



FCC CFR 47 Part 15 Subpart B Certification Test Report

For the

Product : 3D Printer
Model : 2X
Multiple Model : 2X DP303, riZE 2XC
FCC ID : 2AB83-2X
Applicant : Sindoh Co., Ltd.
FCC Rule : CFR 47 Part 15 Subpart B

We hereby certify that the above product has been tested by us with the listed rules and found in compliance with the regulation. The test data and results are issued on the test report no. **TR-W1708-007-01**

Signature

A handwritten signature in black ink, appearing to read 'Choi, Young-min', is written over a horizontal line.

Choi, Young-min / Technical Manager

Date: 2018-11-28

Test Laboratory: ENG Co., Ltd.

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Report No.: TR-W1708-007-01

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjam-eup, Gwangju-si, Gyeonggi-do, Korea 12813

Report Form_02 (Rev.0)

FCC/ISED CANADA TEST REPORT

Project Number : EA2003C-025
Test Report Number : TR-W1708-007-01
Type of Equipment : 3D Printer
Model Name : 2X
Multiple Model Name : 2X DP303, riZE 2XC
FCC ID : 2AB83-2X

Applicant : Sindoh Co., Ltd.
Address : 3, Seongsuiro24(isipsa)-gil, Seongdong-gu, Seoul 04797, Republic of Korea

Manufacturer : Sindoh Co., Ltd.
Address : 3, Seongsuiro24(isipsa)-gil, Seongdong-gu, Seoul 04797, Republic of Korea

Factory 1 : SINDOH (QINGDAO) CO., LTD.
Address : 1008 Emeisan-road, Qingdao Economics & Technology Development Zone, 266555 Qingdao, Shandong, PEOPLE'S REPUBLIC OF CHINA

Factory 2 : Sindoh Co., Ltd.
Address : 1138, Suncheonhyang-ro, Baebang-eup, Asan-si, Chungcheongnam-do 31479, REPUBLIC OF KOREA

FCC Rule : CFR 47 Part 15 Subpart B §15.101 Class A Peripheral Device
ISED Canada Standard : ICES-003 Issue 6 Class A

Total page of Report : 63 pages
Date of Receipt : March 06, 2020
Date of Issue : April, 01, 2020
Test Result : Pass

This test report only contains the result of a single test of the sample supplied for the examination.
 It is not a generally valid assessment of the features of the respective products of the mass-production.

Prepared by Chu, Woo-Sik / Senior Engineer



 Signature

April, 01, 2020

 Date

Reviewed by Choi, Young-min / Technical Manager



 Signature

April, 01, 2020

 Date

CONTENTS

Page

1. TEST SUMMARY	4
1.1 TEST STANDARDS AND RESULTS	4
1.2. TEST METHODOLOGY.....	4
1.3 ADDITIONS, DEVIATIONS, EXCLUSIONS FROM STANDARDS	4
1.4 PURPOSE OF THE TEST	4
1.5 TEST FACILITY.....	5
2. EUT (EQUIPMENT UNDER TEST) DESCRIPTION.....	6
2.1 GENERAL DESCRIPTION	6
2.2 ADDITIONAL MODEL	7
2.3 DESCRIPTION OF SUPPORTED UNITS	7
2.4 CABLE DESCRIPTION	7
2.5 MODE OF OPERATION DURING THE TEST	8
2.6 TEST SETUP DRAWING.....	8
2.7 EUT MODIFICATIONS	9
3. EMISSION TESTS.....	10
3.1 AC POWER LINE CONDUCTED EMISSION	10
3.2 RADIATED EMISSION	29
APPENDIX I - TEST INSTRUMENTATION	49
APPENDIX II - TEST SETUP PHOTOS: AC POWER LINE CONDUCTED EMISSION TEST	50
APPENDIX III - TEST SETUP PHOTOS: RADIATED EMISSION TEST	52
APPENDIX IV - IDENTIFICATION LABEL	56
APPENDIX V - PHOTOGRAPHS REPORT (EXTERNAL PHOTOS)	57
APPENDIX VI - PHOTOGRAPHS REPORT (INTERNAL PHOTOS).....	58

Release Control Record

Issue Report No.	Issued Date	Details/Revisions
TR-W1708-007	August 11, 2017	Initial Release
TR-W1708-007-01	April, 01, 2020	Added Model name Application procedure was changed from DoC to Certification.

1. TEST SUMMARY

1.1 Test standards and results

The sample submitted for evaluation (Hereafter refer to as the EUT) has been tested according to the following specifications::

AGENCY NAME	APPLICABLE SECTION	TEST DESCRIPTION	RESULTS
FCC	Part 15 Subpart B Section 15.107 (b)	AC Power Line Conducted Emission	PASS
	Part 15 Subpart B Section 15.109 (b)	Radiated Emission	PASS
ISED Canada	ICES-003 Issue 6 Section 6.1, Class A	AC Power Line Conducted Emission	PASS
	ICES-003 Issue 6 Section 6.2, Class A	Radiated Emission	PASS

ENG Co., Ltd tested the EUT in accordance with the requirements set forth in the above FCC and ISED Canada Rules and Regulation and the EUT met all of the requirements of the standard.

1.2. Test Methodology

FCC: ANSI C 63.4: 2014, FCC CFR 47 Part 2, and Part 15

ISED Canada: ICES-003 Issue 6

1.3 Additions, deviations, exclusions from standards








No additions, deviations or exclusions have been made from standard.

1.4 Purpose of the test

To determine whether the equipment under test fulfills the FCC and ISED Canada Rules, Regulation and standards stated in section 1.1 and 1.2.

1.5 Test Facility

The measurement facilities are located at 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do 12813, Korea. Description details of test facilities were submitted to the ISED, Canada, accredited as a Conformity Assessment Body (CAB) by the FCC, designated by the RRA (Radio Research Agency), and accredited by KOLAS (Korea Laboratory Accreditation Scheme) in Korea and approved by TUV Rheinland and TUV SÜD according to the requirement of ISO 17025.

Laboratory Qualification	Registration No.	Mark
FCC	KR0160	
ISED (Canada)	IC 12721A-1	
RRA	KR0160	
TUV Rheinland	UA 50314109-0002	
TUV SÜD	CARAT 094465 0004 Rev.00	
Korean Agency for Technology and Standards	KT733	
KOREAN REGISTER OF SHIPPING	PCT40841-TL001	

Remark. This report is not related to KOLAS accreditation and relevant regulation.

2. EUT (Equipment Under Test) Description

2.1 General Description

The Sindoh Co., Ltd., Model 2X (referred to as the EUT in this report) is a 3D Printer, The product specification described herein was obtained from product data sheet or user's manual.

Print Layer Thickness Setting	0.05~0.4 mm
Basic Nozzle diameter	0.4 mm
Filament width	1.75 mm
Printable materials	Sindoh : PLA, ABS, FLEXIBLE, PVA(Water-soluble) PVA+(Water-soluble) Open Material : PLA, ABS, FLEXIBLE, PVA(Water-soluble), ASA, PETG, etc
Printable color	White, Black, Gray, Red, Yellow, Green, Blue, Pink(PLA), Purple(PLA)
Bed leveling	Auto measuring + Manual leveling
Print Head	Two Nozzle
Continuous Nozzle Usage/ Maximum Temperature	Recommended Temperature(Nozzle): PLA 200℃, ABS 230℃, Flexible 240℃, PVA 215℃, PVA+ 200℃ / Max 250℃
Continuous Bed Usage/ Maximum Temperature	Recommended Temperature(Bed): PLA 60℃, ABS 90℃, Flexible 60℃, PVA/PVA+ 60℃ / Max 110℃
Recommended printing speed/maximum speed	40 mm/s Recommended / 200 mm/s max
Interface	USB, Wifi, Ethernet
Contained RF Module	FCC ID: 2AB83-TWFM-M311D IC : 2541A-TWFMM311D Model: TWFM-M311D Manufacturer: LG Innotek Co., Ltd.
Cartridge	Auto Load / Unload
Max. Print Length(mm)	W(max):228, D(max):200, H(max):300
Power Source	100-240 V, 50/60 Hz, 3.8 A
Dimensions	490 x 466 x 573 (W X D X H)
Weight	31kg (excluding cartridge)

2.2 Additional Model

Model Name	Model Difference
2X	Basic Model
2X DP303	Identical to the basic model except for the model designation.
riZE 2XC	

Note: The manufacturer has declared to all the additional model names into basic model name without any further evaluation by ENG Co., Ltd.,

2.3 Description of supported units

The following peripheral devices and/or interface cables were connected during the measurement:

Description	Model No.	Serial No.	Manufacturer.
3D Printer (EUT) *	2X	N/A	Sindoh Co., Ltd.
Notebook PC	TRN-C125	N/A	HP
Adapter for Notebook PC	HSTNN-CA40	N/A	CHICONY Power Technology
Mouse	M-U0026	N/A	Logitech
Access Point (AP)	AW-A1	ABRE400975NT	Unicorn Information System
Adapter for AP	K02-1201000	N/A	Shenzhen KeYu Power Supply Technology Co., Ltd.
USB Memory Stick	8GB-WJ004	N/A	SHENZHEN CHENGE ELECTRONICS CO., LTD.

2.4 Cable Description

Ports Name	Shielded (Y/N)	Ferrite Bead (Y/N)	Length (m)	Connected to
AC In	N	N	1.3	AC Main
LAN	N	N	2.0	Notebook PC
USB 1	Y	N	1.5	Notebook PC
USB 2	N	N	-	USB Memory Stick

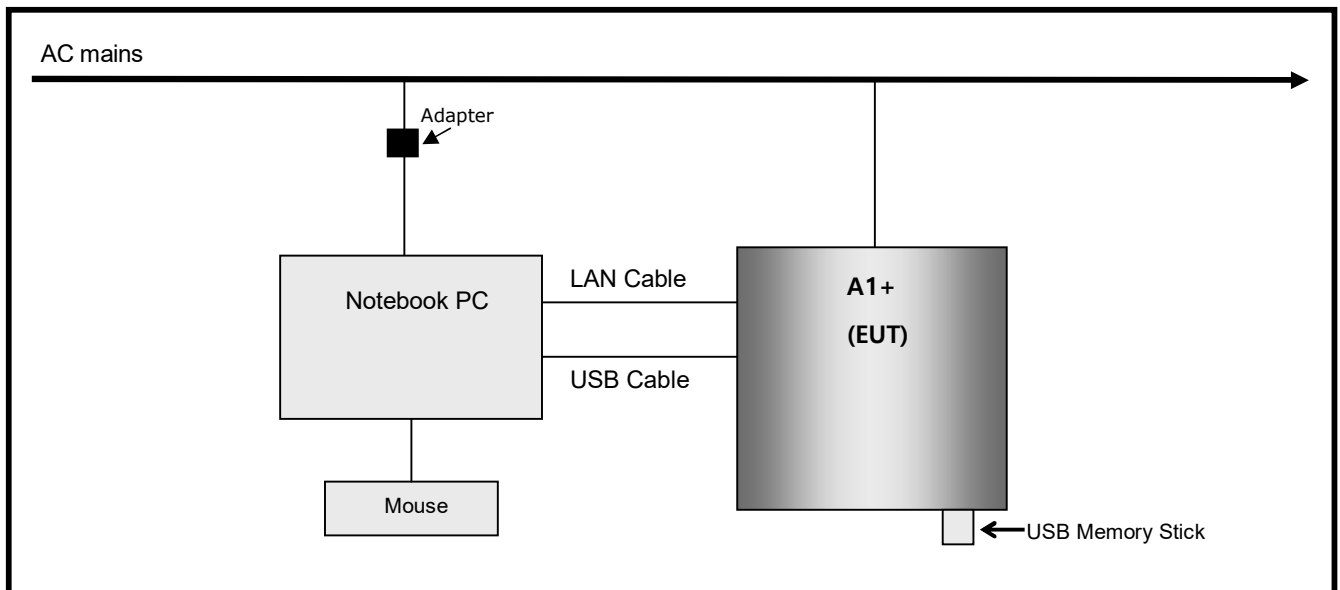
2.5 Mode of operation during the test

For finding worse case configuration and operating mode, the EUT was operated as following test mode.

