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LG Electronics USA

EMC TEST REPORT

Report Type:
FCC Part 18 EMC report

Model:
See Page 2

REPORT NUMBER:
190900855SHA-002

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TEST REPORT

Report no.: 190900855SHA-002

Applicant:	LG Electronics USA 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, United States
Manufacturing Site:	LG Electronics Tianjin Appliances Co., Ltd. No.9 Jinwei Road, Bei Chen Dist., Tianjin 300402, People's Republic of China
Product Name:	Microwave oven
Type/Model:	MVCV21#####, CVM521P#####, PVM9215#####, MVPV21#####, MVPN21#####, PNM9216##### (# represents "A to Z" or "0 to 9" or blank, according to exterior design, color, cooking utensil or market)
FCC ID:	BEJV2272TAB

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:
47CFR Part 18 (2017): Industrial, Scientific, and Medical Equipment **FCC/OET MP-5 (1986):** FCC methods of Measurements of Radio Noise Emissions From Industrial, Scientific, and Medical Equipment

PREPARED BY:	**REVIEWED BY:**
Wade zhang	Danny
Project Engineer Wade Zhang	Reviewer Daniel Zhao

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Content

REVISION HISTORY **4**

MEASUREMENT RESULT SUMMARY **5**

1 GENERAL INFORMATION **6**

1.1 DESCRIPTION OF EQUIPMENT UNDER TEST (EUT) 6
1.2 DESCRIPTION OF TEST FACILITY 6

2 TEST SPECIFICATIONS **7**

2.1 STANDARDS OR SPECIFICATION 7
2.2 MODE OF OPERATION DURING THE TEST 7
2.3 TEST SOFTWARE LIST 7
2.4 TEST PERIPHERALS LIST 7
2.5 TEST LOAD DESCRIPTION 7
2.6 TEST ENVIRONMENT CONDITION: 8
2.7 INSTRUMENT LIST 8
2.8 MEASUREMENT UNCERTAINTY 9

3 OPERATING FREQUENCY **10**

3.1 LIMIT 10
3.2 MEASUREMENT PROCEDURE 10
3.3 TEST RESULTS 10

4 RF OUTPUT POWER MEASUREMENT **11**

4.1 LIMIT 11
4.2 MEASUREMENT PROCEDURE 11
4.3 TEST RESULTS 11

5 RADIATION HAZARD MEASUREMENT **12**

5.1 LIMIT 12
5.2 MEASUREMENT PROCEDURE 12
5.3 TEST RESULTS 12

6 RADIATED EMISSIONS **13**

6.1 LIMIT 13
6.2 MEASUREMENT PROCEDURE 13
6.3 TEST CONFIGURATION 15
6.4 TEST RESULTS OF RADIATED EMISSIONS 17

7 CONDUCTED EMISSION **23**

7.1 LIMIT 23
7.2 TEST CONFIGURATION 23
7.3 MEASUREMENT PROCEDURE 24
7.4 TEST RESULTS OF POWER LINE CONDUCTED EMISSION 25

APPENDIX I: PHOTOGRAPH OF TEST SETUP **27**

APPENDIX II: PHOTOGRAPH OF EQUIPMENT UNDER TEST **27**

Revision History

Report No.	Version	Description	Issued Date
190900855SHA-002	Rev. 01	Initial issue of report	October 24, 2019

Measurement result summary

TEST ITEM	FCC REFERANCE	RESULT
Conducted Emission (150 kHz to 30 MHz)	18.307(b)	Pass
Radiated Emission (9 kHz to 30 MHz)	18.305(b)	Pass
Radiated Emission (30 MHz to1 GHz)	18.305(b)	Pass
Radiated Emission (1 GHz to 25 GHz)	18.305(b)	Pass
Operating Frequency	Clause 4.5	Pass
RF Output Power Measurement	Clause 4.3	Pass

Notes: 1: NA =Not Applicable
2. Determination of the test conclusion is based on IEC Guide 115 in consideration of measurement uncertainty.
3: Additions, Deviations and Exclusions from Standards: None.

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	Microwave oven
Type/Model:	MVCV21#####, CVM521P#####, PVM9215#####, MVPV21#####, MVPN21#####, PNM9216##### (# represents "A to Z" or "0 to 9" or blank, according to exterior design, color, cooking utensil or market)
Brand Name:	LG, GE, Café-Pro, Profile
Description of EUT:	The EUT is a Microwave oven which was install a certified Bluetooth module (FCC ID: ZKJ-BLEA003), there have series models, and they are same except for different appearance or different sellers use different model name. The model PVM9215SK5SS was chosen as representative.
Rating:	AC 120V 60Hz Input: 1700W
Frequency:	2450MHz (Class B/Group 2)
EUT type:	☒ Table top ☐ Floor standing
Software Version:	/
Hardware Version:	/
Sample received date:	September 17, 2019
Date of test:	September 17, 2019 ~ October 19, 2019

1.2 Description of Test Facility

Name:	Intertek Testing Services Shanghai
Address:	Building 86, No. 1198 Qinzhou Road(North), Shanghai 200233, P.R. China
Telephone:	86 21 61278200
Telefax:	86 21 54262353

The test facility is recognized, certified, or accredited by these organizations:	CNAS Accreditation Lab Registration No. CNAS L0139
	FCC Accredited Lab Designation Number: CN1175
	IC Registration Lab CAB identifier.: CN0051
	VCCI Registration Lab Registration No.: R-14243, G-10845, C-14723, T-12252
	A2LA Accreditation Lab Certificate Number: 3309.02

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 18 (2017)
FCC/OET MP-5 (1986)

2.2 Mode of operation during the test

Within this test report, EUT was tested under all available operation modes and tested under its rating voltage and frequency. Other voltage and frequency is specified if used.

