

FCC Test Report

Report No.: RF170901E04-4

FCC ID: NOIKBEA0M05

Test Model: DPT-CP1

Received Date: Sep. 01, 2017

Test Date: Nov. 23 to Dec. 01, 2017

Issued Date: Mar. 06, 2018

Applicant: NETRONIX, INC.

Address: No. 945, Boai St., Jubei City, Hsin-Chu, 302, Taiwan, R.O.C.

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

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Taiwan R.O.C.

Test Location : E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300,
Taiwan R.O.C.

**FCC Registration /
Designation Number:** 723255 / TW2022



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Release Control Record

Issue No.	Description	Date Issued
RF170901E04-4	Original release.	Mar. 06, 2018

1 Certificate of Conformity

Product: Digital Paper

Brand: SONY

Test Model: DPT-CP1

Sample Status: MASS-PRODUCTION

Applicant: NETRONIX, INC.

Test Date: Nov. 23 to Dec. 01, 2017

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:

Mar. 06, 2018

Cindy Hsin / Specialist

Approved by :



Date:

Mar. 06, 2018

May Chen / 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 -19.06dB at 0.16953MHz.
15.225 (a)	The field strength of any emissions within the band 13.553-13.567 MHz	PASS	Meet the requirement of limit.
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 -8.10dB at 39.02MHz.
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) (\pm)
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.84 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.30 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	5.16 dB
	6GHz ~ 18GHz	4.91 dB
	18GHz ~ 40GHz	5.30 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Digital Paper
Brand	SONY
Test Model	DPT-CP1
Status of EUT	MASS-PRODUCTION
Power Supply Rating	3.7Vdc from battery or 5Vdc from USB interface
Modulation Type	ASK
Operating Frequency	13.56MHz
Number of Channel	1
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	Battery x1
Data Cable Supplied	USB cable (shielded, 1.5m) x 1

Note:

1. There are WLAN, Bluetooth and NFC technology used for the EUT.
2. Simultaneously transmission condition.

Condition	Technology		
1	WLAN 2.4GHz	Bluetooth	NFC
2	WLAN 5GHz	Bluetooth	NFC

Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.

3. The EUT needs to be supplied from battery, the information is as below table:

Brand	Model No.	Spec.
Li-ion	185360211	3.7 Vdc, 2.08Ah

4. The antennas provided to the EUT, please refer to the following table:

Antenna No.	PCB Chain No	Antenna Net. Gain(dBi)	Frequency range	Antenna Type	Connector type	Cable Length
Ant 1 (WiFi+BT)	Chain 0	1.54	2.4~2.4835GHz	PCB	IPEX 4	121mm
		2.19	5.15~5.85GHz			
Ant 0 (WiFi)	Chain 1	3.92	2.4~2.4835GHz	PCB	IPEX 4	90mm
		3.49	5.15~5.85GHz			
NFC	-	-	13.56 MHz	FPC	NA	-

5. The EUT incorporates a MIMO function.

2.4GHz Band			
MODULATION MODE	DATA RATE (MCS)	TX & RX CONFIGURATION	
802.11b	1 ~ 11Mbps	1TX diversity	2RX
802.11g	6 ~ 54Mbps	1TX diversity	2RX
802.11n (HT20)	MCS 0~7	1TX diversity	2RX
	MCS 8~15	2TX	2RX
5GHz Band			
MODULATION MODE	DATA RATE (MCS)	TX & RX CONFIGURATION	
802.11a	6 ~ 54Mbps	1TX diversity	2RX
802.11n (HT20)	MCS 0~7	1TX diversity	2RX
	MCS 8~15	2TX	2RX
802.11n (HT40)	MCS 0~7	1TX diversity	2RX
	MCS 8~15	2TX	2RX
802.11ac (VHT20)	MCS0~8 Nss=1	1TX diversity	2RX
	MCS0~8 Nss=2	2TX	2RX
802.11ac (VHT40)	MCS0~9 Nss=1	1TX diversity	2RX
	MCS0~9 Nss=2	2TX	2RX
802.11ac (VHT80)	MCS0~9 Nss=1	1TX diversity	2RX
	MCS0~9 Nss=2	2TX	2RX

6. For the radiated emissions, the EUT was pre-tested under the following modes:

Test Mode	Description
Mode A	Power from adapter
Mode B	Power from battery

From the above modes, the worst case was found in **Mode A**. Therefore only the test data of the mode was recorded in this report.

7. 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	FREQ. (MHz)
1	13.56

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable to				Description
	RE	PLC	FS	EB	
1	√	√	√	√	Adapter Mode
2	-	√	-	-	Laptop Mode

Where **RE:** Radiated Emission **PLC:** Power Line Conducted Emission
FS: Frequency Stability **EB:** 20dB Bandwidth measurement

NOTE: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **X-plane**.

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.

Available Channel	Tested Channel	Modulation Type
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.

Available Channel	Tested Channel	Modulation Type
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.

Available Channel	Tested Channel	Modulation Type
1	1	ASK

20dB 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.

Available Channel	Tested Channel	Modulation Type
1	1	ASK

TEST CONDITION:

Applicable To	ENVIRONMENTAL CONDITIONS	INPUT POWER (System)	TESTED BY
RE	24deg. C, 69%RH 23deg. C, 69%RH	120Vac, 60Hz	Frank Chuang
PLC	25deg. C, 58%RH 25deg. C, 75%RH	120Vac, 60Hz	Andy Ho
FS	25deg. C, 60%RH	120Vac, 60Hz	Anderson Chen
EB	25deg. C, 60%RH	120Vac, 60Hz	Anderson Chen

3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Adapter	SONY	AC-UUD12	NA	NA	Supplied by client
B.	NFC Card	Sony	XPERIA NFC Card	NA	NA	Supplied by client
C.	Laptop	DELL	E6420	B92T3R1	FCC DoC	Provided by Lab