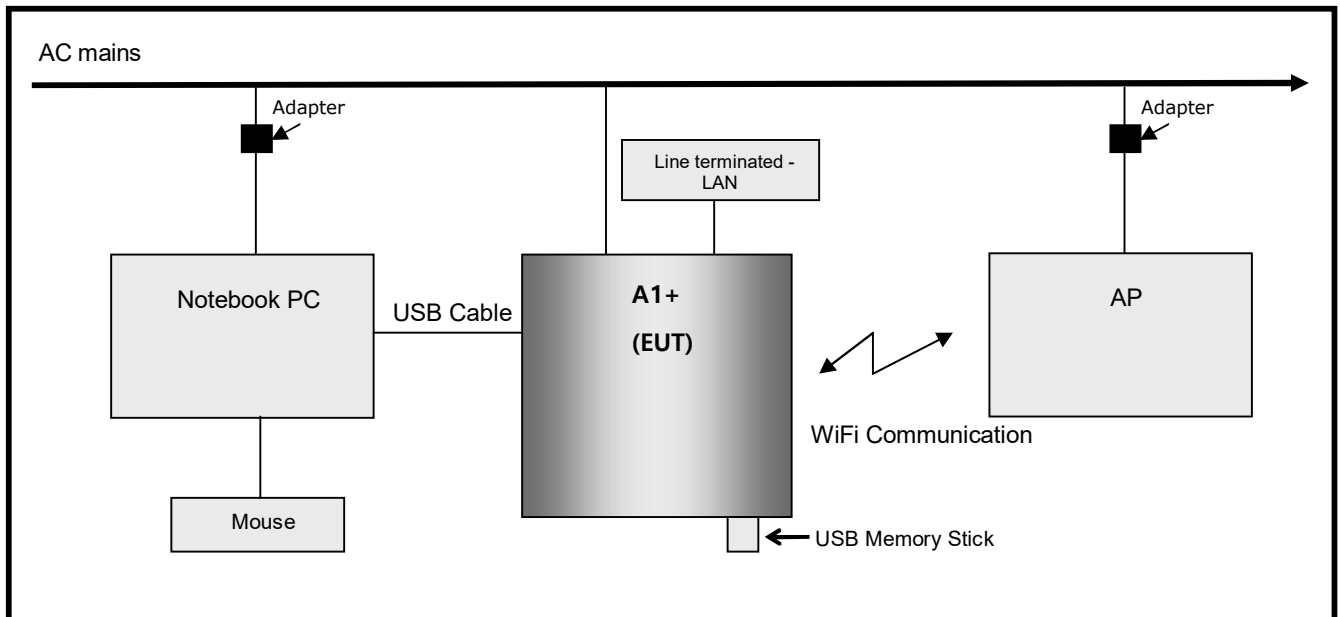
Test Mode	Description
# 1	The EUT was operated in standby mode
# 2	Printing mode using Ethernet speed, 100 Mbps
# 3	Printing mode using Ethernet speed, 1 000 Mbps
# 4	Printing mode using USB cable between the EUT and Notebook PC
# 5	Printing mode using USB memory stick
# 6	Printing mode using Wi-Fi function, 802.11 b
# 7	Printing mode using Wi-Fi function, 802.11 g
# 8	Printing mode using Wi-Fi function, 802.11 n (HT20)
# 9	Printing mode using Wi-Fi function, 802.11 n (HT40)

2.6 Test Setup Drawing

[Mode #1 ~ #5]



[Mode #6 ~ #9]



2.7 EUT Modifications

- No EMC Relevant Modifications were performed by this test laboratory.

3. EMISSION TESTS

3.1 AC Power Line Conducted Emission

3.1.1 Test setup

The EUT and all supporting equipments were placed on a non-metallic table approximately 0.8 m above the ground plane.

Power was fed to the EUT through a 50 Ω/50 μH + 5 Ω Line Impedance Stabilization Network (LISN) and all supporting equipments were connected to another LISN. The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient noise. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.4: 2014 7.3.3 to determine the worse operating conditions.

The test set-up photos are included in appendix I.

Used Software for measurement is EMC 32 supplied by Rohde&Schwarz.

3.1.2 Measurement uncertainty

Frequency range	Val. acc. CISPR 16-4-2
150 kHz ~ 30 MHz	± 2.07 dB

The measurement uncertainties are given with 95 % confidence.

3.1.3 Sample Calculated Example

At 5.31 MHz

QP Limit = 60.0 dBμV

Correction Factor (C. Factor) of LISN, Pulse Limiter and cable loss at 5.31 MHz = 9.7 dB


Q.P Reading from the Test receiver = 20.8 dBμV

(Calculated value for system losses by software EMC32 manufactured by Rohde & Schwarz)

