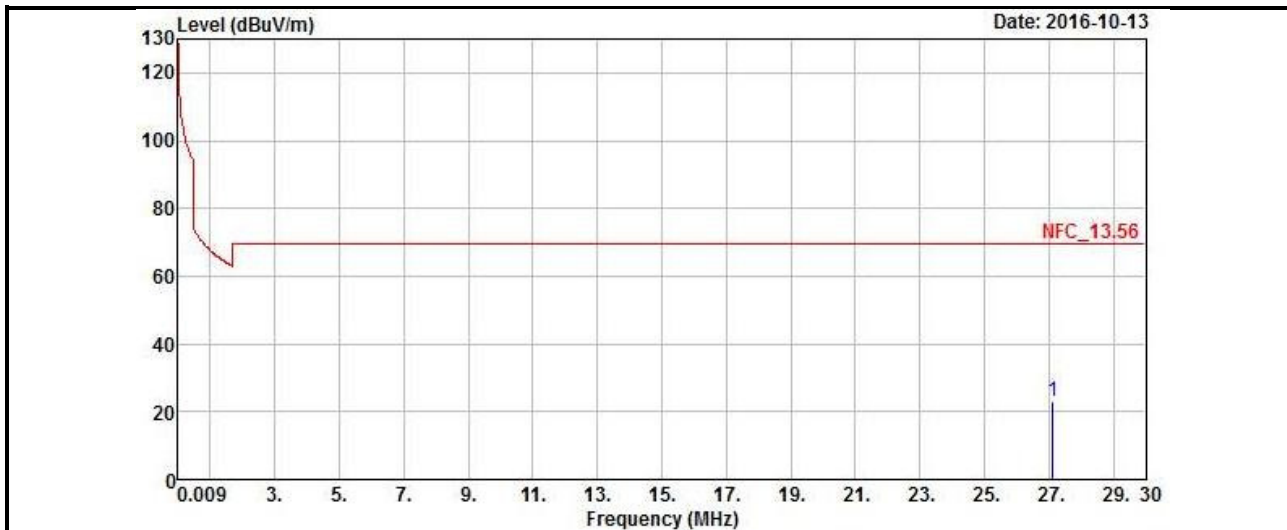


Antenna Polarity & Test Distance: Loop Antenna Open at 3M										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
27.12	23.46	28.86	69.54	-46.08	35.55	0.38	41.33	100	360	Peak

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
– Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 30 MHz
Input Power	120 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Getaz Yang



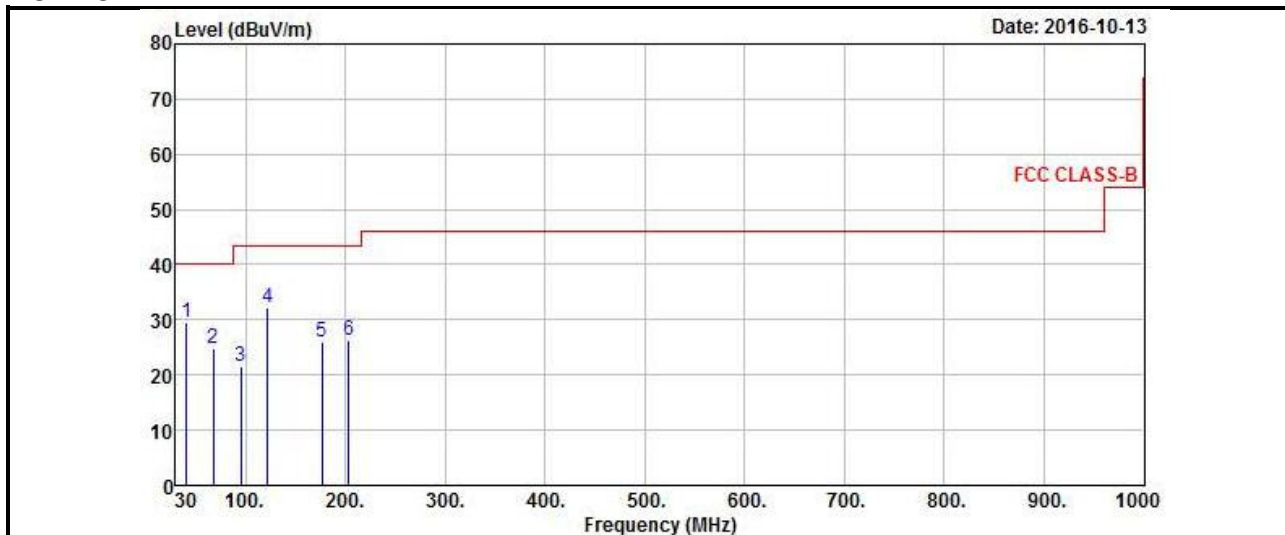
Antenna Polarity & Test Distance: Loop Antenna Close at 3M										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
27.12	23.12	28.52	69.54	-46.42	35.55	0.38	41.33	100	0	Peak