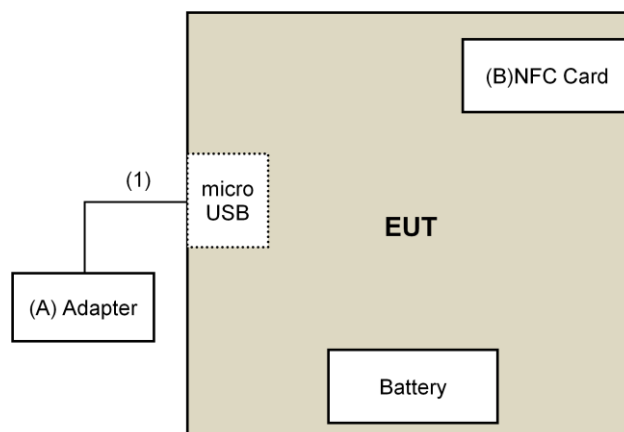
Note:

1. All power cords of the above support units are non-shielded (1.8m).

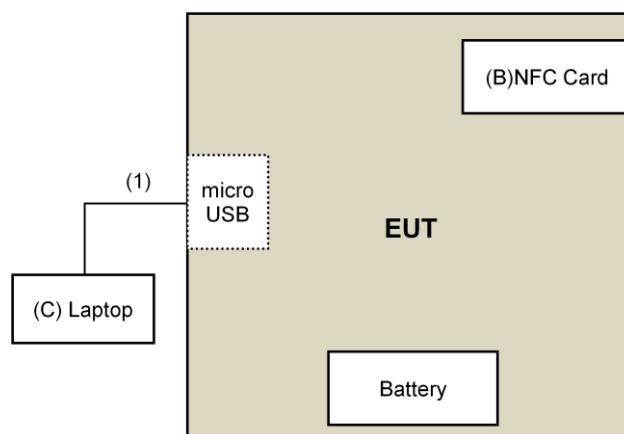
ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	USB Cable	1	1.5	Yes	0	Supplied by client

3.4 Configuration of System under Test

For Adapter Mode :



For Laptop Mode :



3.5 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

(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 band shall not exceed the general radiated emission limits in §15.209 as below 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

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 1000MHz, 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 20dB under any condition of modulation.

4.1.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Keysight	N9038A	MY54450088	July 08, 2017	July 07, 2018
Pre-Amplifier ^(*) EMCI	EMC001340	980142	Jan. 20, 2016	Jan. 19, 2018
Loop Antenna ^(*) Electro-Metrics	EM-6879	264	Dec. 16, 2016	Dec. 15, 2018
RF Cable	NA	LOOPCAB-001 LOOPCAB-002	Jan. 17, 2017	Jan. 16, 2018
Pre-Amplifier Mini-Circuits	ZFL-1000VH2B	AMP-ZFL-01	Nov. 09, 2017	Nov. 08, 2018
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-406	Dec. 13, 2016	Dec. 12, 2017
RF Cable	8D	966-4-1 966-4-2 966-4-3	Apr. 01, 2017	Mar. 31, 2018
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-3m-4-01	Oct. 03, 2017	Oct. 02, 2018
Software	ADT_Radiated_V8.7.08	NA	NA	NA
Antenna Tower & Turn Table Max-Full	MF-7802	MF780208410	NA	NA
Spectrum Analyzer R&S	FSv40	100964	July 01, 2017	June 30, 2018
Spectrum Analyzer Keysight	N9030A	MY54490570	July 08, 2017	July 07, 2018
AC Power Source Extech Electronics	6502	1140503	NA	NA
Temperature & Humidity Chamber TERCHY	MHU-225AU	911033	Dec. 02, 2016	Dec. 01, 2017
DC Power Supply GOOD WILL INSTRUMENT CO., LTD.	GPC - 3030D	7700087	NA	NA
Digital Multimeter FLUKE	325	31130711WS	May 29, 2017	May 28, 2018

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 calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. The test was performed in 966 Chamber No. 4.
4. The CANADA Site Registration No. is 20331-2
5. Loop antenna was used for all emissions below 30 MHz.
6. Tested Date: Nov. 23 to 24, 2017

4.1.3 Test Procedures

For Radiated emission below 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. 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. Both X and Y axes of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case 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 Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. 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. The height of 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 quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

Note:

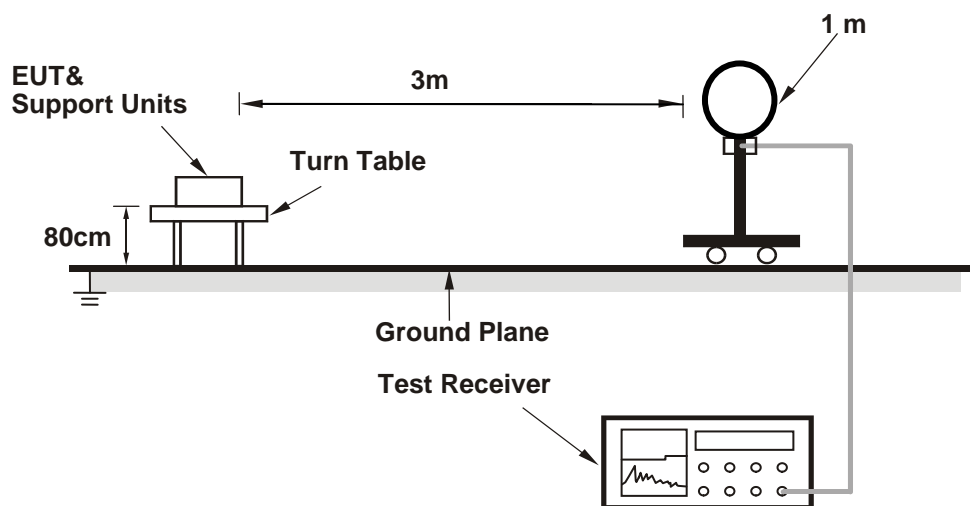
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency above 30MHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