Worst test mode: Working mode with full power

2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	ESxS-K1	R&S	V2.1.0
Radiated emission	ES-K1	R&S	V1.71

2.4 Test peripherals list

Item No.	Name	Band and Model	Description
1	Beaker	NA	1000mL

2.5 Test Load Description

Load for power output measurement, frequency measurement, radiation hazard test: 1000 milliliters of water in the beaker located in the center of the oven;
Load for measurement of radiation on second and third harmonic: Two loads, one of 700 and the other of 300 milliliters, of water are used. Each load is tested both with the beaker located in the center of the oven and with it in the right front corner.
Load for all other measurements: 700 milliliters of water, with the beaker located in the center of the oven.

2.6 Test environment condition:

Test items	Temperature	Humidity
Radiated Emissions	22°C	55% RH
Conducted Emission	21°C	52% RH

2.7 Instrument list

Conducted Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	Test Receiver	R&S	ESCS 30	EC 2107	2020-07-14
☑	A.M.N.	R&S	ESH2-Z5	EC 3119	2019-11-29
☑	A.M.N.	R&S	ENV4200	EC 3558	2020-06-11
☑	Shielded room	Zhongyu	-	EC 2838	2020-01-13
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	Test Receiver	R&S	ESIB 26	EC 3045	2020-09-12
☑	Test Receiver	R&S	ESCI 7	EC 4501	2020-09-12
☑	Active loop antenna	Schwarzbeck	FMZB1519	EC 5345	2020-03-14
☑	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2019-12-10
☑	Horn antenna	R&S	HF 906	EC 3049	2019-11-16
☑	Horn antenna	ETS	3117	EC 4792-1	2020-02-25
☑	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2020-07-09
☑	Pre-amplifier	R&S	Pre-amp 18	EC5881	2020-06-11
☑	Semi-anechoic chamber	Albatross project	-	EC 3048	2020-07-31
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3783	2020-03-10
☑	Pressure meter	YM3	Shanghai Mengde	EC 3320	2020-07-01

2.8 Measurement uncertainty

The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Test item	Measurement uncertainty
Radiated Emissions in restricted frequency bands below 1GHz	± 4.90dB
Radiated Emissions in restricted frequency bands above 1GHz	± 5.02dB
Power line conducted emission	± 3.19dB

3 Operating Frequency

Test result: Pass

3.1 Limit

ISM equipment may be operated on any frequency above 9 kHz. And the frequency band 2400-2500MHz is allocated for use by ISM equipment. (§18.301)

ISM frequency	Tolerance
6.78 MHz	±15.0 kHz
13.56 MHz	±7.0 kHz
27.12 MHz	±163.0 kHz
40.68 MHz	±20.0 kHz
915 MHz	±13.0 MHz
2,450 MHz	±50.0 MHz
5,800 MHz	±75.0 MHz
24,125 MHz	±125.0 MHz
61.25 GHz	±250.0 MHz
122.50 GHz	±500.0 MHz
245.00 GHz	±1.0 GHz

3.2 Measurement Procedure

a) Frequency for Normal Voltage

The operating frequency was measured using a spectrum analyzer. Starting with the EUT at room temperature, a 1000mL water load was placed in the center of the oven and the oven was operated at maximum output power. The fundamental operating frequency was monitored until the water load was reduced to 20 percent of the original load.

b) Frequency for Line Voltage

The EUT was operated / warmed by at least 10 minutes of use with a 1000 mL water load at room temperature at the beginning of the test. Then the operating frequency was monitored as the input voltage was varied between 80 and 125 percent of the nominal rating.

3.3 Test Results

Item	START Frequency (MHz)	STOP Frequency (MHz)
Frequency for Normal Voltage	2401.6	2471.4
Frequency for Line Voltage	2402.3	2471.6

4 RF Output Power Measurement

Test result: Pass

4.1 Limit

NA

4.2 Measurement Procedure

The EUT in microwave mode with full power.

Formula:

$$P = \frac{4{,}187 \cdot m_w (T_2 - T_1) + 0{,}55 \cdot m_c (T_2 - T_0)}{t}$$

NOTE:
P is the microwave power output (W)
mw is the mass of the water (g)
mc is the mass of the container (g)
T0 is the ambient temperature (℃)
T_1 is the initial temperature of the water (℃)
T_2 is the final temperature of the water (℃)
t is the heating time (s), excluding the magnetron filament heating-up time (s).

4.3 Test Results

Quantity of Water [ml]	Mass of the container [g]	Ambient temperature [°C]	Initial temperature [°C]	Final temperature [°C]	Heating time [s]	Power output [W]
1 000	72	25.0	10.0	33.8	120	**833.3**

5 Radiation Hazard Measurement

Test result: Pass

5.1 Limit

A maximum of 1.0mW/cm^2 is allowed in accordance with the applicable FCC standards. Hence, microwave leakage in the as-received condition with the oven door closed was below the maximum allowed.