REMARKS:

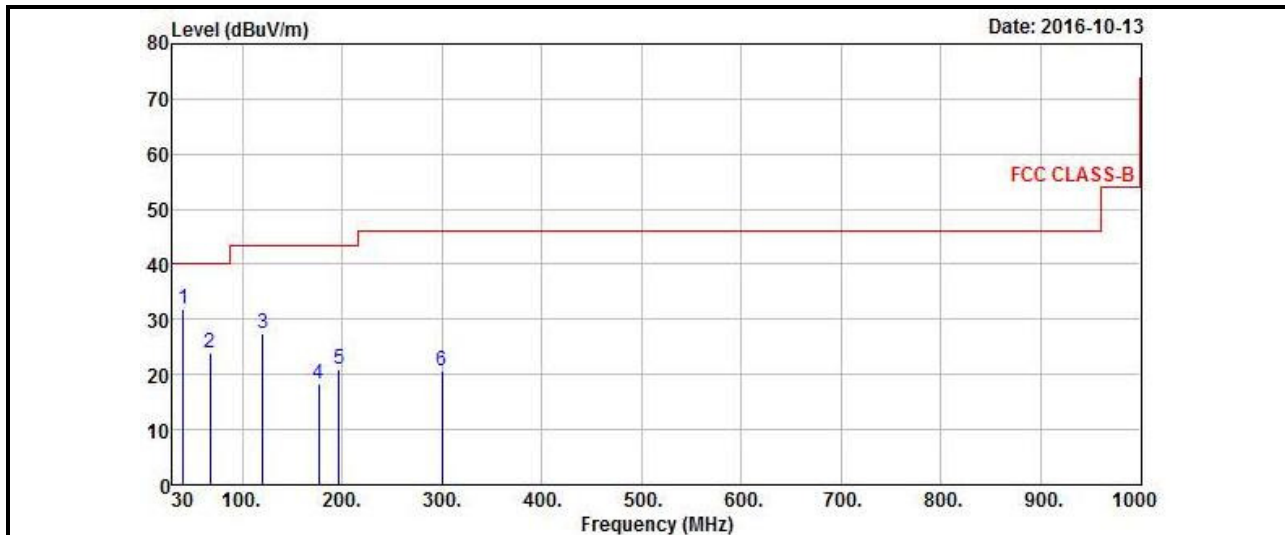
1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
– Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 1000 MHz
Input Power	120 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Getaz Yang