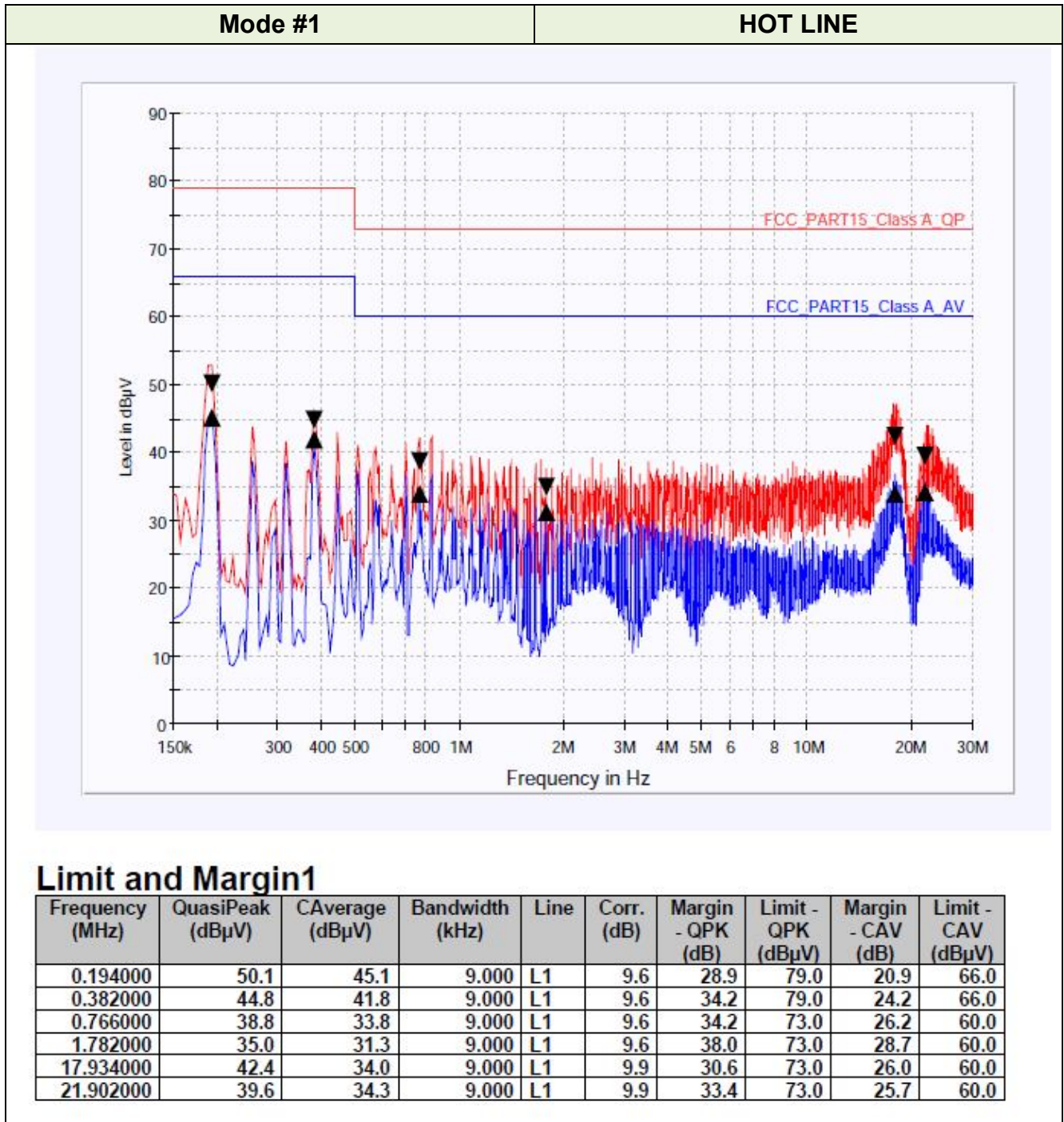
Therefore Q.P Margin = 60 - 20.8 = 39.2

so the EUT has 39.2 dB margin at 5.31 MHz

3.1.4 Test Result

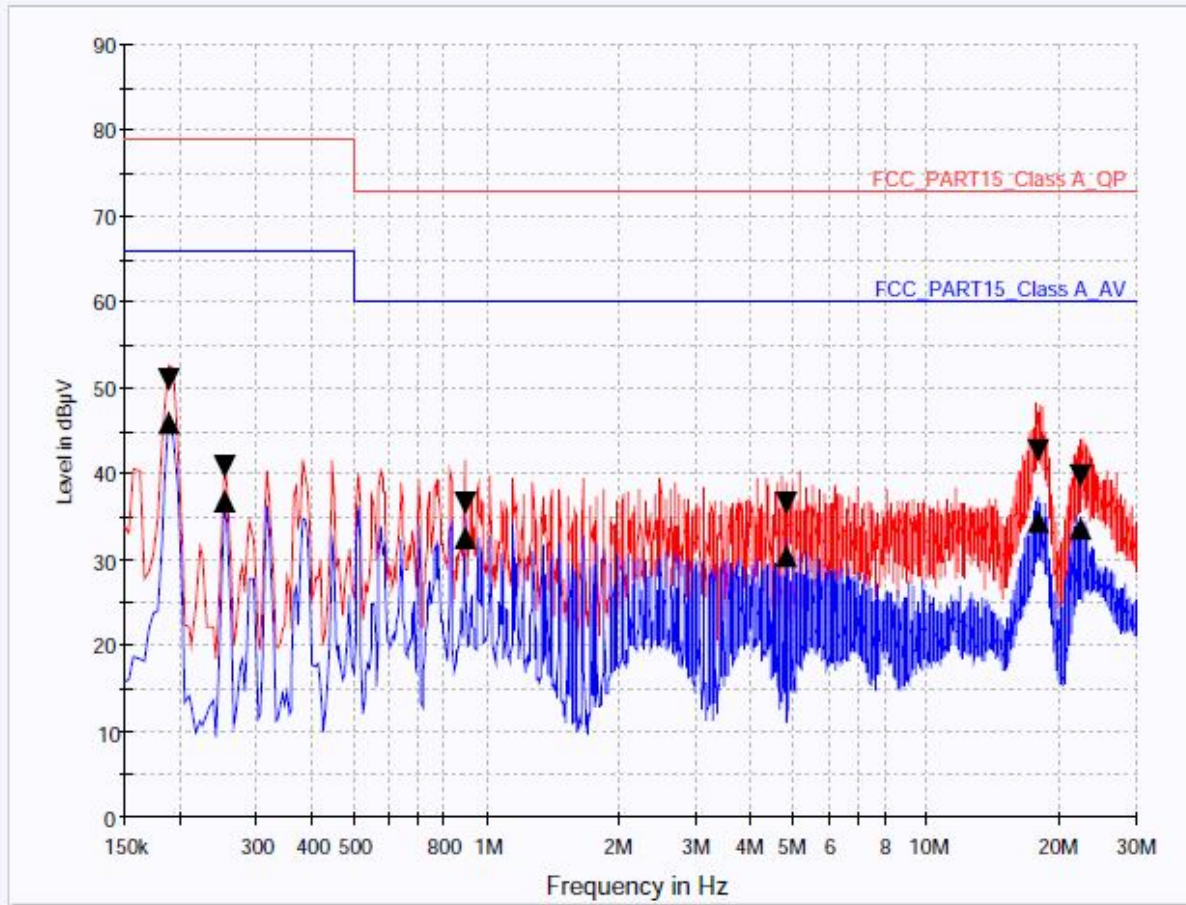
Date of Test	2017-08-10		
Temperature	23.4 °C	Relative humidity	50.9 % R.H.
Operating Input Voltage	120 Vac	Input Frequency	60 Hz
Frequency range	Resolution Bandwidth	Video Bandwidth	Detector Mode
0.15 MHz ~ 30 MHz	9 kHz	30 kHz	Peak , Q.P and/or Average
Test Mode	Mode #1 ~ #9		
Test Result	Pass	Tested By	Kim, Kwang-hyun 

3.1.5 Test Data



Mode #1

NEUTRAL LINE

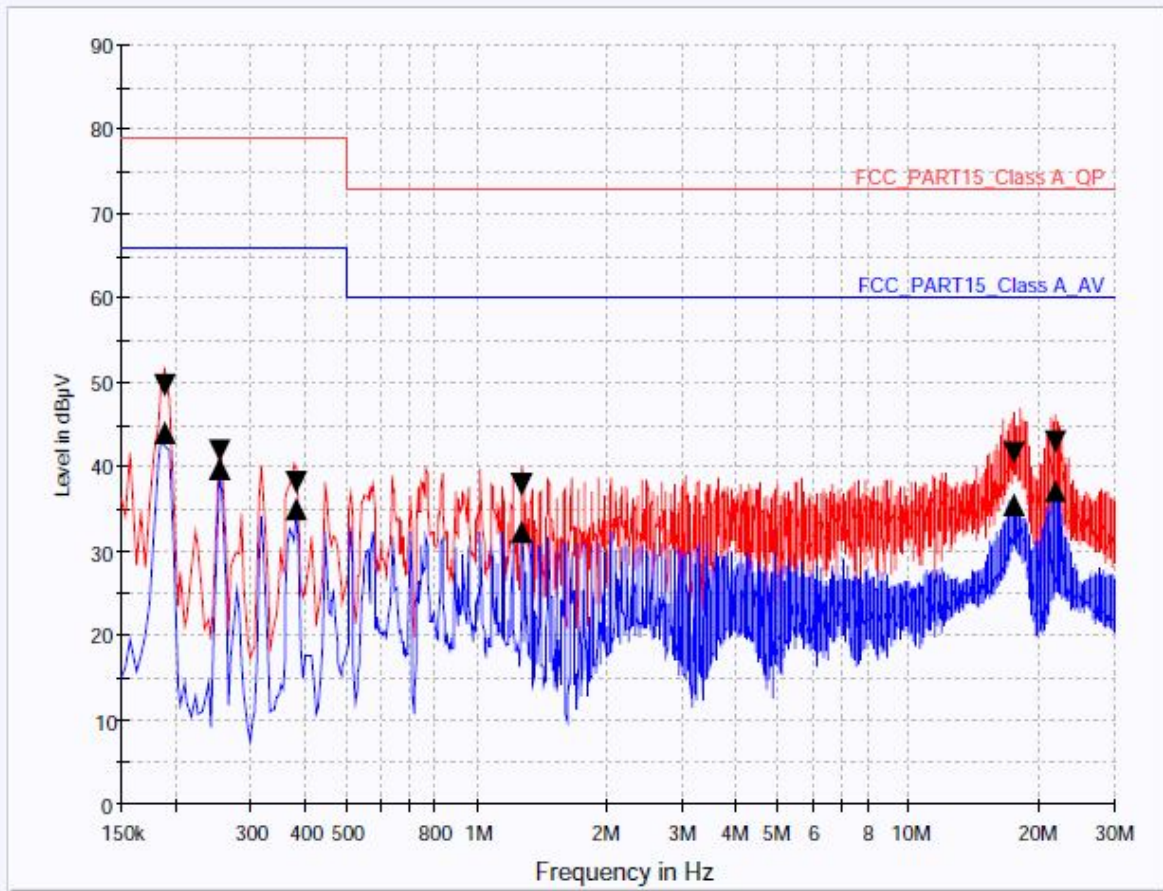


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	51.1	46.0	9.000	N	9.6	27.9	79.0	20.0	66.0
0.254000	40.8	36.9	9.000	N	9.6	38.2	79.0	29.1	66.0
0.894000	36.6	32.6	9.000	N	9.6	36.4	73.0	27.4	60.0
4.774000	36.7	30.3	9.000	N	9.7	36.3	73.0	29.7	60.0
17.922000	42.7	34.5	9.000	N	9.9	30.3	73.0	25.5	60.0
22.286000	39.9	33.7	9.000	N	10.0	33.1	73.0	26.3	60.0

Mode #2

HOT LINE

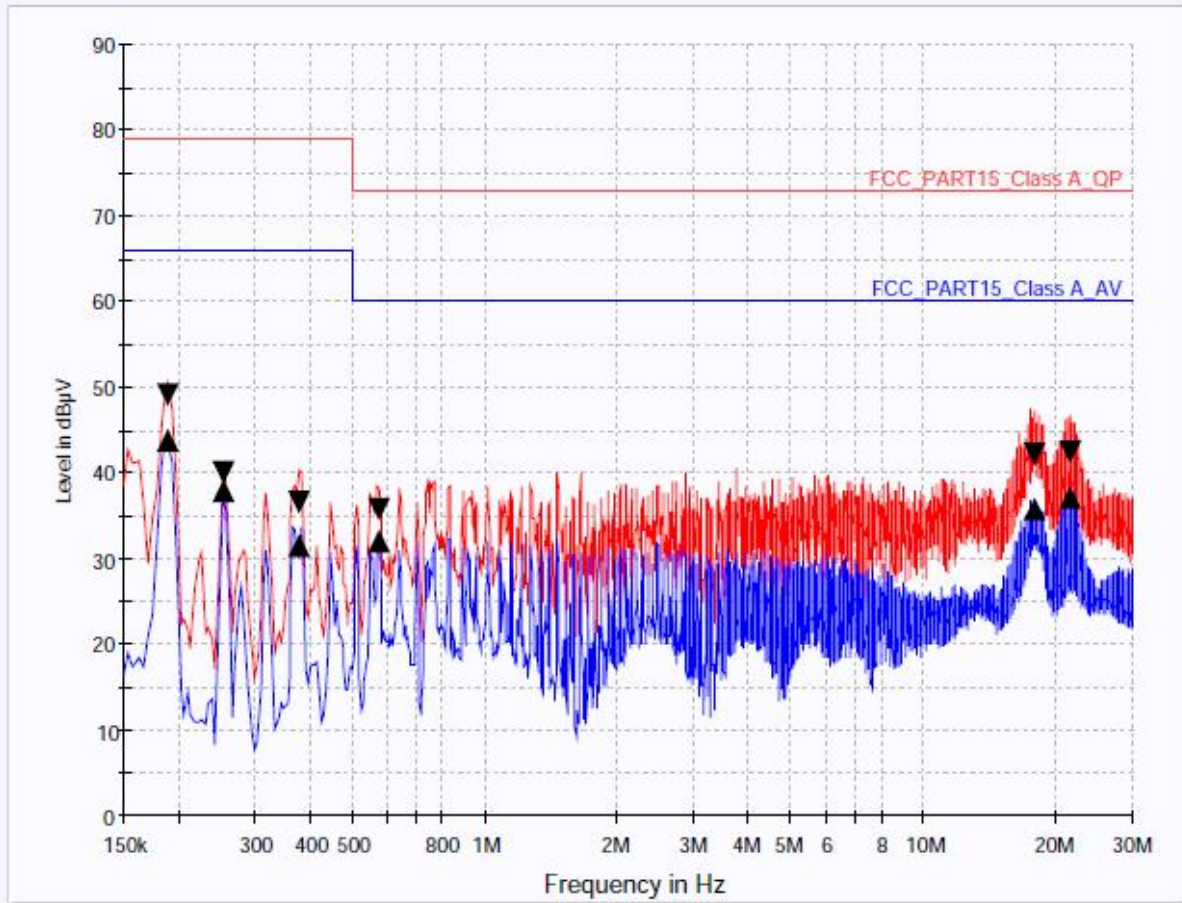


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	49.6	44.2	9.000	L1	9.6	29.4	79.0	21.8	66.0
0.254000	41.9	39.8	9.000	L1	9.6	37.1	79.0	26.2	66.0
0.382000	38.2	35.1	9.000	L1	9.6	40.8	79.0	30.9	66.0
1.274000	37.9	32.4	9.000	L1	9.6	35.1	73.0	27.6	60.0
17.574000	41.7	35.6	9.000	L1	9.9	31.3	73.0	24.4	60.0
21.778000	43.0	37.1	9.000	L1	9.9	30.0	73.0	22.9	60.0