5.2 Measurement Procedure

The EUT was set-up according to the FCC MP-5 and FCC Part 18 for Radiation Hazard Measurement. The measurement was using a microwave leakage meter to measure the Radiation leakage in the as-received condition with the oven door closed. A 1000ml water load in a beaker was located in the center of the oven and the Microwave Oven was set to maximum power. While the oven operating, the microwave meter will check the leakage and then record the maximum leakage.

5.3 Test Results

There was no microwave leakage exceeding a power level of 0.15mW/cm^2 observed at any point 5cm or more from the external surface of the oven.

6 Radiated Emissions

Test result: Pass

6.1 Limit

(a) ISM equipment operation on a frequency specified in §18.301 is permitted unlimited radiated energy in the band specified for that frequency.
(b) The field strength levels of emissions which lie outside the bands specified in §18.301, unless otherwise indicated, shall not exceed the following:

Equipment	Operating frequency	RF Power generated by equipment (watts)	Field strength limit (uV/m)	Distance (meters)
Any type unless otherwise specified (miscellaneous)	Any ISM frequency	Below 500	25	300
		500 or more	25 × SQRT(power/500)	300

RF Power = 833.3W according to clause 4.3

Limit = 20lg(25*SQRT(power/500)) + 20lg(300/3) = 30.2+40 = 70.2dBuV/m @ 3m distance.

6.2 Measurement Procedure

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.

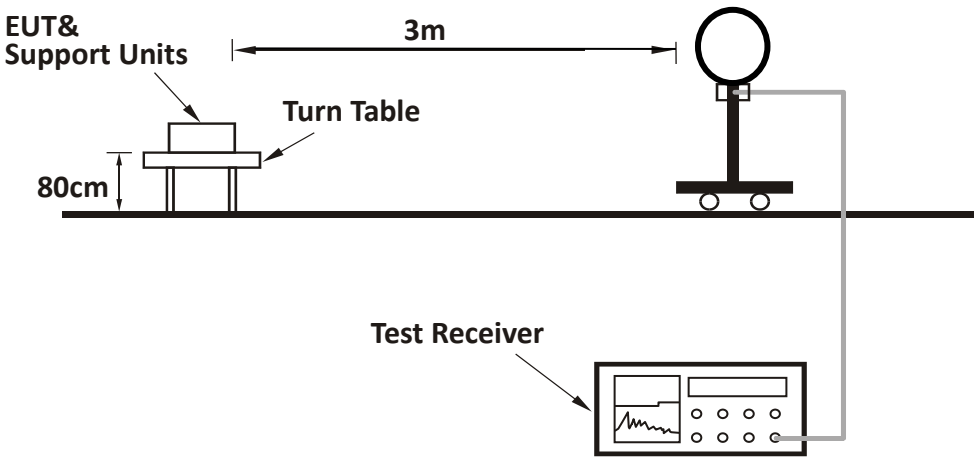
f) The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

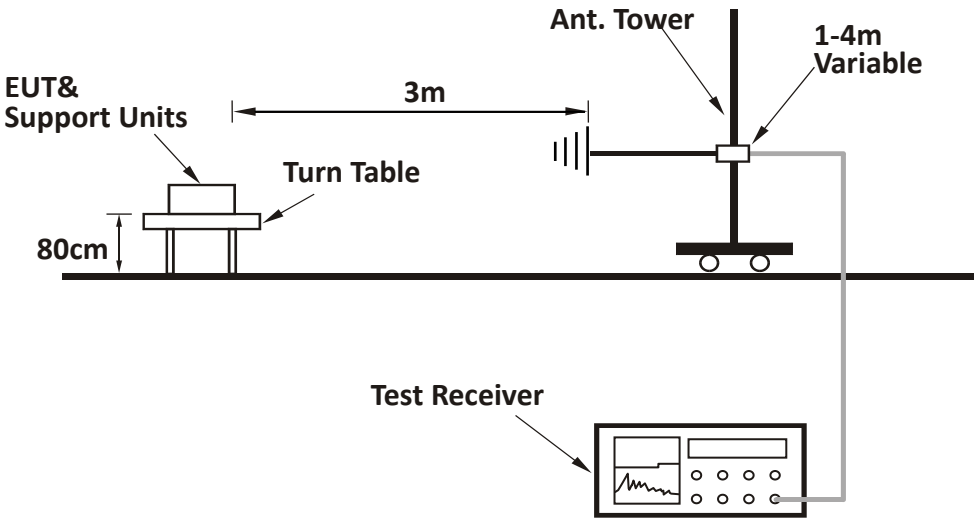
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

6.3 Test Configuration

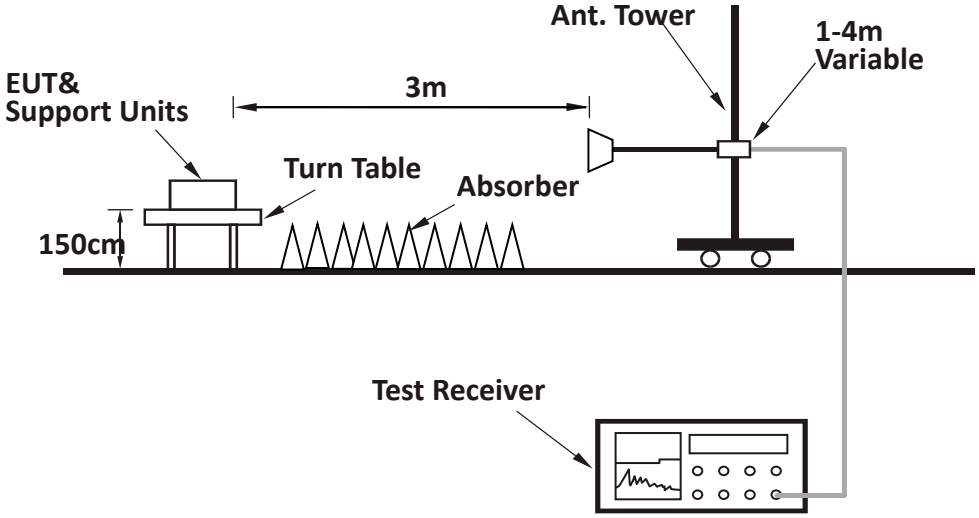
For Radiated emission below 30MHz:



For Radiated emission 30MHz to 1GHz:

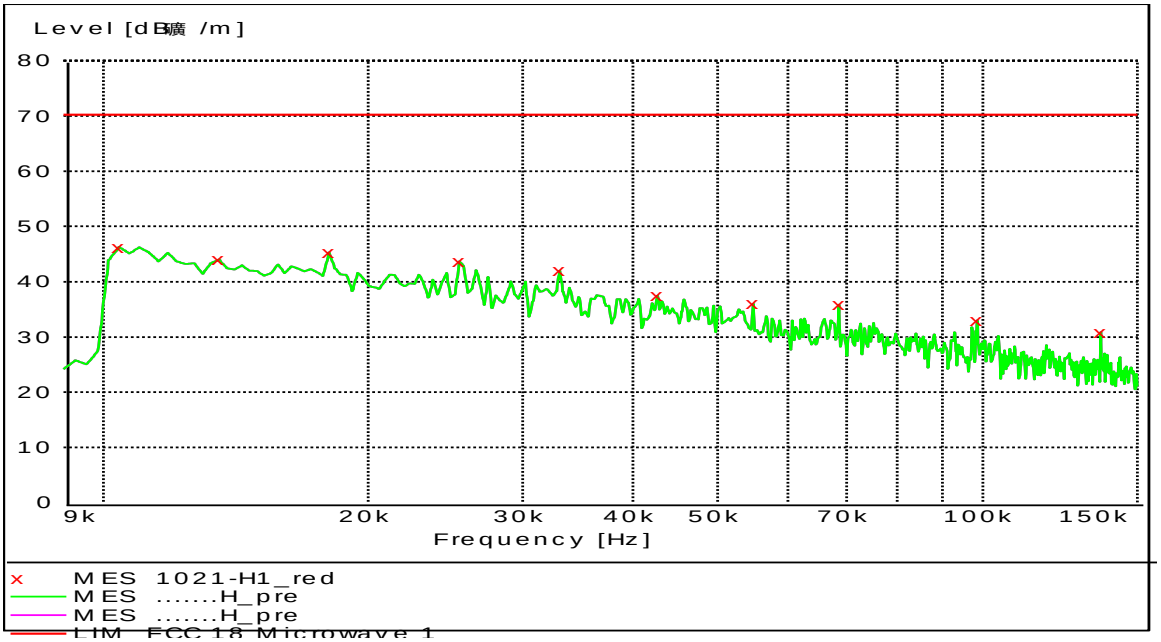


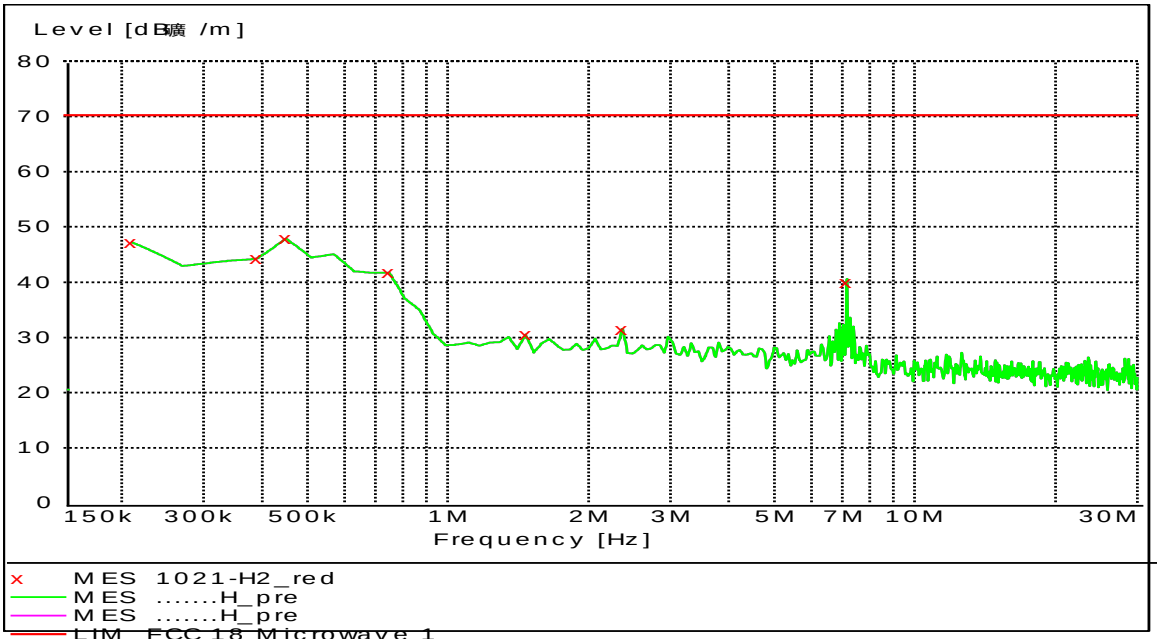
For Radiated emission above 1GHz:



6.4 Test Results of Radiated Emissions

Test plots of 9KHz ~ 30MHz:





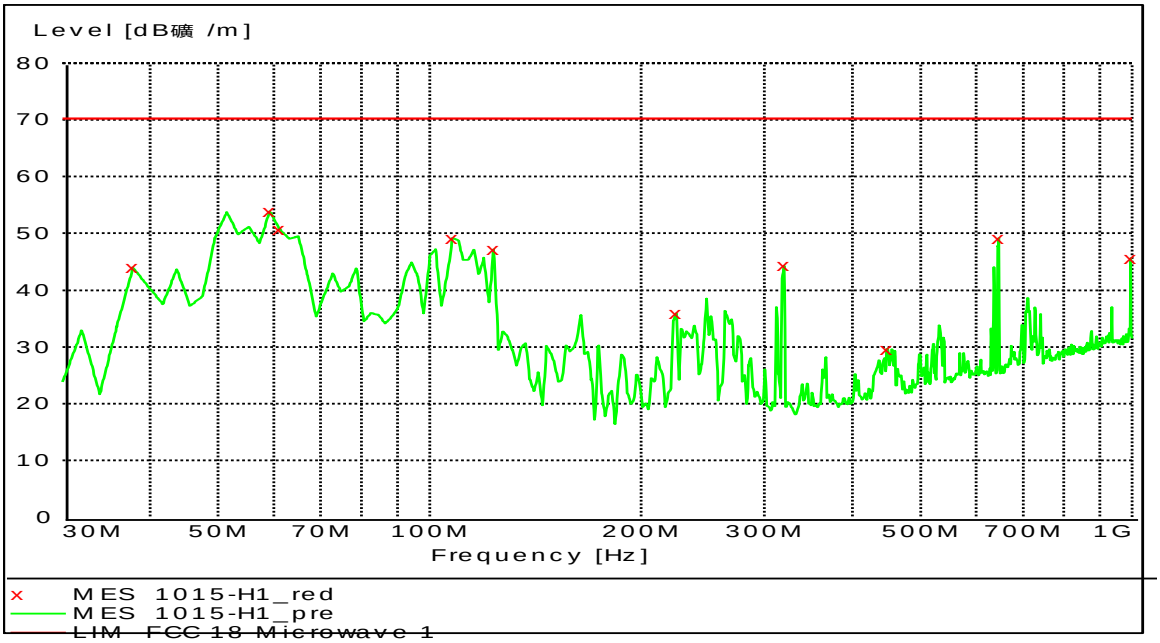
Test data of 9KHz ~ 30MHz:

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
X/Y	0.209820	47.20	20.10	70.20	23.00	PK
X/Y	0.389279	44.20	20.00	70.20	26.00	PK
X/Y	0.449098	47.90	20.00	70.20	22.30	PK
X/Y	0.748196	41.70	20.10	70.20	28.50	PK
X/Y	1.466032	30.50	20.20	70.20	39.70	PK
X/Y	2.363327	31.50	20.30	70.20	38.70	PK
X/Y	7.148898	40.00	20.20	70.20	30.20	PK
X/Y	0.010413	46.20	20.00	70.20	24.00	PK
X/Y	0.013521	44.00	20.10	70.20	26.20	PK
X/Y	0.018042	45.30	20.20	70.20	24.90	PK
X/Y	0.025389	43.60	20.30	70.20	26.60	PK
X/Y	0.033018	42.00	20.30	70.20	28.20	PK
X/Y	0.042625	37.40	20.30	70.20	32.80	PK
X/Y	0.054776	36.00	20.30	70.20	34.20	PK
X/Y	0.068621	35.80	20.30	70.20	34.40	PK
X/Y	0.098573	33.00	20.30	70.20	37.20	PK