HORIZONTAL



VERTICAL



Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
40.67	29.53	46.35	40	-10.47	13.55	0.65	31.02	102	149	Peak
67.83	24.9	44.78	40	-15.1	11	0.85	31.73	120	210	Peak
94.99	21.63	43.89	43.5	-21.87	8.68	1.02	31.96	125	104	Peak
122.15	32.21	51.81	43.5	-11.29	11.15	1.15	31.9	123	84	Peak
176.47	26.12	45.65	43.5	-17.38	11.1	1.17	31.8	131	95	Peak
203.63	26.37	47.24	43.5	-17.13	9.52	1.31	31.7	106	168	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
40.67	31.74	48.56	40	-8.26	13.55	0.65	31.02	111	254	Peak
67.83	23.85	43.73	40	-16.15	11	0.85	31.73	115	150	Peak
120.21	27.38	47.1	43.5	-16.12	11.02	1.16	31.9	112	61	Peak
176.47	18.41	37.94	43.5	-25.09	11.1	1.17	31.8	140	280	Peak
196.84	20.81	41.7	43.5	-22.69	9.57	1.28	31.74	138	290	Peak
299.66	20.6	37.87	46	-25.4	12.94	1.63	31.84	125	106	Peak

REMARKS:

1. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value.

4.2 Conducted Emission Measurement

4.2.1 Limits of Conducted Emission Measurement

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

Note:

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date Of Calibration	Due Date Of Calibration
Test Receiver ROHDE & SCHWARZ	ESCI	100613	Nov. 16, 2015	Nov. 15, 2016
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond1-01	Dec. 26, 2015	Dec. 25, 2016
LISN/AMN ROHDE & SCHWARZ (EUT)	ESH3-Z5	835239/001	Feb. 26, 2016	Feb. 25, 2017
LISN/AMN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Jul. 28, 2016	Jul. 27, 2017
Software ADT	BV ADT_Cond_ V7.3.7.3	NA	NA	NA

- NOTE:**
1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
 2. The test was performed in HwaYa Shielded Room 1.
 3. The VCCI Site Registration No. is C-2040.

4.2.3 Test Procedures

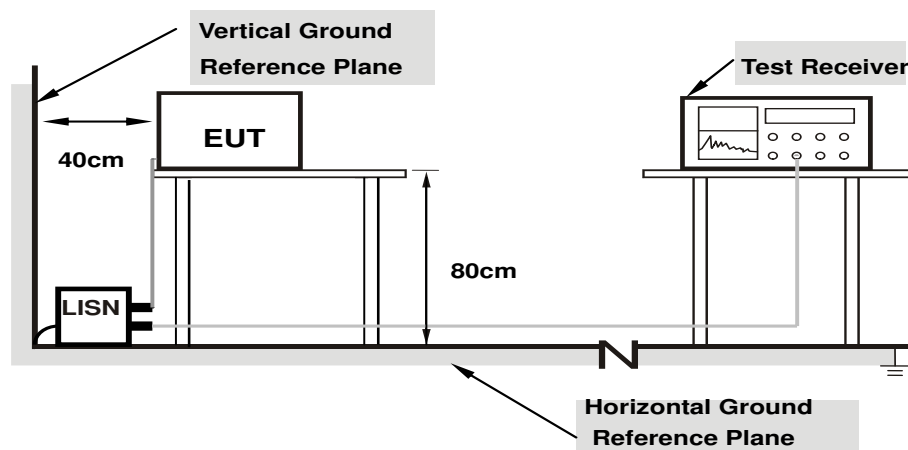
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50 uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz - 30 MHz.

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



**Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80
from other units and other metal planes**

For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.2.6 EUT Operating Conditions

- Placed the EUT on the testing table.
- Set the EUT under transmission condition continuously at specific channel frequency.

4.2.7 Test Results

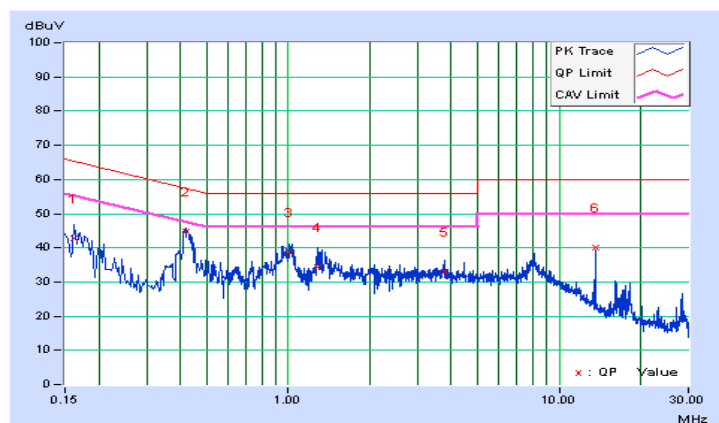
Mode A

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Toby Tian	Test Date	2016/10/26