Mode #2

NEUTRAL LINE

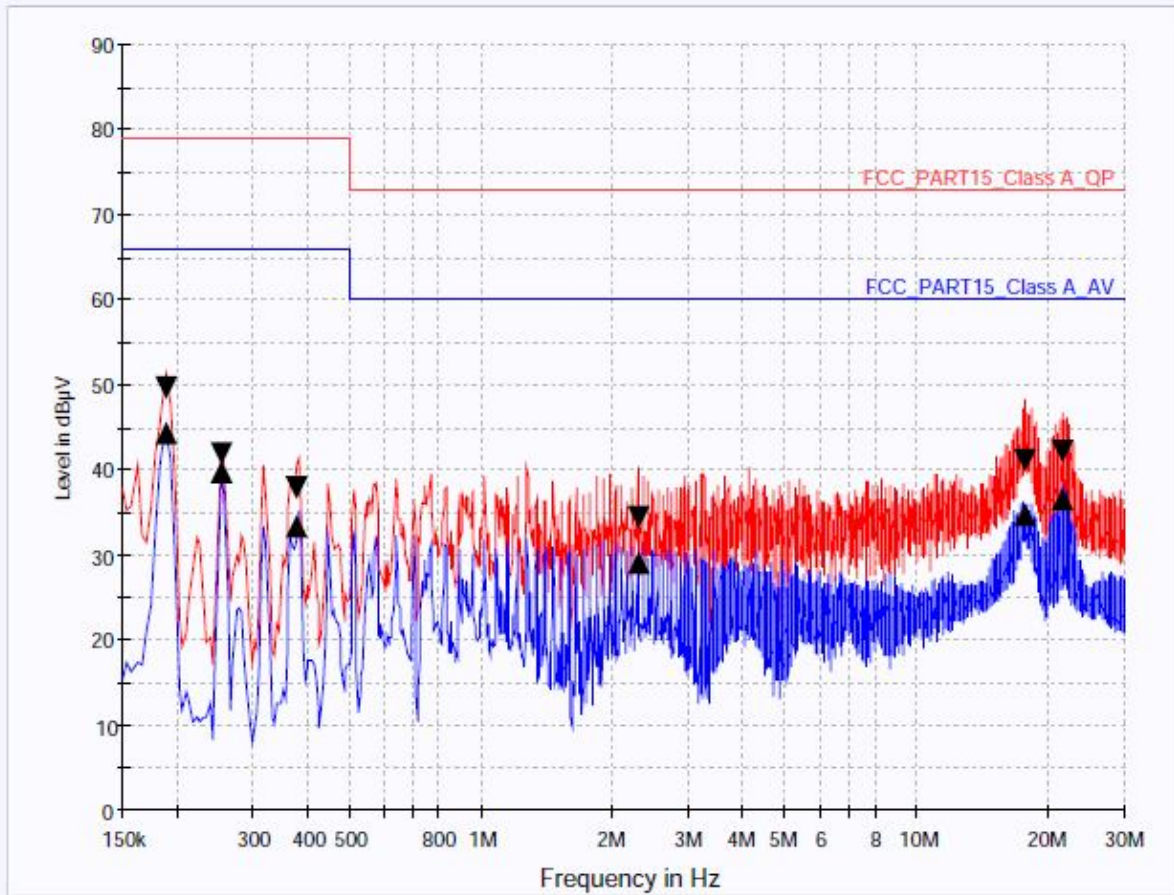


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	49.2	43.9	9.000	N	9.6	29.8	79.0	22.1	66.0
0.254000	40.0	37.9	9.000	N	9.6	39.0	79.0	28.1	66.0
0.378000	36.6	31.5	9.000	N	9.6	42.4	79.0	34.5	66.0
0.574000	35.7	32.2	9.000	N	9.6	37.3	73.0	27.8	60.0
17.894000	42.3	35.8	9.000	N	9.9	30.7	73.0	24.2	60.0
21.586000	42.6	37.0	9.000	N	10.0	30.4	73.0	23.0	60.0

Mode #3

HOT LINE

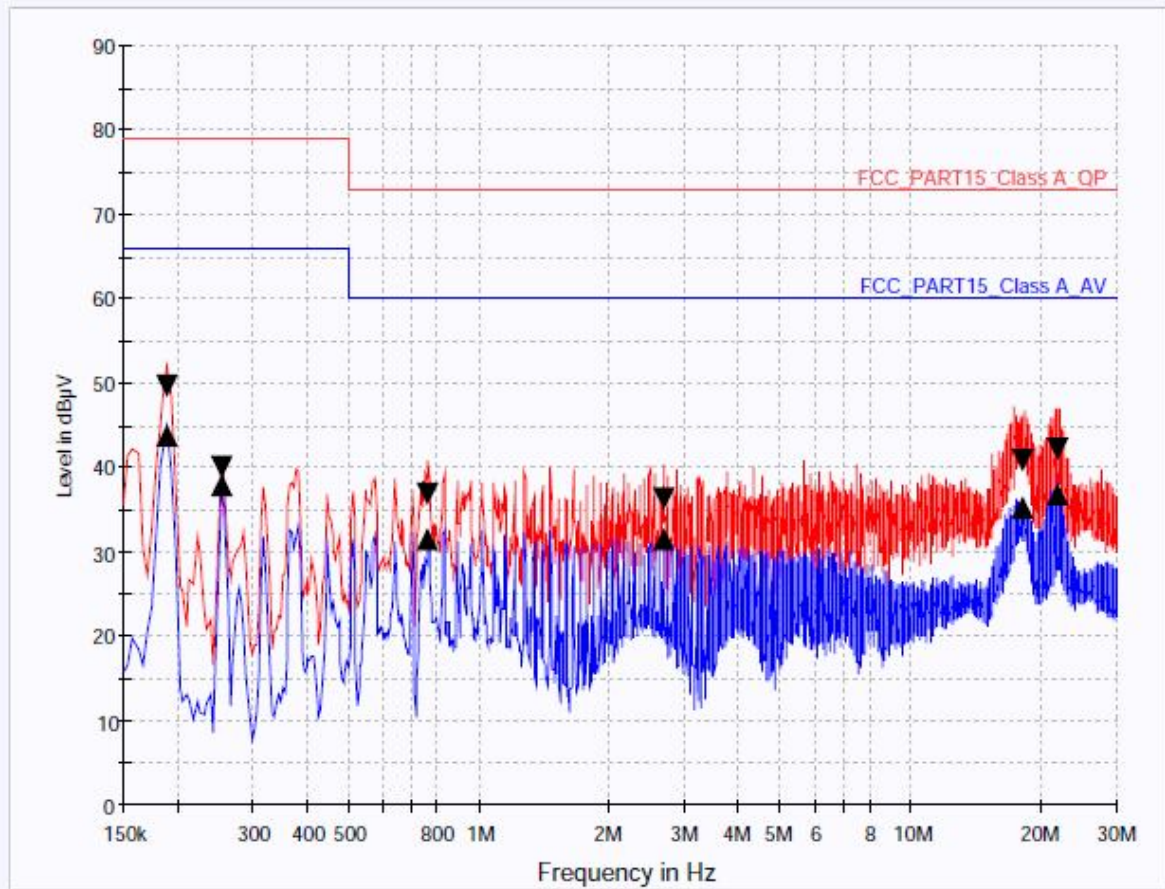


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	49.8	44.4	9.000	L1	9.6	29.2	79.0	21.6	66.0
0.254000	41.9	39.8	9.000	L1	9.6	37.1	79.0	26.2	66.0
0.378000	37.8	33.4	9.000	L1	9.6	41.2	79.0	32.6	66.0
2.290000	34.3	29.2	9.000	L1	9.7	38.7	73.0	30.8	60.0
17.766000	41.0	34.8	9.000	L1	9.9	32.0	73.0	25.2	60.0
21.710000	42.2	36.5	9.000	L1	9.9	30.8	73.0	23.5	60.0

Mode #3

NEUTRAL LINE

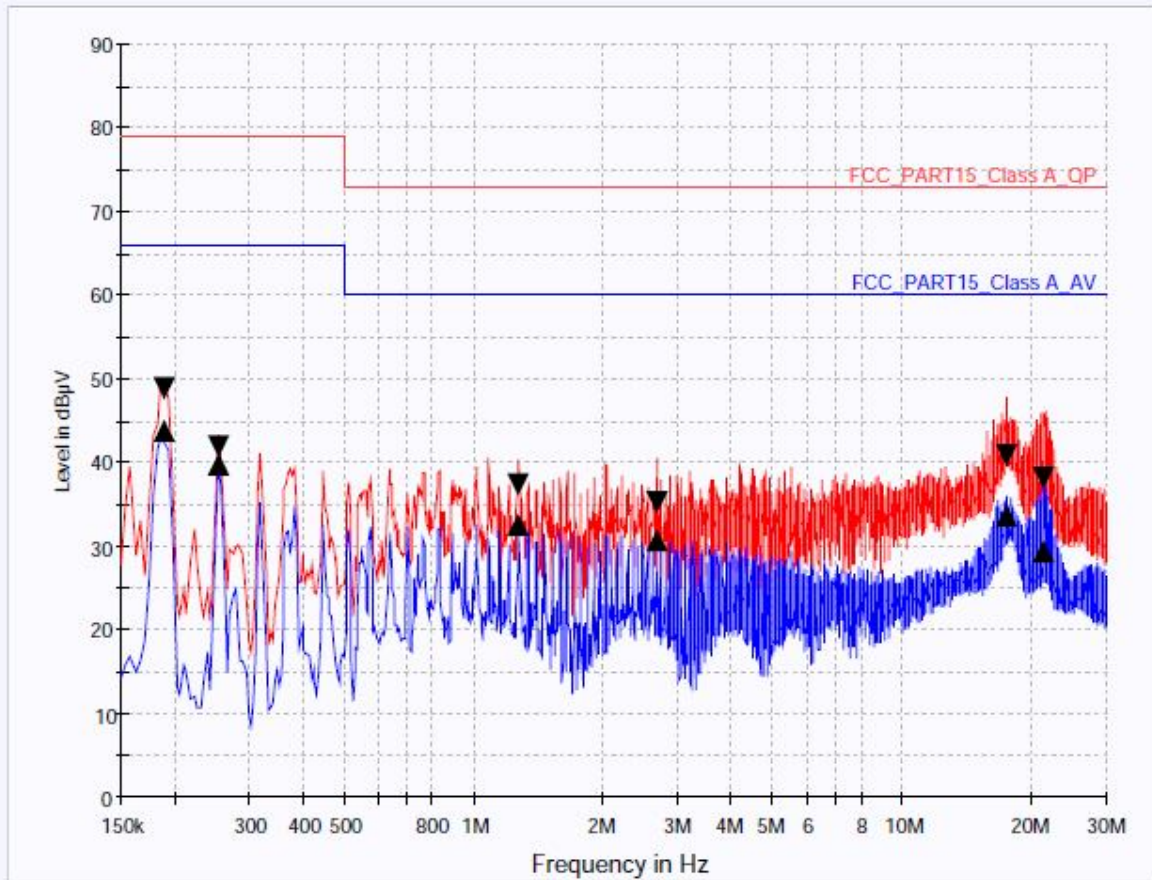


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	49.6	43.9	9.000	N	9.6	29.4	79.0	22.1	66.0
0.254000	40.0	37.9	9.000	N	9.6	39.0	79.0	28.1	66.0
0.762000	36.8	31.5	9.000	N	9.7	36.2	73.0	28.5	60.0
2.674000	36.4	31.6	9.000	N	9.7	36.6	73.0	28.4	60.0
18.082000	41.0	35.3	9.000	N	9.9	32.0	73.0	24.7	60.0
21.838000	42.1	36.7	9.000	N	10.0	30.9	73.0	23.3	60.0