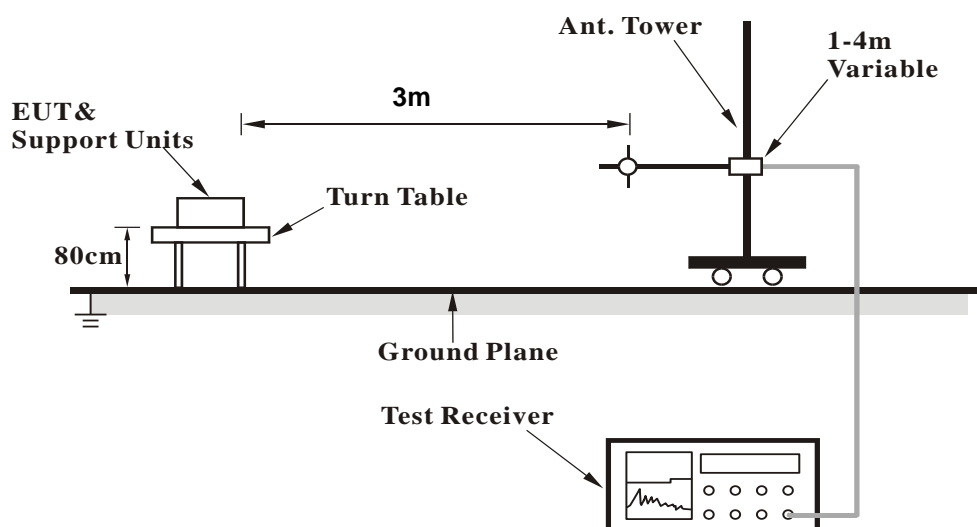
No deviation.

4.1.5 Test Setup

For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



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

4.1.6 EUT Operating Conditions

- Controlling software (NFC Card touch) has been activated to set the EUT on specific status.

4.1.7 Test Results

Type A

Frequency Range	13.110 ~ 14.010MHz	Detector Function	Quasi-Peak
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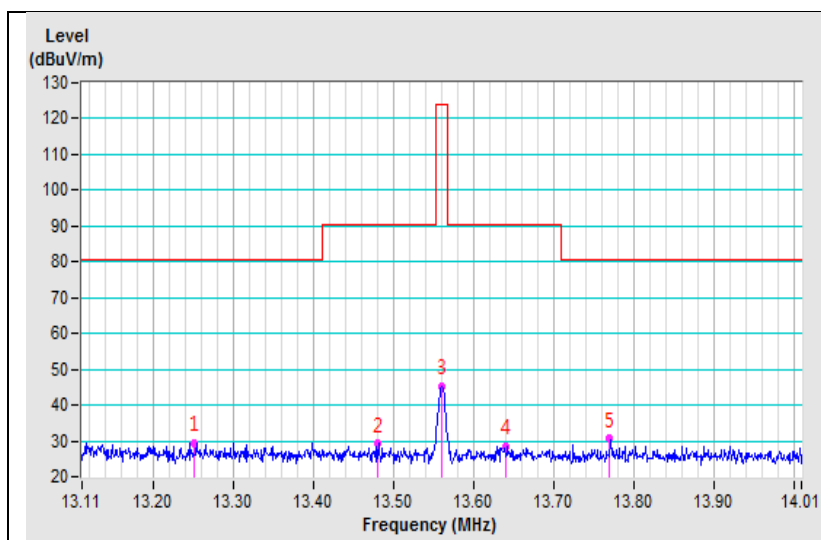
Antenna Polarity & Test Distance: Loop Antenna Open At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	13.25	29.50 QP	80.50	-51.00	1.00	59	32.80	-3.30
2	13.48	29.20 QP	90.50	-61.30	1.00	59	32.50	-3.30
3	*13.56	45.10 QP	124.00	-78.90	1.00	59	48.40	-3.30
4	13.64	28.30 QP	90.50	-62.20	1.00	59	31.60	-3.30
5	13.77	30.50 QP	80.50	-50.00	1.00	59	33.90	-3.40

- 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
 6. " * ": Fundamental frequency.

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:

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



Frequency Range	13.110 ~ 14.010MHz	Detector Function	Quasi-Peak
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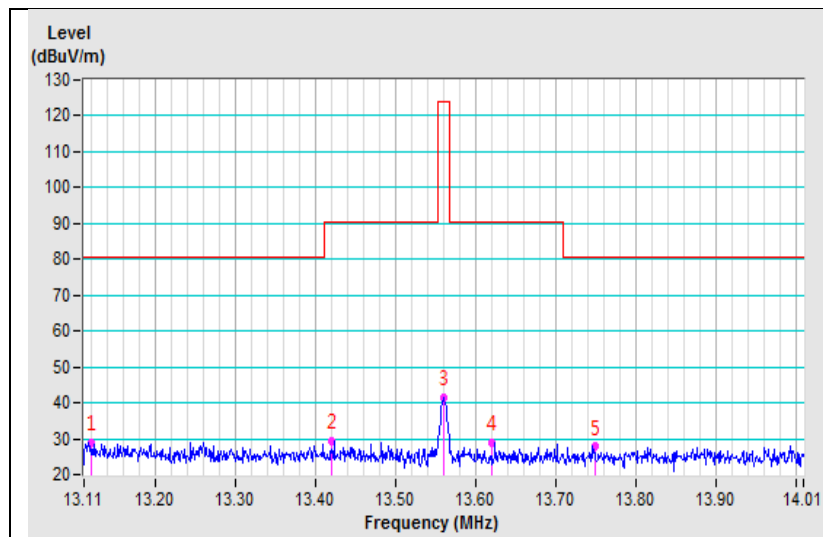
Antenna Polarity & Test Distance: Loop Antenna Close At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	13.12	28.80 QP	80.50	-51.70	1.00	317	32.10	-3.30
2	13.42	29.40 QP	90.50	-61.10	1.00	317	32.70	-3.30
3	*13.56	41.50 QP	124.00	-82.50	1.00	317	44.80	-3.30
4	13.62	29.00 QP	90.50	-61.50	1.00	317	32.30	-3.30
5	13.75	27.70 QP	80.50	-52.80	1.00	317	31.10	-3.40

- 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
 6. " * ": Fundamental frequency.