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16173	10.02	32.68	22.16	42.70	32.18	65.37	55.37	-22.67	-23.19
2	0.42000	10.12	34.60	27.98	44.72	38.10	57.45	47.45	-12.73	-9.35
3	1.01411	10.20	28.49	22.96	38.69	33.16	56.00	46.00	-17.31	-12.84
4	1.29172	10.22	24.25	17.94	34.47	28.16	56.00	46.00	-21.53	-17.84
5	3.75893	10.39	22.71	17.74	33.10	28.13	56.00	46.00	-22.90	-17.87
6	13.56130	10.93	28.97	30.03	39.90	40.96	60.00	50.00	-20.10	-9.04

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

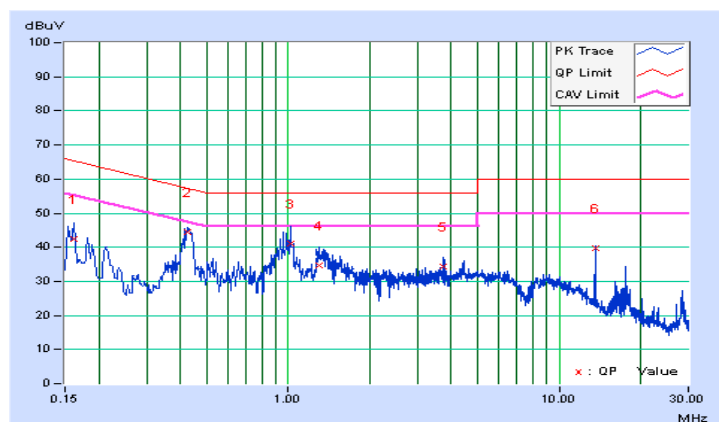


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Toby Tian	Test Date	2016/10/26

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16173	10.03	32.26	21.15	42.29	31.18	65.37	55.37	-23.08	-24.19
2	0.42445	10.13	34.17	26.90	44.30	37.03	57.36	47.36	-13.06	-10.33
3	1.01799	10.21	30.91	25.49	41.12	35.70	56.00	46.00	-14.88	-10.30
4	1.29563	10.23	24.58	18.03	34.81	28.26	56.00	46.00	-21.19	-17.74
5	3.75130	10.41	24.00	20.72	34.41	31.13	56.00	46.00	-21.59	-14.87
6	13.56130	11.02	28.56	28.58	39.58	39.60	60.00	50.00	-20.42	-10.40

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value



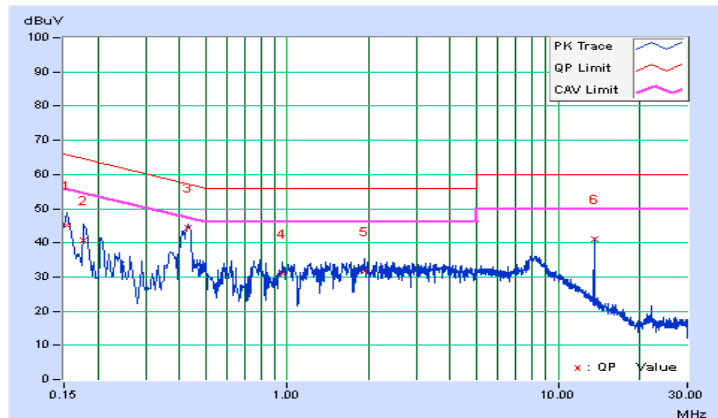
Mode B

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Toby Tian	Test Date	2016/10/26