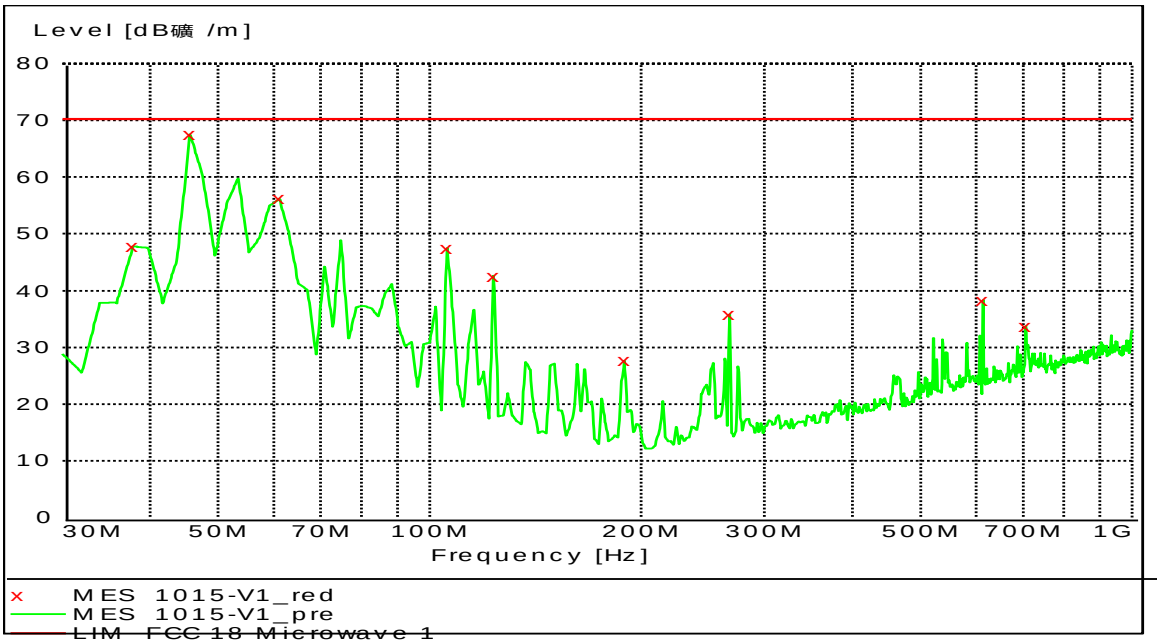
TEST REPORT

Test plots of 30MHz ~ 1GHz:

Horizontal



Vertical



Test data of 30MHz ~ 1GHz:

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	37.78	44.00	17.70	70.20	26.20	PK
H	59.16	53.90	5.40	70.20	16.30	PK
H	61.10	50.70	5.70	70.20	19.50	PK
H	107.76	49.10	11.40	70.20	21.10	PK
H	123.31	47.20	11.80	70.20	23.00	PK
H	224.39	35.90	12.00	70.20	34.30	PK
H	319.64	44.30	15.30	70.20	25.90	PK
H	447.94	29.60	18.00	70.20	40.60	PK
H	646.21	49.10	21.70	70.20	21.10	PK
H	996.11	45.60	25.90	70.20	24.60	PK
V	37.78	47.80	17.70	70.20	22.40	PK
V	45.55	67.60	12.50	70.20	2.60	PK
V	61.10	56.20	5.70	70.20	14.00	PK
V	105.81	47.50	11.30	70.20	22.70	PK
V	123.31	42.60	11.80	70.20	27.60	PK
V	189.40	27.60	11.10	70.20	42.60	PK
V	267.15	35.80	13.50	70.20	34.40	PK
V	613.17	38.20	20.90	70.20	32.00	PK
V	706.47	33.70	22.50	70.20	36.50	PK

Test data of 1GHz ~ 18GHz:

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	1238.48	31.30	-10.80	70.20	38.90	PK
H	1749.50	34.60	-8.20	70.20	35.60	PK
H	2226.45	36.10	-5.20	70.20	34.10	PK
H	2975.95	53.30	-3.90	70.20	16.90	PK
H	4202.40	52.60	1.30	70.20	17.60	PK
H	4883.77	67.90	2.90	70.20	2.30	PK
H	7370.74	64.70	7.40	70.20	5.50	PK
H	9857.72	50.10	13.20	70.20	20.10	AV
H	12310.62	67.60	13.70	70.20	2.60	PK
H	17250.50	46.20	20.40	70.20	24.00	AV
V	1306.61	31.30	-10.60	70.20	38.90	PK
V	1749.50	34.60	-8.20	70.20	35.60	PK
V	1953.91	35.20	-6.90	70.20	35.00	PK
V	2737.47	52.50	-4.00	70.20	17.70	pk
V	4202.40	52.50	1.30	70.20	17.70	PK
V	4917.84	46.30	2.90	70.20	23.90	AV
V	7370.74	65.20	7.40	70.20	5.00	PK
V	8188.38	51.70	9.90	70.20	18.50	AV
V	12310.62	48.50	13.70	70.20	21.70	AV
V	17250.50	46.40	20.40	70.20	23.80	AV

Test data of 18GHz ~ 25GHz:

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	18378.76	51.50	3.70	70.20	18.70	PK
H	19178.36	58.30	5.10	70.20	11.90	PK
H	19697.39	67.60	5.80	70.20	2.60	PK
H	19949.9	59.00	5.70	70.20	11.20	PK
H	20931.86	44.10	5.80	70.20	26.10	PK
H	21885.77	65.30	6.70	70.20	4.90	PK
H	22166.33	53.20	6.80	70.20	17.00	PK
H	23176.35	41.50	7.50	70.20	28.70	PK
H	23835.67	43.40	6.90	70.20	26.80	PK
H	24873.75	46.30	7.00	70.20	23.90	PK
V	18406.81	50.80	3.70	70.20	19.40	PK
V	18911.82	52.30	4.50	70.20	17.90	PK
V	19655.31	67.50	5.80	70.20	2.70	PK
V	19935.87	49.70	5.70	70.20	20.50	PK
V	20525.05	42.00	5.50	70.20	28.20	PK
V	21899.8	58.80	6.70	70.20	11.40	PK
V	21927.86	50.60	6.60	70.20	19.60	PK
V	22713.43	40.40	7.40	70.20	29.80	PK
V	23877.76	40.10	6.80	70.20	30.10	PK
V	24593.19	41.30	6.60	70.20	28.90	PK

Remark:
1. Correct Factor = Antenna Factor + Cable Loss (+ Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = Limit - Corrected Reading
4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,
Limit = 40.00dBuV/m.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m;
Margin = 40.00dBuV/m - 10.20dBuV/m = 29.80dB.