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:

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



Frequency Range	Below 30MHz	Detector Function	Quasi-Peak
-----------------	-------------	-------------------	------------

Antenna Polarity & Test Distance: Loop Antenna Open At 3m								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	3.01	25.90 QP	69.50	-43.60	1.00	321	28.90	-3.00
2	10.02	30.70 QP	69.50	-38.80	1.00	151	33.50	-2.80
3	12.82	29.40 QP	69.50	-40.10	1.00	2	32.60	-3.20
4	22.69	32.80 QP	69.50	-36.70	1.00	20	36.50	-3.70
5	24.61	40.20 QP	69.50	-29.30	1.00	302	43.50	-3.30
6	26.89	41.40 QP	69.50	-28.10	1.00	121	44.20	-2.80
Antenna Polarity & Test Distance: Loop Antenna Close At 3m								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	3.62	24.80 QP	69.50	-44.70	1.00	151	27.80	-3.00
2	7.20	26.70 QP	69.50	-42.80	1.00	62	29.60	-2.90
3	10.09	31.10 QP	69.50	-38.40	1.00	55	33.90	-2.80
4	22.69	33.20 QP	69.50	-36.30	1.00	145	36.90	-3.70
5	24.05	33.20 QP	69.50	-36.30	1.00	54	36.60	-3.40
6	27.27	37.80 QP	69.50	-31.70	1.00	328	40.50	-2.70

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

Frequency Range	30MHz ~ 1000MHz	Detector Function	Quasi-Peak
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Antenna Polarity & Test Distance: Horizontal At 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	49.50	22.40 QP	40.00	-17.60	1.00	287	30.50	-8.10
2	174.29	22.10 QP	43.50	-21.40	2.00	283	30.50	-8.40
3	193.71	24.20 QP	43.50	-19.30	1.00	116	35.10	-10.90
4	325.32	23.10 QP	46.00	-22.90	1.50	38	29.80	-6.70
5	530.81	26.90 QP	46.00	-19.10	1.50	276	29.00	-2.10
6	626.65	29.30 QP	46.00	-16.70	1.50	0	29.10	0.20
Antenna Polarity & Test Distance: Vertical At 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	42.12	26.20 QP	40.00	-13.80	1.00	307	34.30	-8.10
2	58.66	23.70 QP	40.00	-16.30	1.00	95	32.10	-8.40
3	122.03	22.90 QP	43.50	-20.60	1.00	360	32.30	-9.40
4	197.30	20.20 QP	43.50	-23.30	2.00	89	31.40	-11.20
5	477.41	25.80 QP	46.00	-20.20	1.50	299	28.70	-2.90
6	672.75	29.10 QP	46.00	-16.90	1.00	266	28.50	0.60

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

Type F

Frequency Range	13.110 ~ 14.010MHz	Detector Function	Quasi-Peak
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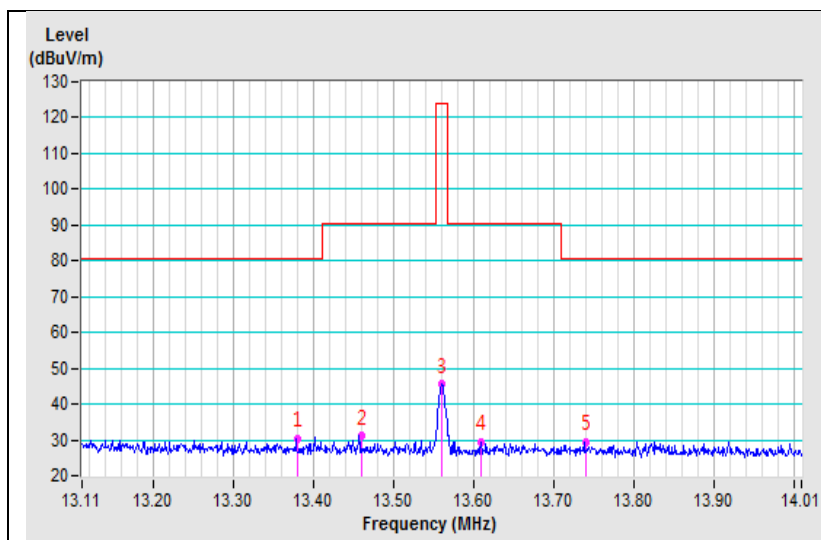
Antenna Polarity & Test Distance: Loop Antenna Open At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	13.38	30.20 QP	80.50	-50.30	1.00	5	33.50	-3.30
2	13.46	31.00 QP	90.50	-59.50	1.00	5	34.30	-3.30
3	*13.56	45.50 QP	124.00	-78.50	1.00	5	48.80	-3.30
4	13.61	29.30 QP	90.50	-61.20	1.00	5	32.60	-3.30
5	13.74	29.40 QP	80.50	-51.10	1.00	5	32.80	-3.40

- 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
 6. " * ": Fundamental frequency.

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:

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



Frequency Range	13.110 ~ 14.010MHz	Detector Function	Quasi-Peak
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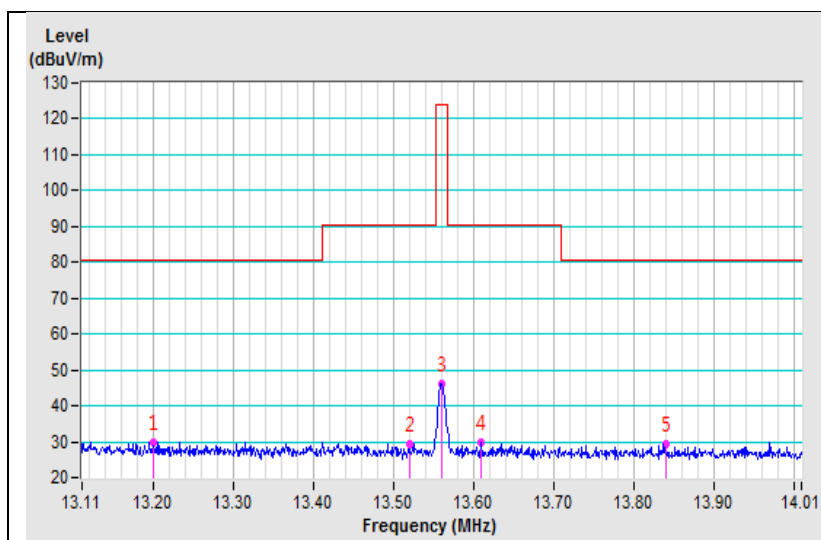
Antenna Polarity & Test Distance: Loop Antenna Close At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	13.20	29.70 QP	80.50	-50.80	1.00	319	33.00	-3.30
2	13.52	29.50 QP	90.50	-61.00	1.00	319	32.80	-3.30
3	*13.56	46.00 QP	124.00	-78.00	1.00	319	49.30	-3.30
4	13.61	29.70 QP	90.50	-60.80	1.00	319	33.00	-3.30
5	13.84	29.30 QP	80.50	-51.20	1.00	319	32.70	-3.40

- 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
 6. " * ": Fundamental frequency.

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:

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



Frequency Range	Below 30MHz	Detector Function	Quasi-Peak
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Antenna Polarity & Test Distance: Loop Antenna Open At 3m								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2.17	25.50 QP	69.50	-44.00	1.00	32	26.90	-1.40
2	6.71	27.00 QP	69.50	-42.50	1.00	122	29.90	-2.90
3	10.09	31.30 QP	69.50	-38.20	1.00	3	34.10	-2.80
4	11.61	34.00 QP	69.50	-35.50	1.00	263	37.00	-3.00
5	22.69	31.60 QP	69.50	-37.90	1.00	330	35.30	-3.70
6	25.57	42.50 QP	69.50	-27.00	1.00	229	45.50	-3.00
Antenna Polarity & Test Distance: Loop Antenna Close At 3m								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	1.60	31.10 QP	63.50	-32.40	1.00	230	31.50	-0.40
2	3.60	27.10 QP	69.50	-42.40	1.00	152	30.10	-3.00
3	10.10	30.60 QP	69.50	-38.90	1.00	102	33.40	-2.80
4	11.47	28.90 QP	69.50	-40.60	1.00	78	31.90	-3.00
5	22.69	32.30 QP	69.50	-37.20	1.00	302	36.00	-3.70
6	25.38	42.30 QP	69.50	-27.20	1.00	332	45.40	-3.10

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

Frequency Range	30MHz ~ 1000MHz	Detector Function	Quasi-Peak
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Antenna Polarity & Test Distance: Horizontal At 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	51.87	22.40 QP	40.00	-17.60	1.50	215	30.60	-8.20
2	162.55	21.70 QP	43.50	-21.80	2.00	152	29.50	-7.80
3	193.71	22.40 QP	43.50	-21.10	1.00	106	33.30	-10.90
4	294.76	21.50 QP	46.00	-24.50	1.00	229	29.10	-7.60
5	437.13	25.60 QP	46.00	-20.40	2.00	193	29.20	-3.60
6	596.29	28.20 QP	46.00	-17.80	2.00	39	28.40	-0.20
Antenna Polarity & Test Distance: Vertical At 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	39.02	31.90 QP	40.00	-8.10	1.00	346	40.20	-8.30
2	117.03	25.90 QP	43.50	-17.60	1.00	346	35.70	-9.80
3	195.00	28.10 QP	43.50	-15.40	1.00	345	39.10	-11.00
4	353.28	23.40 QP	46.00	-22.60	1.00	360	29.50	-6.10
5	585.01	30.10 QP	46.00	-15.90	1.00	345	30.90	-0.80
6	644.37	29.80 QP	46.00	-16.20	1.00	70	29.40	0.40

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

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 0.50MHz.

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.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver R&S	ESCS 30	847124/029	Nov. 01, 2017	Oct. 31, 2018
Line-Impedance Stabilization Network (for EUT) R&S	ESH3-Z5	848773/004	Nov. 15, 2016	Nov. 14, 2018
Line-Impedance Stabilization Network (for Peripheral) R&S	ENV216	100072	June 03, 2017	June 02, 2018
50 ohms Terminator	N/A	EMC-02	Sep. 22, 2017	Sep. 21, 2018
RF Cable	5D-FB	COCCAB-001	Sep. 29, 2017	Sep. 28, 2018
10 dB PAD Mini-Circuits	HAT-10+	CONATT-004	June 18, 2017	June 17, 2018
Software BVADT	BVADT_Cond_ V7.3.7.4	NA	NA	NA

Note:

1. The calibration interval of the above test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in Shielded Room No. 1.
3. Tested Date: Nov. 29 to Dec. 01, 2017

4.2.3 Test Procedures

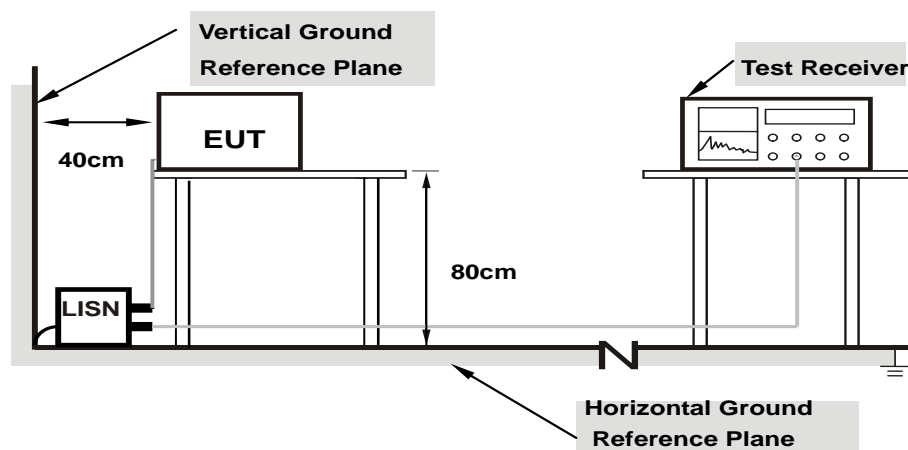
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance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

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

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 TEST SETUP



Note: 1.Support units were connected to second LISN.