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15391	10.02	35.07	24.99	45.09	35.01	65.79	55.79	-20.70	-20.78
2	0.17744	10.02	30.63	21.72	40.65	31.74	64.60	54.60	-23.95	-22.86
3	0.43008	10.12	34.42	27.59	44.54	37.71	57.25	47.25	-12.71	-9.54
4	0.96319	10.20	20.83	14.42	31.03	24.62	56.00	46.00	-24.97	-21.38
5	1.92514	10.26	21.26	13.98	31.52	24.24	56.00	46.00	-24.48	-21.76
6	13.56130	10.93	30.14	30.29	41.07	41.22	60.00	50.00	-18.93	-8.78

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

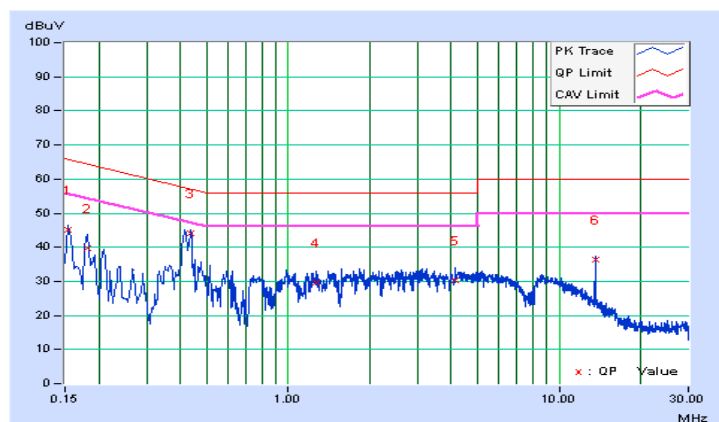


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Toby Tian	Test Date	2016/10/26

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15391	10.03	34.95	24.22	44.98	34.25	65.79	55.79	-20.81	-21.54
2	0.18122	10.03	29.66	18.96	39.69	28.99	64.43	54.43	-24.74	-25.44
3	0.43579	10.13	33.87	27.77	44.00	37.90	57.14	47.14	-13.14	-9.24
4	1.27217	10.23	19.33	11.09	29.56	21.32	56.00	46.00	-26.44	-24.68
5	4.14211	10.44	19.77	13.37	30.21	23.81	56.00	46.00	-25.79	-22.19
6	13.56130	11.02	25.27	27.02	36.29	38.04	60.00	50.00	-23.71	-11.96

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

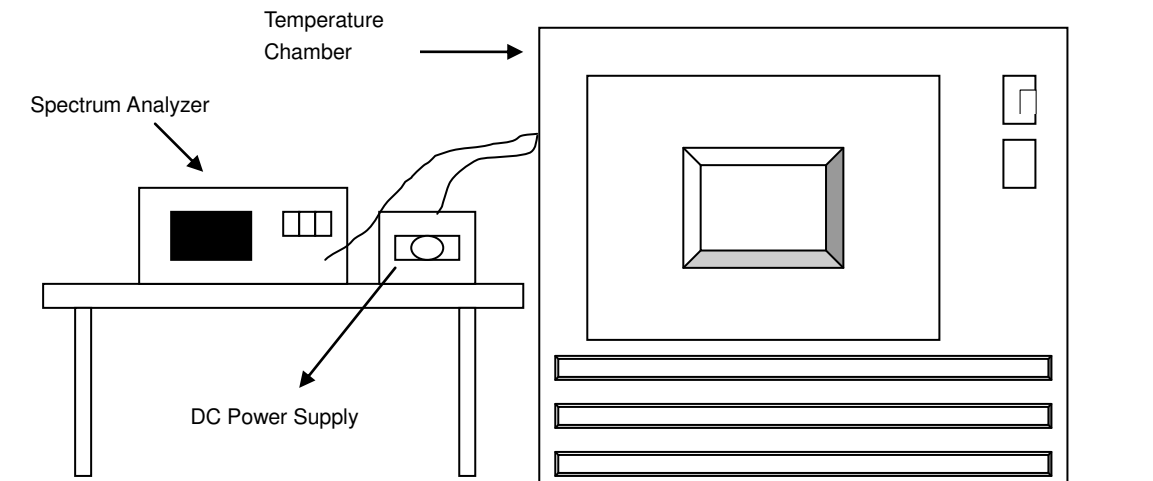


4.3 Frequency Stability

4.3.1 Limits of Frequency Stability Measurement

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to 50 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.