Mode #4

HOT LINE

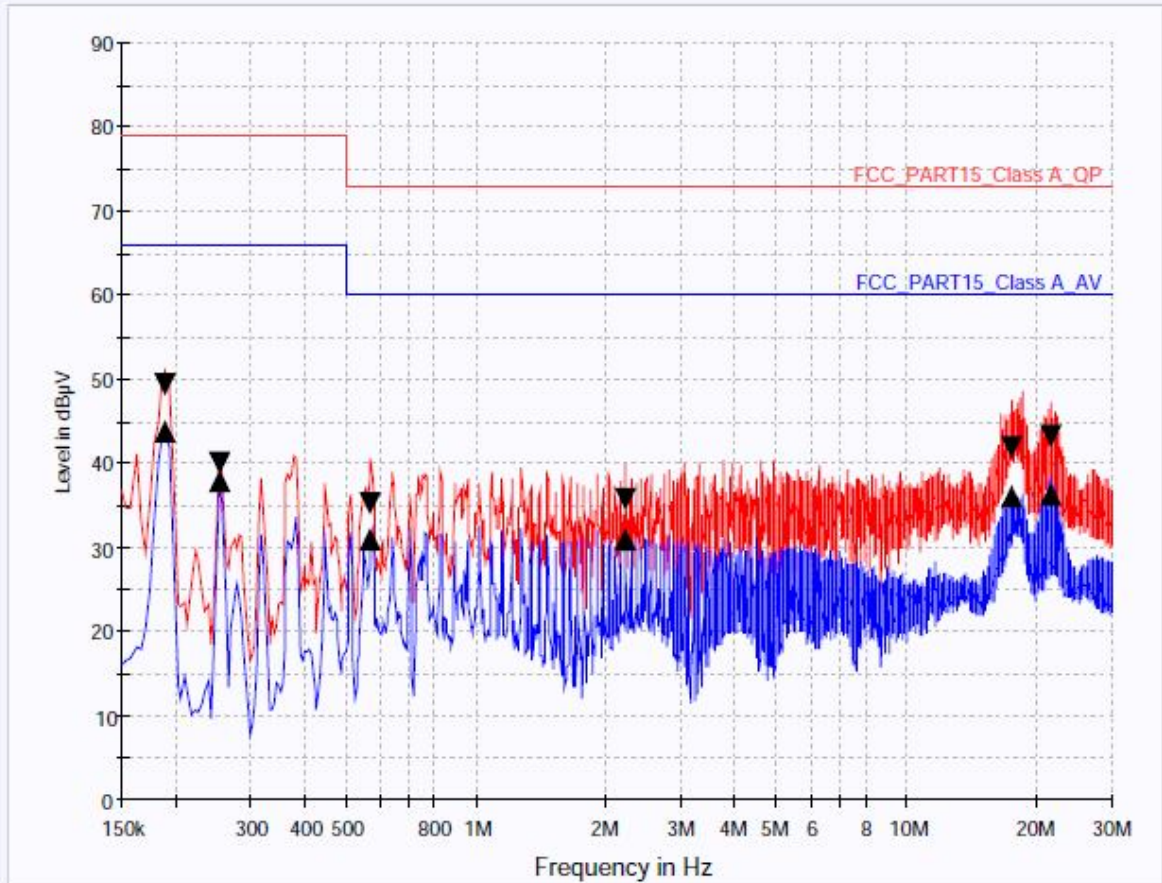


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	48.9	43.7	9.000	L1	9.6	30.1	79.0	22.3	66.0
0.254000	42.0	39.8	9.000	L1	9.6	37.0	79.0	26.2	66.0
1.274000	37.5	32.5	9.000	L1	9.6	35.5	73.0	27.5	60.0
2.674000	35.4	30.6	9.000	L1	9.7	37.6	73.0	29.4	60.0
17.562000	40.9	33.6	9.000	L1	9.9	32.1	73.0	26.4	60.0
21.510000	38.1	29.4	9.000	L1	9.9	34.9	73.0	30.6	60.0

Mode #4

NEUTRAL LINE

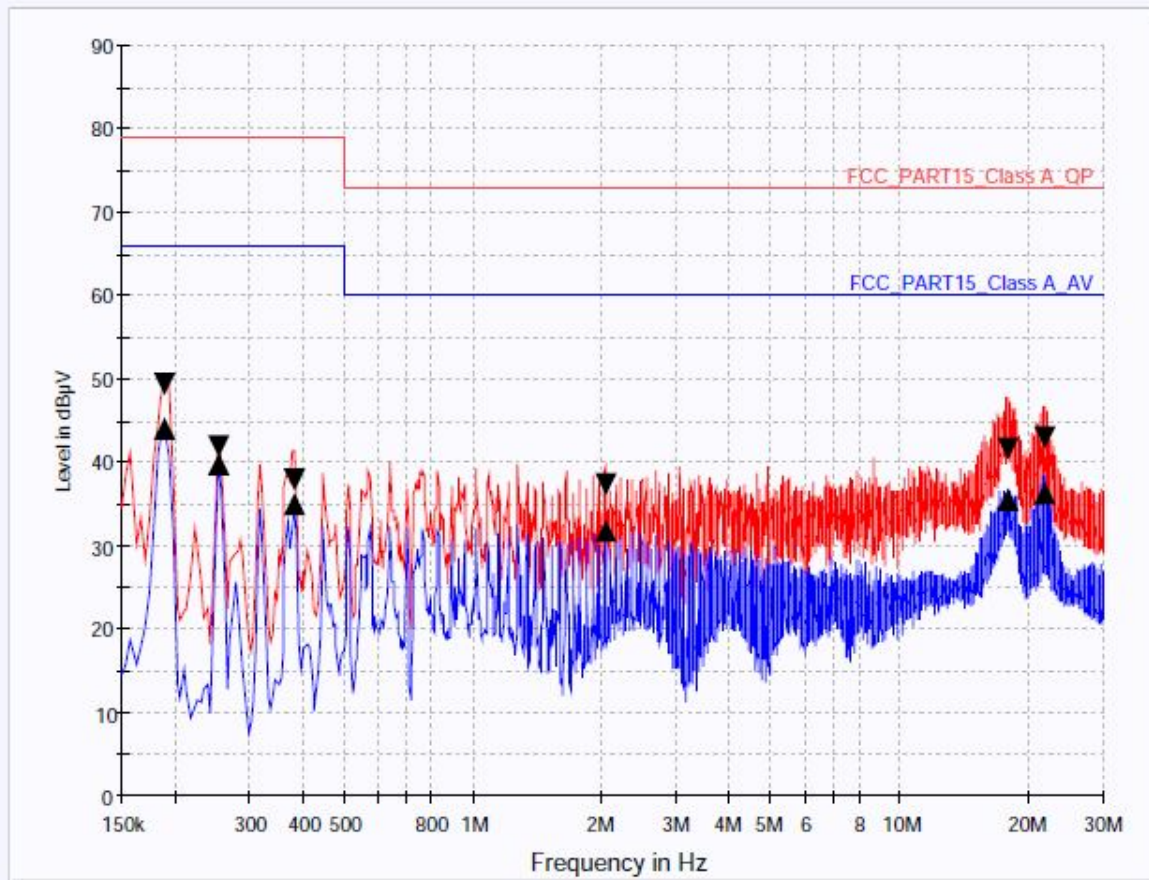


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	49.4	43.8	9.000	N	9.6	29.6	79.0	22.2	66.0
0.254000	40.0	37.9	9.000	N	9.6	39.0	79.0	28.1	66.0
0.570000	35.1	31.1	9.000	N	9.6	37.9	73.0	28.9	60.0
2.230000	35.7	31.1	9.000	N	9.7	37.3	73.0	28.9	60.0
17.574000	42.0	36.0	9.000	N	9.9	31.0	73.0	24.0	60.0
21.526000	43.3	36.4	9.000	N	10.0	29.7	73.0	23.6	60.0

Mode #5

HOT LINE

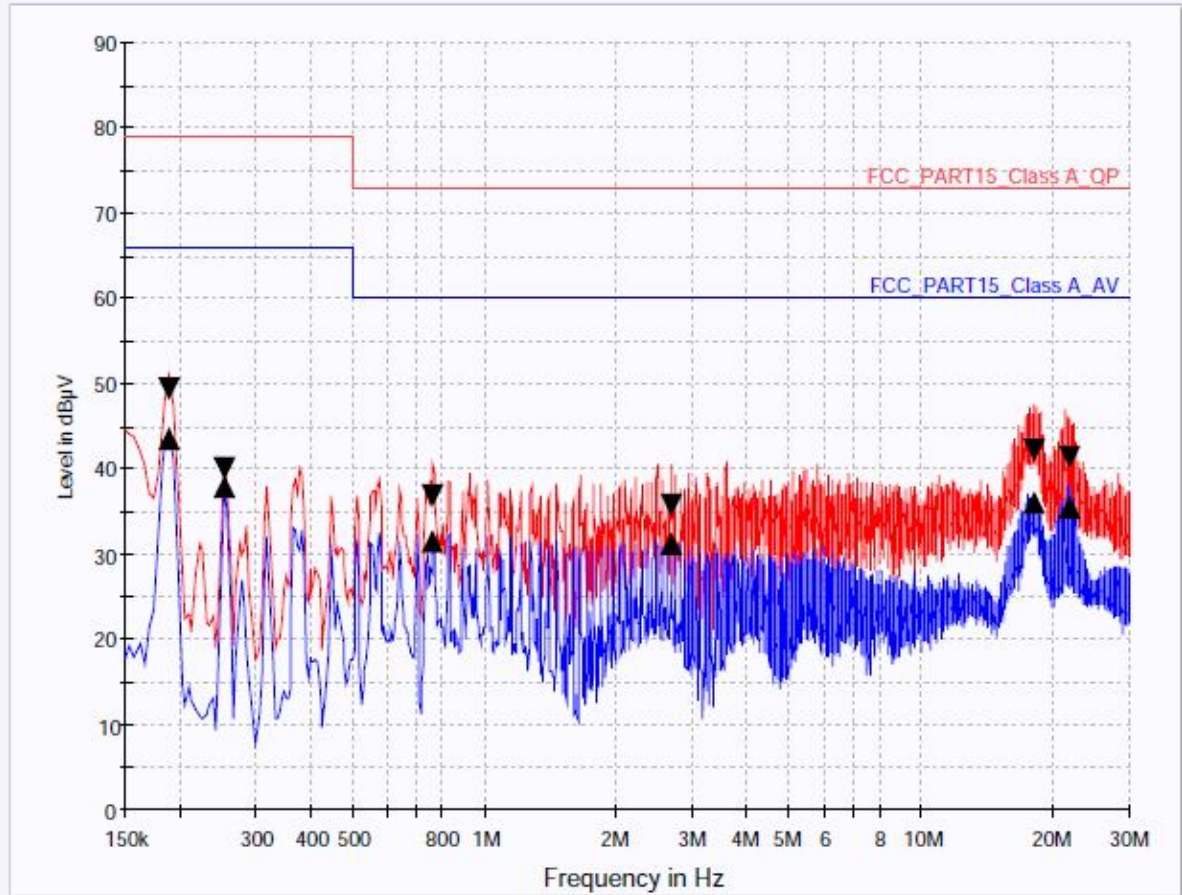


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	49.5	44.0	9.000	L1	9.6	29.5	79.0	22.0	66.0
0.254000	41.8	39.7	9.000	L1	9.6	37.2	79.0	26.3	66.0
0.382000	37.9	35.0	9.000	L1	9.6	41.1	79.0	31.0	66.0
2.038000	37.3	31.8	9.000	L1	9.6	35.7	73.0	28.2	60.0
18.022000	41.7	35.5	9.000	L1	9.9	31.3	73.0	24.5	60.0
21.778000	43.0	36.4	9.000	L1	9.9	30.0	73.0	23.6	60.0