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

4.2.6 EUT Operating Conditions

Same as 4.1.6.

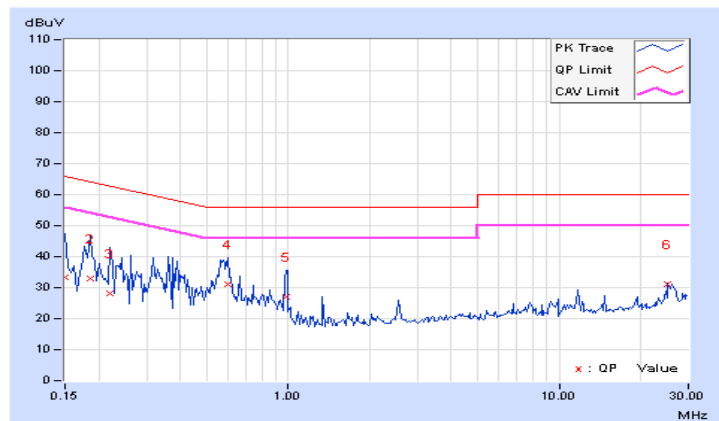
4.2.7 Test Results (Mode 1)

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
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No	Freq. [MHz]	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
		(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.09	23.15	6.18	33.24	16.27	66.00	56.00	-32.76	-39.73
2	0.18516	10.07	23.01	3.46	33.08	13.53	64.25	54.25	-31.17	-40.72
3	0.22031	10.08	17.96	1.81	28.04	11.89	62.81	52.81	-34.77	-40.92
4	0.59922	10.14	21.10	5.21	31.24	15.35	56.00	46.00	-24.76	-30.65
5	0.97813	10.17	16.98	1.79	27.15	11.96	56.00	46.00	-28.85	-34.04
6	25.22656	11.66	19.51	8.03	31.17	19.69	60.00	50.00	-28.83	-30.31

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.

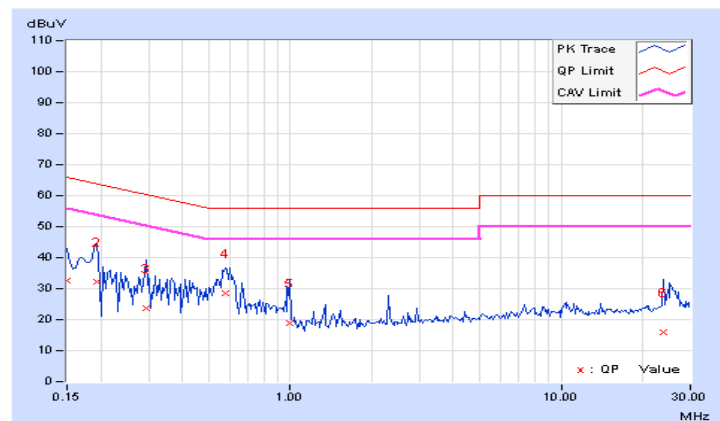


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
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No	Freq. [MHz]	Corr.	Reading Value		Emission Level		Limit		Margin	
		Factor	[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
		(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.08	22.69	6.42	32.77	16.50	66.00	56.00	-33.23	-39.50
2	0.19297	10.04	22.21	-1.52	32.25	8.52	63.91	53.91	-31.66	-45.39
3	0.29453	10.08	13.51	-4.82	23.59	5.26	60.40	50.40	-36.81	-45.14
4	0.57578	10.12	18.28	2.53	28.40	12.65	56.00	46.00	-27.60	-33.35
5	0.99766	10.13	8.83	-4.74	18.96	5.39	56.00	46.00	-37.04	-40.61
6	23.91797	11.28	4.48	-6.81	15.76	4.47	60.00	50.00	-44.24	-45.53

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.



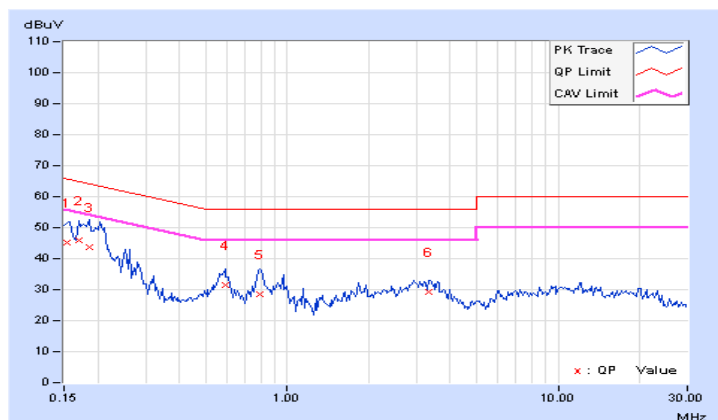
4.2.8 Test Results (Mode 2)

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
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No	Freq. [MHz]	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
		(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15391	10.07	35.23	20.48	45.30	30.55	65.79	55.79	-20.49	-25.24
2	0.16953	10.07	35.85	21.54	45.92	31.61	64.98	54.98	-19.06	-23.37
3	0.18516	10.06	33.80	16.84	43.86	26.90	64.25	54.25	-20.39	-27.35
4	0.59141	10.12	21.44	13.11	31.56	23.23	56.00	46.00	-24.44	-22.77
5	0.79063	10.14	18.31	9.36	28.45	19.50	56.00	46.00	-27.55	-26.50
6	3.34375	10.24	18.86	13.49	29.10	23.73	56.00	46.00	-26.90	-22.27

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.