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedure

- The EUT was placed inside the environmental test chamber and powered by nominal AC voltage.
- Turned the EUT on and coupled its output to a spectrum analyzer.
- Turned the EUT off and set the chamber to the highest temperature specified.
- Allowed sufficient time (approximately 30 min) for the temperature of the chamber to stabilize then turned the EUT on and measured the operating frequency after 2, 5, and 10 minutes.
- Repeated step 2 and 3 with the temperature chamber set to the lowest temperature.
- The test chamber was allowed to stabilize at $+20$ degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Conditions

- Placed the EUT on the testing table.
- Set the EUT under transmission condition continuously at specific channel frequency.

4.3.7 Test Result

Mode A

Frequency Stability Versus Temperature									
Temp. (°C)	Power Supply (Vdc)	0 Minute		2 Minute		5 Minute		10 Minute	
		Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift
		(MHz)	%	(MHz)	%	(MHz)	%	(MHz)	%
55	20.0	13.560021	0.00015	13.560027	0.00020	13.560013	0.00010	13.560009	0.00007
50	20.0	13.560023	0.00017	13.560028	0.00021	13.560036	0.00027	13.560036	0.00027
40	20.0	13.559953	-0.00035	13.559954	-0.00034	13.559962	-0.00028	13.559979	-0.00015
30	20.0	13.560052	0.00038	13.560062	0.00046	13.560053	0.00039	13.560062	0.00046
20	20.0	13.560041	0.00030	13.560057	0.00042	13.560032	0.00024	13.560046	0.00034
10	20.0	13.559990	-0.00007	13.559991	-0.00007	13.560003	0.00002	13.559997	-0.00002
0	20.0	13.559949	-0.00038	13.559961	-0.00029	13.559949	-0.00038	13.559959	-0.00030
-10	20.0	13.560042	0.00031	13.560044	0.00032	13.560059	0.00044	13.560036	0.00027
-20	20.0	13.559989	-0.00008	13.559976	-0.00018	13.559994	-0.00004	13.559991	-0.00007
-30	20.0	13.559922	-0.00058	13.559942	-0.00043	13.559917	-0.00061	13.559935	-0.00048

Frequency Stability Versus Voltage									
Temp. (°C)	Power Supply (Vdc)	0 Minute		2 Minute		5 Minute		10 Minute	
		Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift
		(MHz)	%	(MHz)	%	(MHz)	%	(MHz)	%
20	22.0	13.560041	0.00030	13.560057	0.00042	13.560034	0.00025	13.560043	0.00032
	20.0	13.560041	0.00030	13.560057	0.00042	13.560032	0.00024	13.560046	0.00034
	18.0	13.56004	0.00029	13.560054	0.00040	13.560032	0.00024	13.560047	0.00035

4.4 20 dB Bandwidth

4.4.1 Limits of 20 dB Bandwidth Measurement

The 20 dB bandwidth shall be specified in operating frequency band.

4.4.2 Test Setup

Refer to section 4.1.5.

4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 Test Procedures

The bandwidth of the fundamental frequency was measured by spectrum analyzer with 1 kHz RBW and 3 kHz VBW. The 20 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB.

4.4.5 Deviation from Test Standard

No deviation.