7 Conducted Emission

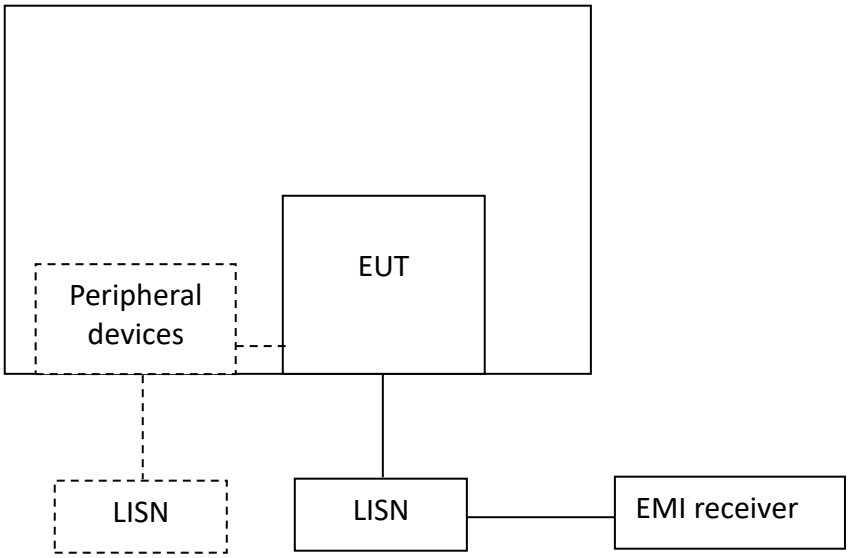
Test result: **Pass**

7.1 Limit

Frequency range (MHz)	Limits dB(μV)	
	Quasi-peak	Average
0.15 ~ 0.5	66 ~ 56 *	56 ~ 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

Note: 1. * Means the limit decreasing linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz
2. If the limit for the measurement with the average detector is met when using a receiver with a quasi-peak detector, the equipment under test shall be deemed to meet both limits and the measurement using the receiver with an average detector need not be carried out.

7.2 Test Configuration



7.3 Measurement Procedure

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

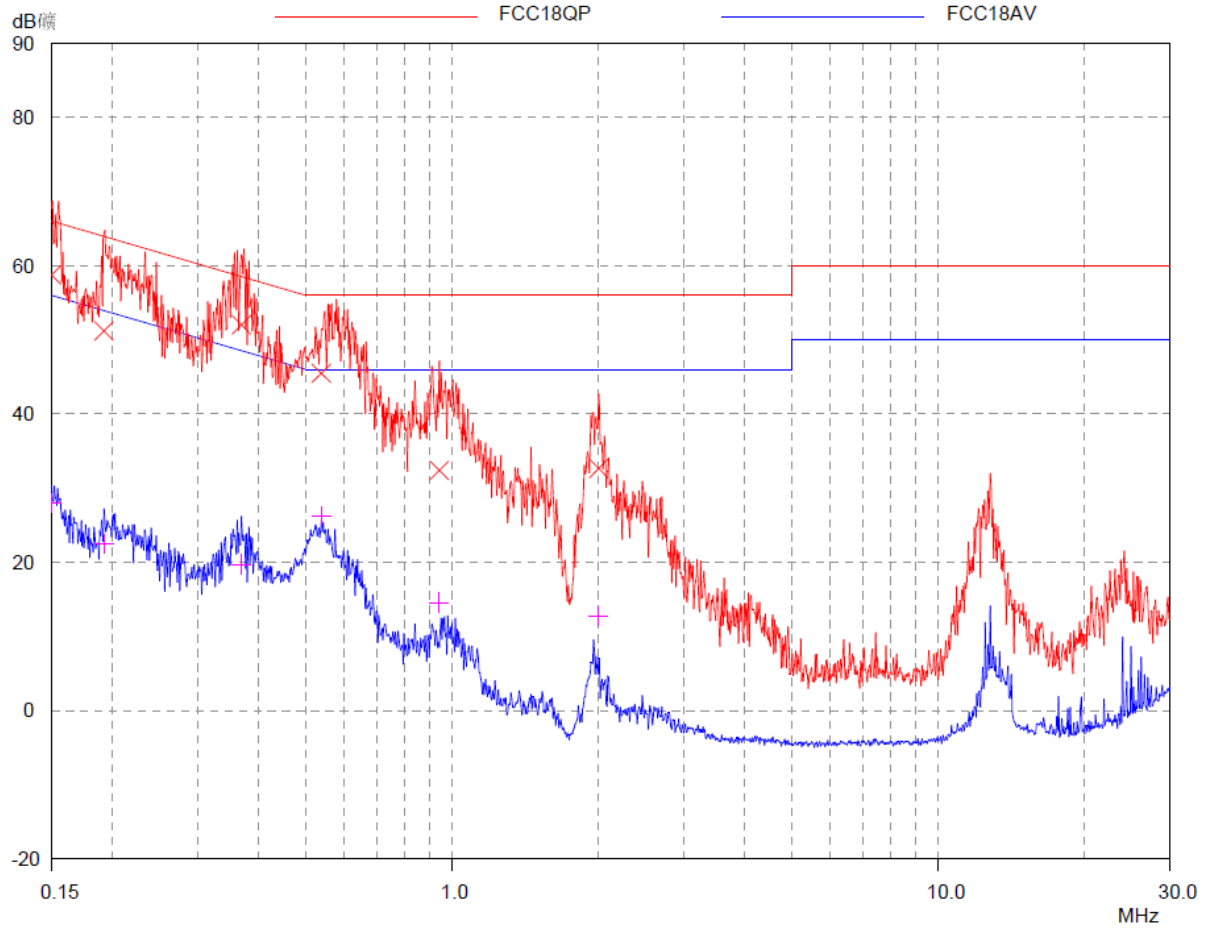
Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.