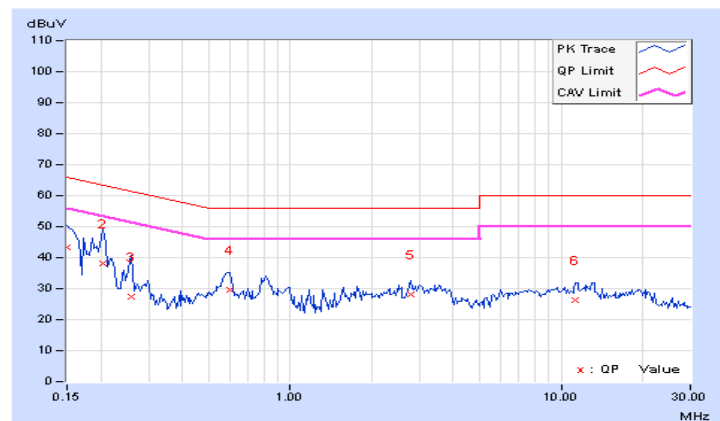


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
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No	Freq. [MHz]	Corr.	Reading Value		Emission Level		Limit		Margin	
		Factor	[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
		(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.07	33.16	22.09	43.23	32.16	66.00	56.00	-22.77	-23.84
2	0.20469	10.03	28.21	7.78	38.24	17.81	63.42	53.42	-25.18	-35.61
3	0.25938	10.05	17.36	5.38	27.41	15.43	61.45	51.45	-34.04	-36.02
4	0.59922	10.11	19.55	11.03	29.66	21.14	56.00	46.00	-26.34	-24.86
5	2.78516	10.19	17.89	13.14	28.08	23.33	56.00	46.00	-27.92	-22.67
6	11.29688	10.62	15.70	10.05	26.32	20.67	60.00	50.00	-33.68	-29.33

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.

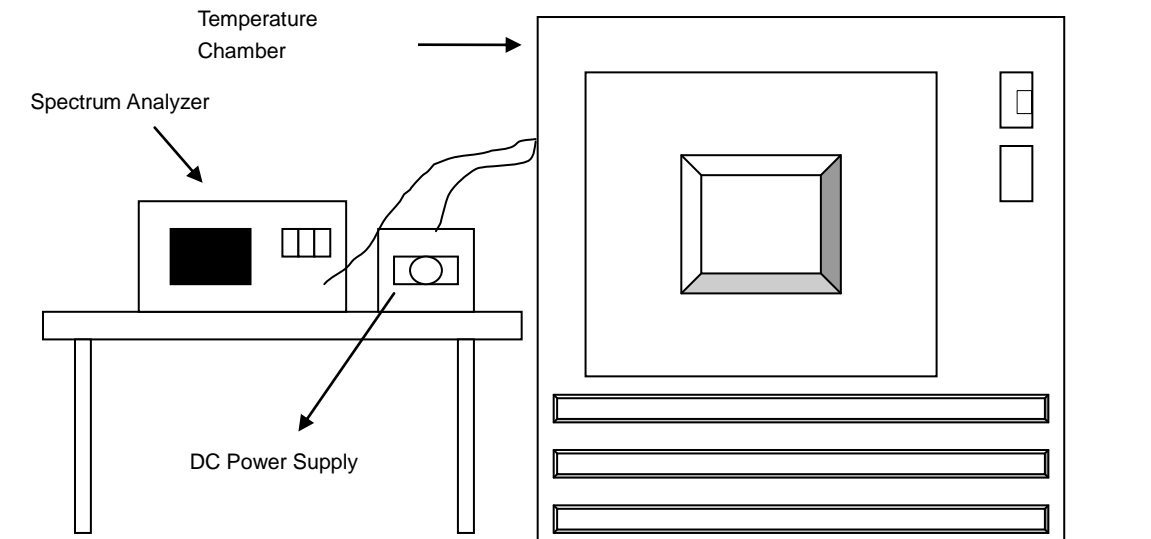


4.3 Frequency Stability

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 DC 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

Same as Item 4.1.6.

4.3.7 Test Result

Frequency Stability Versus Temp.									
TEMP. (°C)	Power Supply (Vdc)	0 Minute		2 Minutes		5 Minutes		10 Minutes	
		Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift
		(MHz)	%	(MHz)	%	(MHz)	%	(MHz)	%
50	3.7	13.55993	-0.00052	13.55993	-0.00052	13.55994	-0.00044	13.55994	-0.00044
40	3.7	13.55995	-0.00037	13.55994	-0.00044	13.55995	-0.00037	13.55995	-0.00037
30	3.7	13.55995	-0.00037	13.55995	-0.00037	13.55995	-0.00037	13.55996	-0.00029
20	3.7	13.56006	0.00044	13.56005	0.00037	13.56006	0.00044	13.56004	0.00029
10	3.7	13.56005	0.00037	13.56006	0.00044	13.56005	0.00037	13.56005	0.00037
0	3.7	13.56002	0.00015	13.56002	0.00015	13.56002	0.00015	13.56003	0.00022
-10	3.7	13.55997	-0.00022	13.55998	-0.00015	13.55999	-0.00007	13.55998	-0.00015
-20	3.7	13.56004	0.00029	13.56003	0.00022	13.56003	0.00022	13.56003	0.00022
-30	3.7	13.55999	-0.00007	13.56	0.00000	13.56	0.00000	13.55999	-0.00007

Frequency Stability Versus Voltage									
TEMP. (°C)	Power Supply (Vdc)	0 Minute		2 Minutes		5 Minutes		10 Minutes	
		Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift
		(MHz)	%	(MHz)	%	(MHz)	%	(MHz)	%
20	4.255	13.56006	0.00044	13.56005	0.00037	13.56006	0.00044	13.56004	0.00029
	3.7	13.56006	0.00044	13.56005	0.00037	13.56006	0.00044	13.56004	0.00029
	3.145	13.56006	0.00044	13.56005	0.00037	13.56006	0.00044	13.56004	0.00029

4.4 20dB bandwidth

4.4.1 Limits of 20dB Bandwidth Measurement

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

4.4.2 Test Setup

Same as Item 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 10HzRBW and 30Hz VBW. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

4.4.5 Deviation from Test Standard

No deviation.