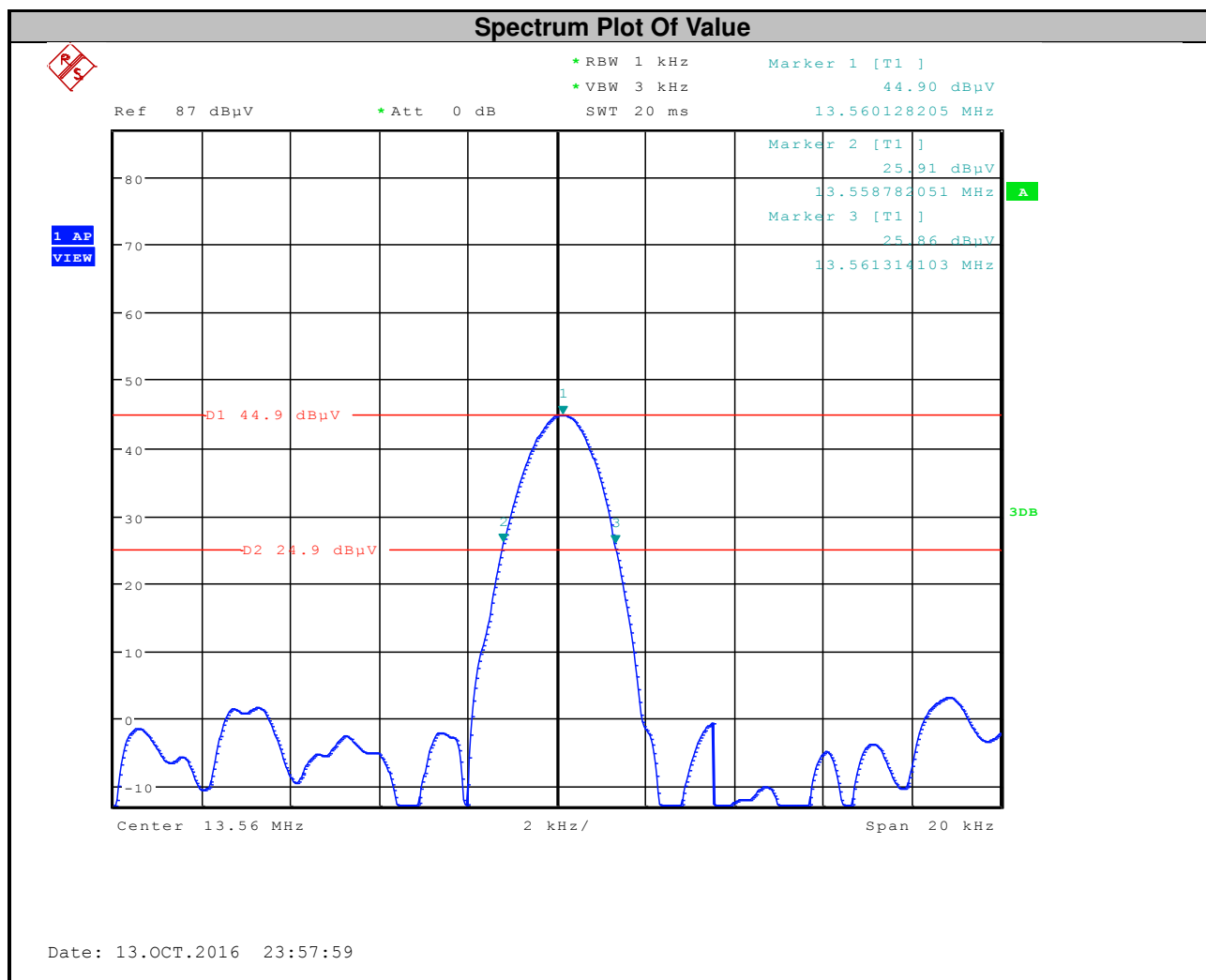
4.4.6 EUT Operating Conditions

- a. Placed the EUT on the testing table.
- b. Set the EUT under transmission condition continuously at specific channel frequency.