7.4 Test Results of Power line conducted emission

Test Curve:

L Line

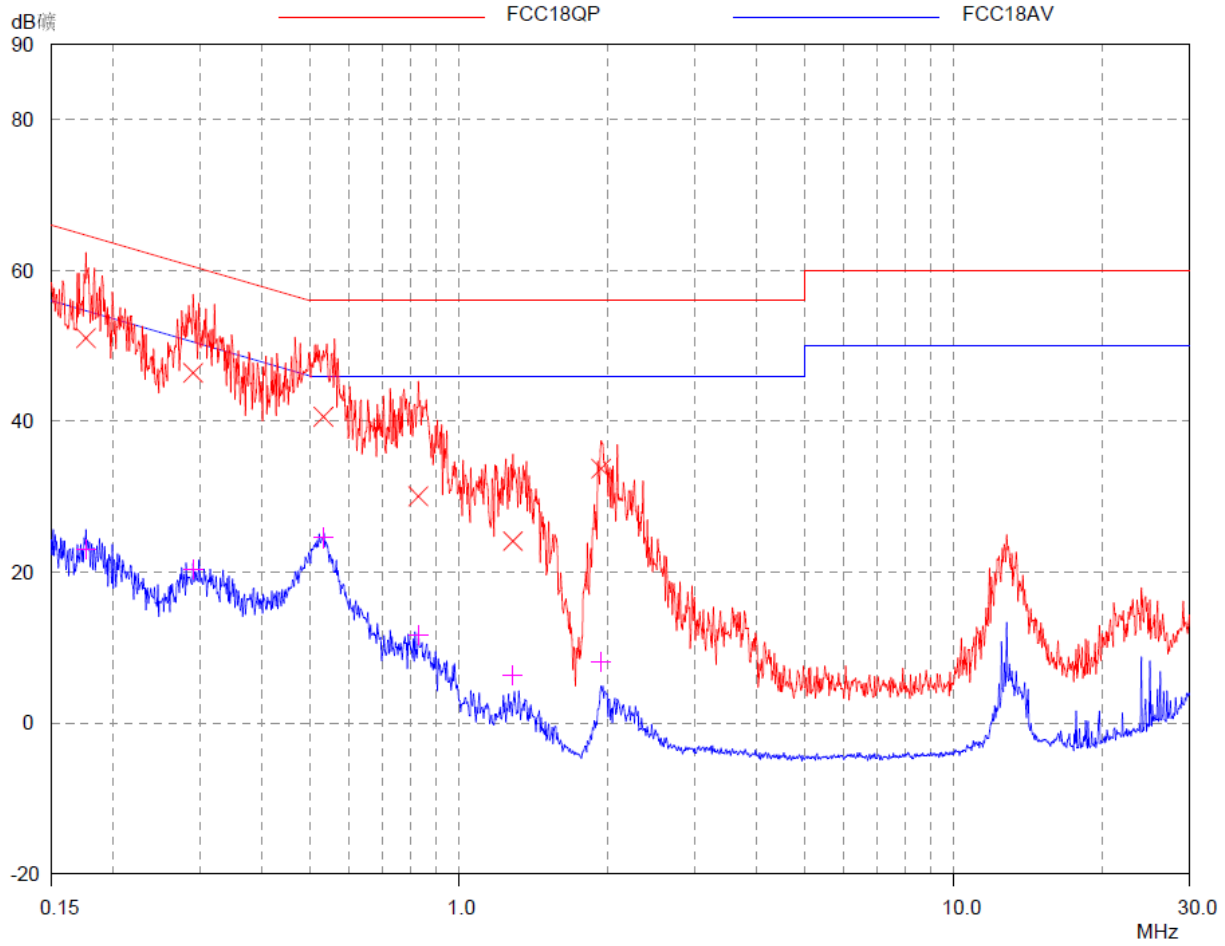


Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.150	58.75	66.00	7.25	28.00	56.00	28.00
0.192	51.21	63.94	12.73	22.46	53.94	31.48
0.368	52.03	58.54	6.51	19.71	48.54	28.83
0.538	45.49	56.00	10.51	26.18	46.00	19.82
0.941	32.37	56.00	23.63	14.57	46.00	31.43
2.001	32.65	56.00	23.35	12.70	46.00	33.30

Test Curve:

N Line



Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.176	51.02	64.67	13.65	23.10	54.67	31.57
0.290	46.42	60.53	14.11	20.34	50.53	30.19
0.532	40.60	56.00	15.40	24.53	46.00	21.47
0.828	30.04	56.00	25.96	11.67	46.00	34.33
1.285	24.11	56.00	31.89	6.30	46.00	39.70
1.938	33.71	56.00	22.29	8.13	46.00	37.87

Remark: 1. Correct Factor = LISN Factor + Cable Loss, the value was added to Original Receiver Reading by the software automatically.
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = Limit - Corrected Reading
4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Appendix I: Photograph of test setup

Refer to Test set up photos.

Appendix II: Photograph of equipment under test

Refer to EUT External photos and Internal photos.

********** END **********