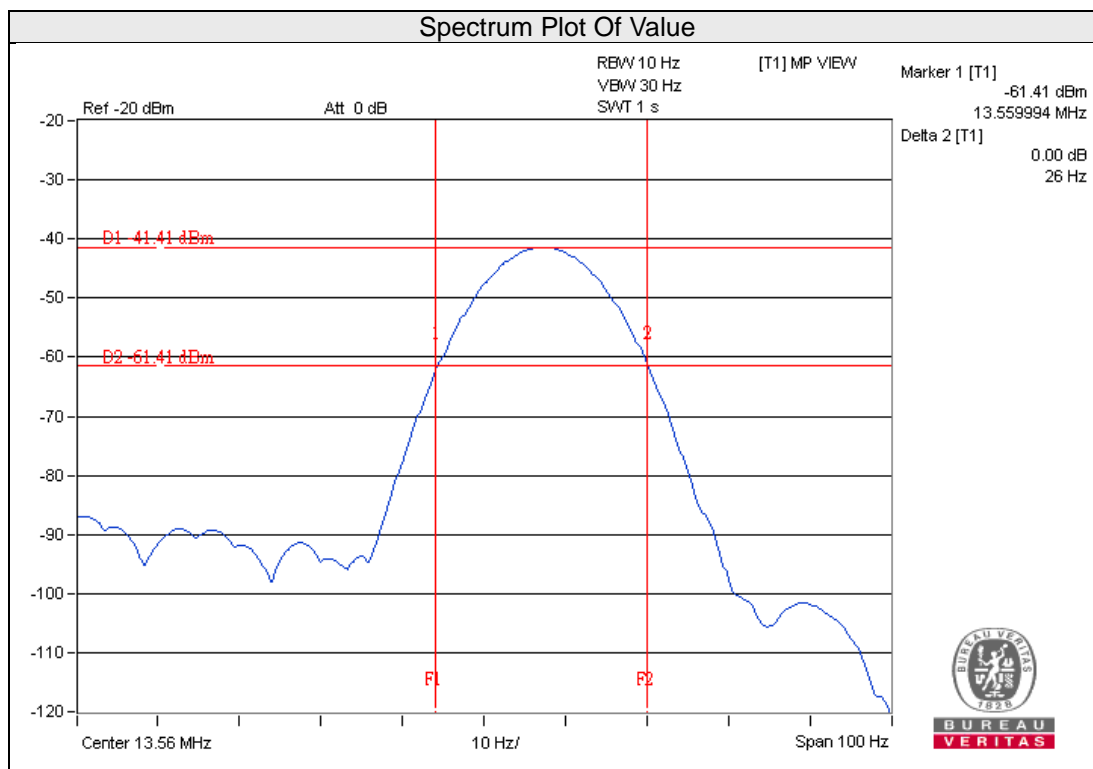
4.4.6 EUT Operating Conditions

Same as Item 4.1.6.

4.4.7 Test Results

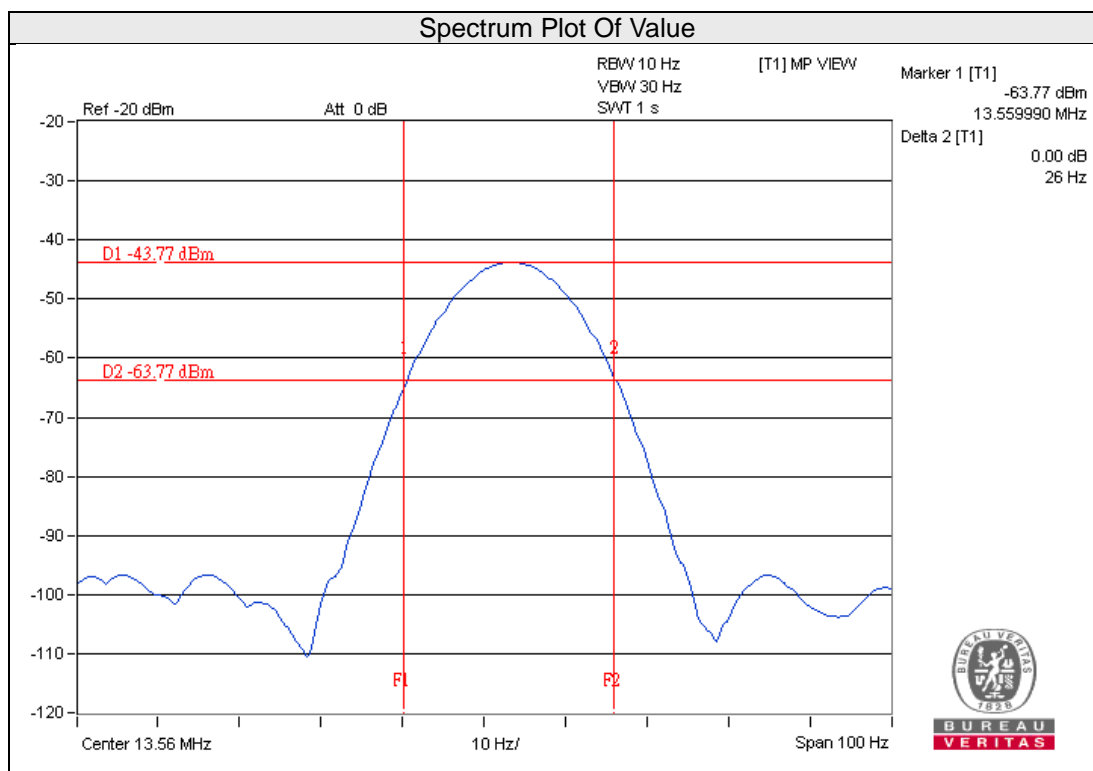
Type A

20dBc point (Low)	20dBc point (High)	Operating frequency band (MHz)	Pass/Fail
13.559994	13.56002	13.11 – 14.01	PASS



Type F

20dBc point (Low)	20dBc point (High)	Operating frequency band (MHz)	Pass/Fail
13.55999	13.560016	13.11 – 14.01	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 FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

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

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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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