Mode #5

NEUTRAL LINE

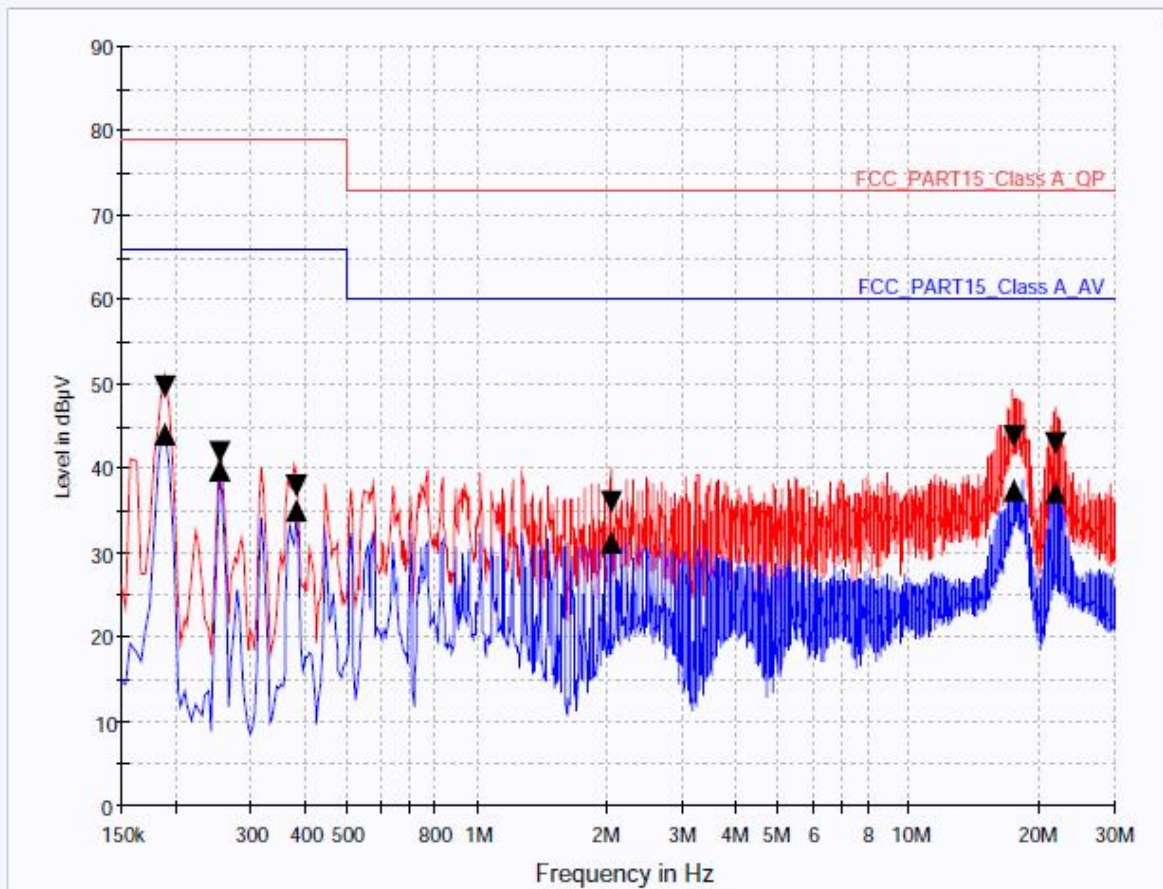


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	49.5	43.6	9.000	N	9.6	29.5	79.0	22.4	66.0
0.254000	39.9	37.8	9.000	N	9.6	39.1	79.0	28.2	66.0
0.762000	36.7	31.5	9.000	N	9.7	36.3	73.0	28.5	60.0
2.674000	35.9	31.3	9.000	N	9.7	37.1	73.0	28.7	60.0
18.210000	42.2	36.2	9.000	N	9.9	30.8	73.0	23.8	60.0
21.838000	41.3	35.5	9.000	N	10.0	31.7	73.0	24.5	60.0

Mode #6

HOT LINE

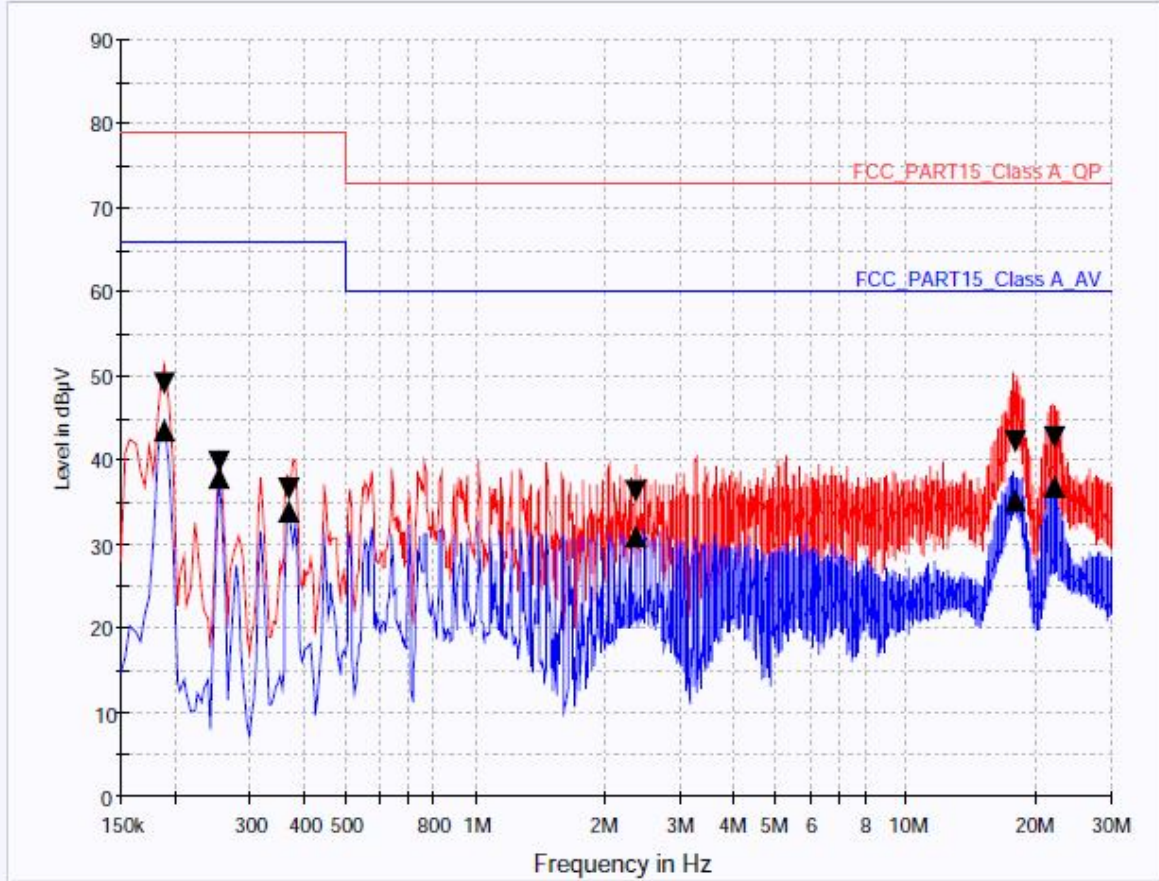


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	49.7	44.1	9.000	L1	9.6	29.3	79.0	21.9	66.0
0.254000	41.8	39.7	9.000	L1	9.6	37.2	79.0	26.3	66.0
0.382000	37.9	35.1	9.000	L1	9.6	41.1	79.0	30.9	66.0
2.038000	36.1	31.3	9.000	L1	9.6	36.9	73.0	28.7	60.0
17.638000	43.8	37.4	9.000	L1	9.9	29.2	73.0	22.6	60.0
21.778000	43.0	37.1	9.000	L1	9.9	30.0	73.0	22.9	60.0

Mode #6

NEUTRAL LINE

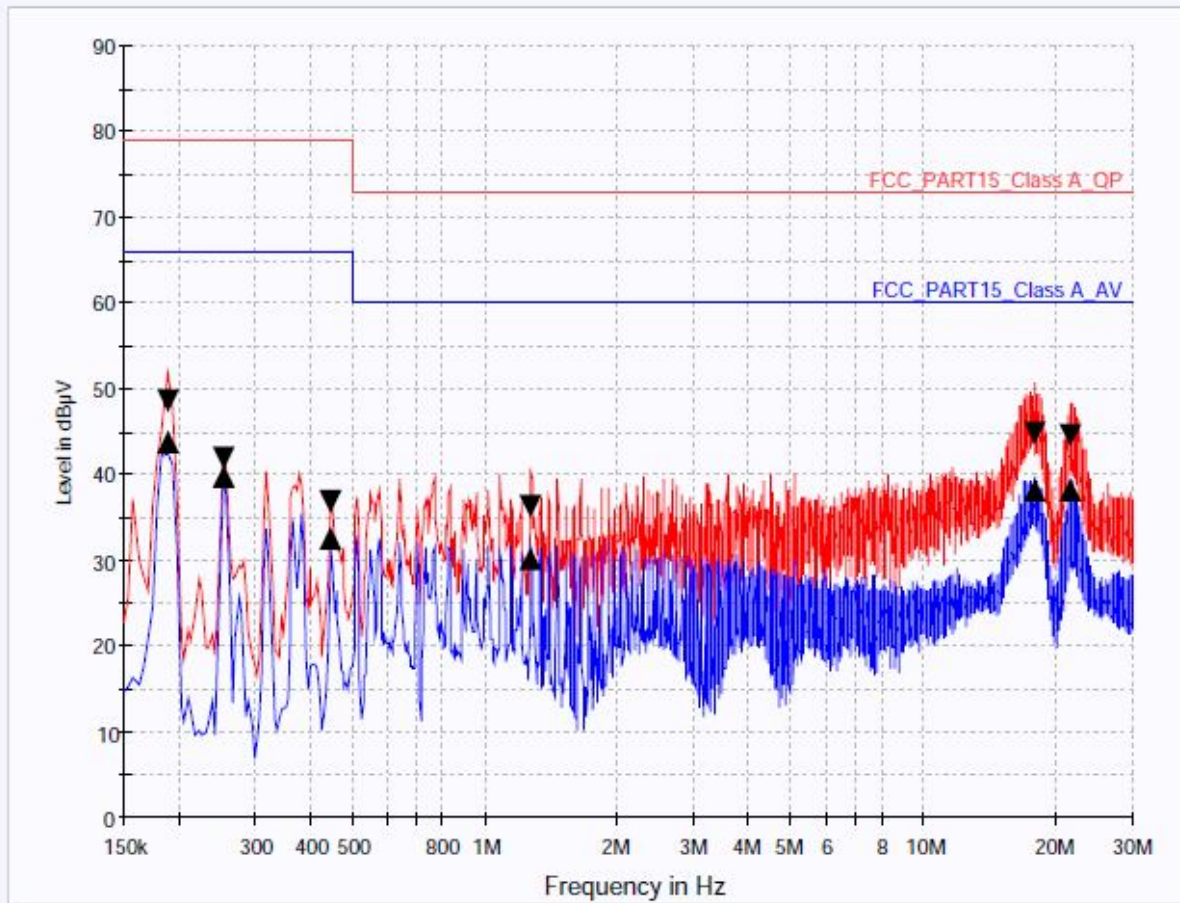


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	49.0	43.6	9.000	N	9.6	30.0	79.0	22.4	66.0
0.254000	39.9	37.8	9.000	N	9.6	39.1	79.0	28.2	66.0
0.370000	36.7	34.0	9.000	N	9.6	42.3	79.0	32.0	66.0
2.358000	36.3	31.1	9.000	N	9.7	36.7	73.0	28.9	60.0
17.998000	42.2	35.4	9.000	N	9.9	30.8	73.0	24.6	60.0
22.034000	42.8	36.9	9.000	N	10.0	30.2	73.0	23.1	60.0