4.4.7 Test Results

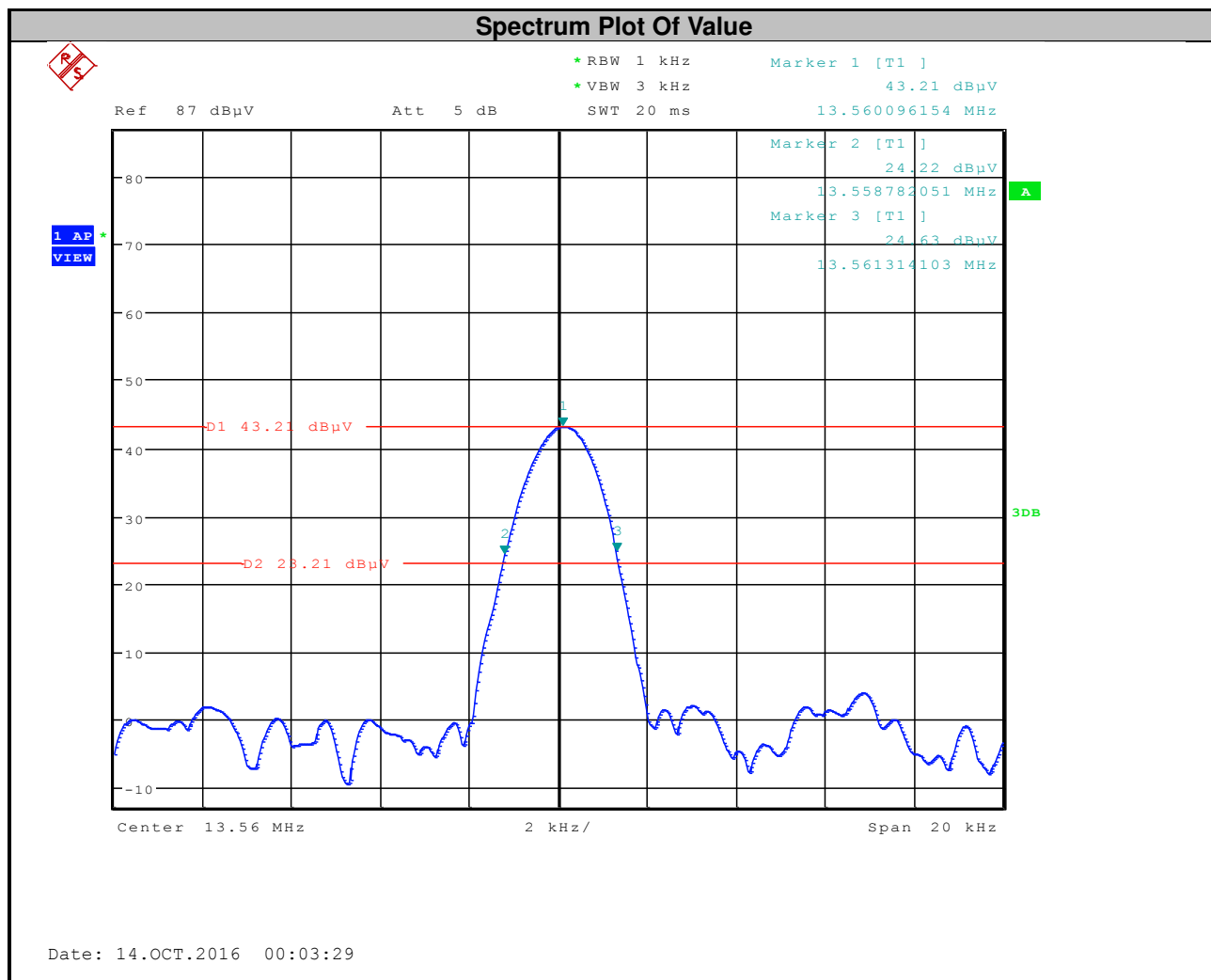
Mode A

20 dBc Point (Low)	20 dBc Point (High)	Operating Frequency Band (MHz)	Pass / Fail
13.558782051 MHz	13.561314103 MHz	13.553~13.567	Pass



Mode B

20 dBc Point (Low)	20 dBc Point (High)	Operating Frequency Band (MHz)	Pass / Fail
13.558782051 MHz	13.561314103 MHz	13.553~13.567	Pass



5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Appendix – Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Linko EMC/RF Lab

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab

Tel: 886-3-6668565

Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety

Tel: 886-3-3183232

Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com

Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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