Mode #7

HOT LINE

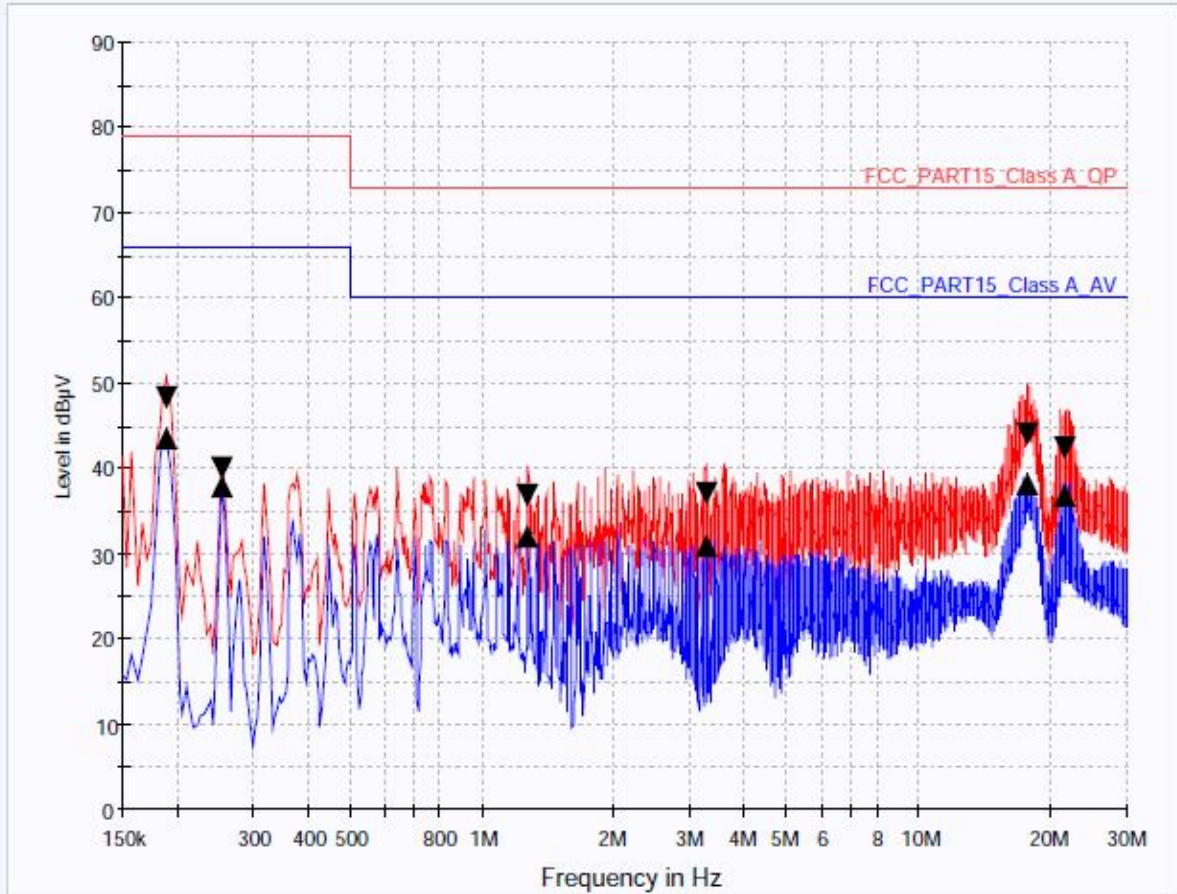


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	48.7	43.9	9.000	L1	9.6	30.3	79.0	22.1	66.0
0.254000	42.0	39.8	9.000	L1	9.6	37.0	79.0	26.2	66.0
0.446000	36.8	32.5	9.000	L1	9.6	42.2	79.0	33.5	66.0
1.270000	36.4	30.1	9.000	L1	9.6	36.6	73.0	29.9	60.0
17.954000	44.9	38.3	9.000	L1	9.9	28.1	73.0	21.7	60.0
21.714000	44.5	38.1	9.000	L1	9.9	28.5	73.0	21.9	60.0

Mode #7

NEUTRAL LINE

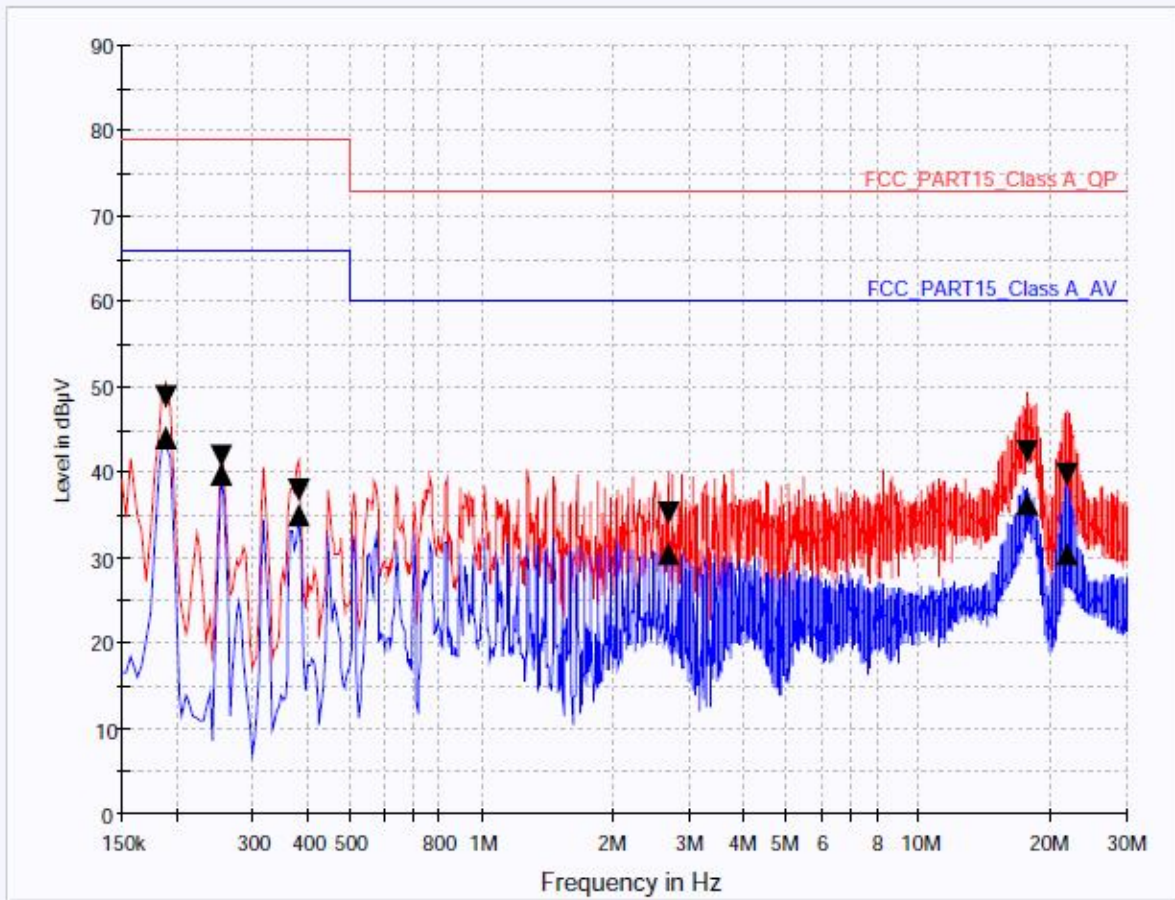


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	48.2	43.5	9.000	N	9.6	30.8	79.0	22.5	66.0
0.254000	40.1	37.9	9.000	N	9.6	38.9	79.0	28.1	66.0
1.274000	36.9	31.9	9.000	N	9.7	36.1	73.0	28.1	60.0
3.250000	37.1	30.9	9.000	N	9.7	35.9	73.0	29.1	60.0
17.702000	44.0	38.1	9.000	N	9.9	29.0	73.0	21.9	60.0
21.582000	42.6	36.8	9.000	N	10.0	30.4	73.0	23.2	60.0

Mode #8

HOT LINE

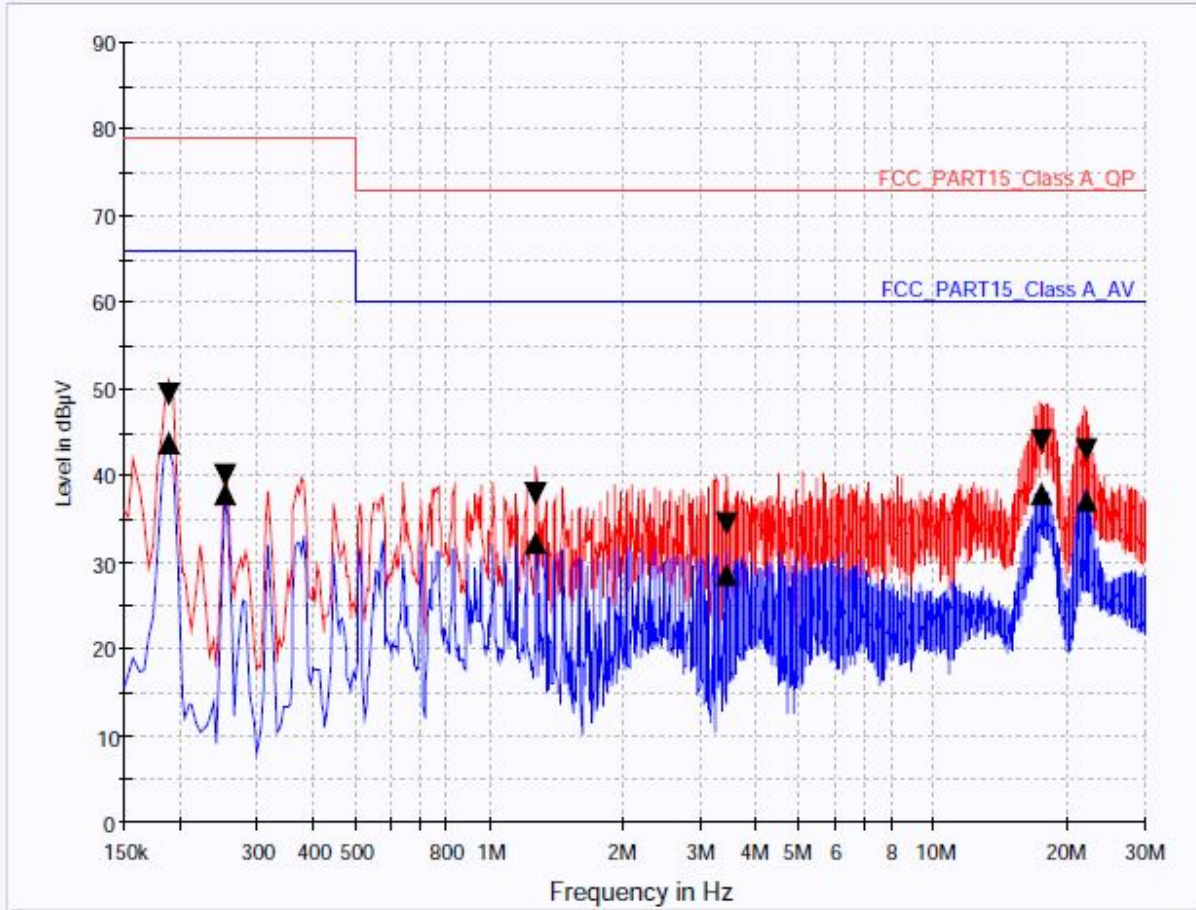


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	48.8	44.0	9.000	L1	9.6	30.2	79.0	22.0	66.0
0.254000	41.9	39.8	9.000	L1	9.6	37.1	79.0	26.2	66.0
0.382000	38.0	35.1	9.000	L1	9.6	41.0	79.0	30.9	66.0
2.674000	35.1	30.6	9.000	L1	9.7	37.9	73.0	29.4	60.0
17.830000	42.5	36.3	9.000	L1	9.9	30.5	73.0	23.7	60.0
21.782000	39.7	30.5	9.000	L1	9.9	33.3	73.0	29.5	60.0

Mode #8

NEUTRAL LINE

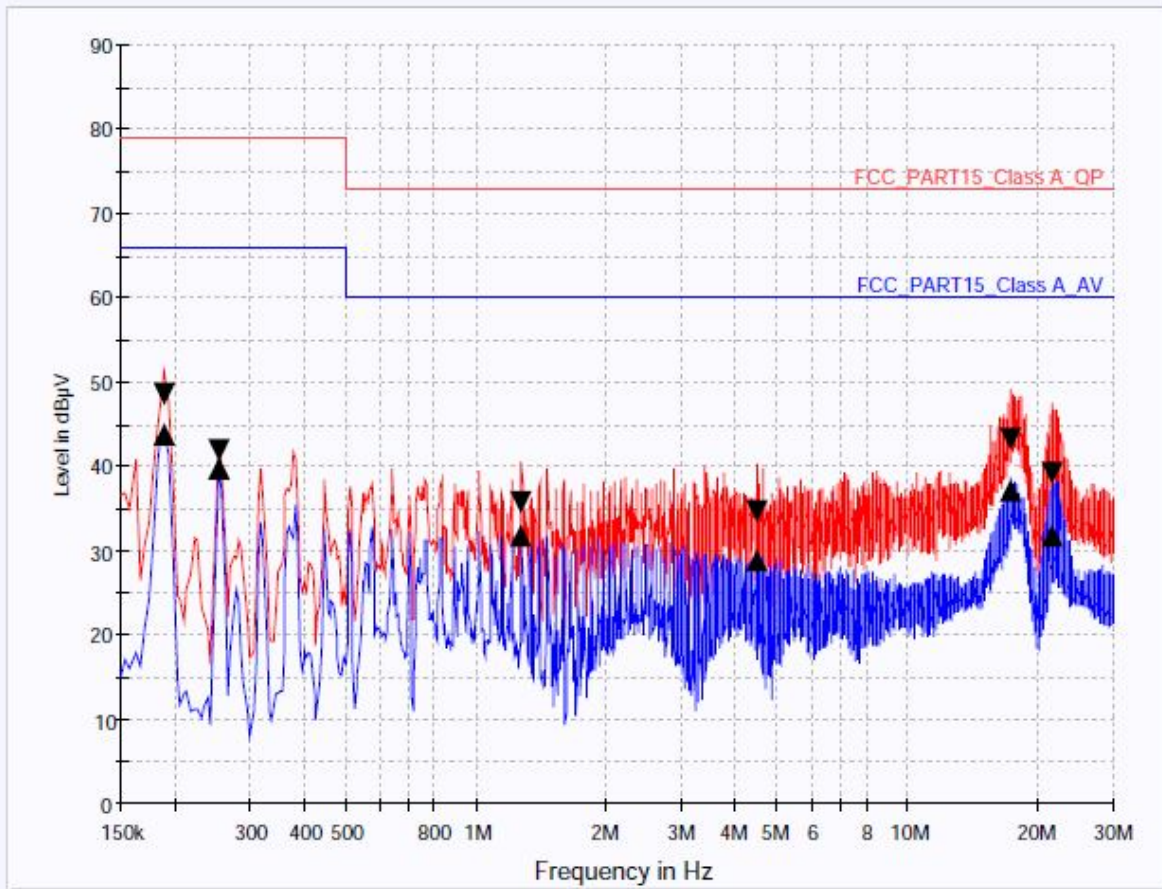


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	49.4	43.8	9.000	N	9.6	29.6	79.0	22.2	66.0
0.254000	40.0	37.9	9.000	N	9.6	39.0	79.0	28.1	66.0
1.274000	38.0	32.4	9.000	N	9.7	35.0	73.0	27.6	60.0
3.442000	34.4	28.6	9.000	N	9.7	38.6	73.0	31.4	60.0
17.574000	44.0	37.9	9.000	N	9.9	29.0	73.0	22.1	60.0
22.030000	43.1	37.2	9.000	N	10.0	29.9	73.0	22.8	60.0

Mode #9

HOT LINE

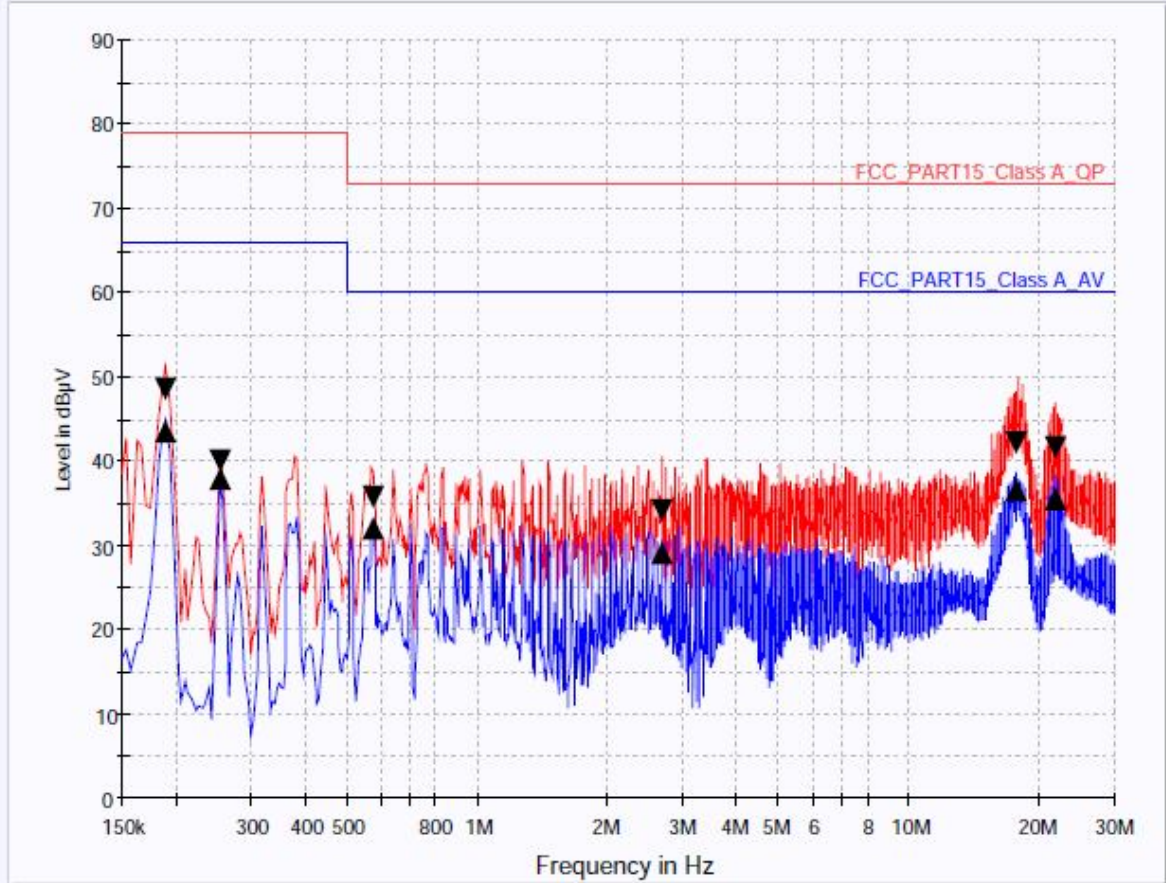


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	48.6	43.9	9.000	L1	9.6	30.4	79.0	22.1	66.0
0.254000	41.8	39.7	9.000	L1	9.6	37.2	79.0	26.3	66.0
1.274000	35.8	31.7	9.000	L1	9.6	37.2	73.0	28.3	60.0
4.458000	34.6	28.8	9.000	L1	9.7	38.4	73.0	31.2	60.0
17.322000	43.2	37.3	9.000	L1	9.9	29.8	73.0	22.7	60.0
21.710000	39.2	31.7	9.000	L1	9.9	33.8	73.0	28.3	60.0

Mode #9

NEUTRAL LINE



Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.190000	48.5	43.6	9.000	N	9.6	30.5	79.0	22.4	66.0
0.254000	40.0	37.9	9.000	N	9.6	39.0	79.0	28.1	66.0
0.574000	35.8	32.2	9.000	N	9.6	37.2	73.0	27.8	60.0
2.678000	34.3	29.2	9.000	N	9.7	38.7	73.0	30.8	60.0
17.698000	42.1	36.6	9.000	N	9.9	30.9	73.0	23.4	60.0
21.838000	41.6	35.6	9.000	N	10.0	31.4	73.0	24.4	60.0

3.2 Radiated Emission

3.2.1 Test setup

The radiated emissions measurements were in the 3/10 m, Semi Anechoic Chamber. The EUT and all local supporting equipments were placed on a non-conductive table approximately 0.8 m above the ground plane.

The frequency spectrum from 30 MHz to the maximum frequency as specified in CFR 47 Part 15 section 15.33 was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

Preliminary radiated emission test was conducted using the procedure in ANSI C63.4: 2014 8.3.1.1 below 1 000 MHz, 8.3.1.2 above 1 GHz to determine the worse operating conditions

Measurement distance between the EUT and an antenna was as below table.

Frequency range (MHz)	Measurement Distance	
	Class B Device	Class A Device
Below 1 000 MHz	3 m	10 m
Above 1 000 MHz	3 m	3 m

The test set-up photos are included in appendix II.

Used Software for measurement is manufactured by TSJ.

3.2.2 Measurement frequency range

Highest frequency generated or used in the device or on which the device operates or tunes	Upper Frequency of Measurement range (MHz)
Below 1.705 MHz	30
(1.705 ~ 108) MHz	1 000
(108 ~ 500) MHz	2 000
(500 ~ 1 000) MHz	5 000
Above 1 000 MHz	5th harmonic of the highest freq. or 40 GHz, whichever is lower

The measurement uncertainties are given with 95 % confidence.

3.2.3 Measurement uncertainty

Frequency range	Uncertainty
Below 1 000 MHz	4.66 dB
Above 1 000 MHz	4.75 dB

The measurement uncertainties are given with 95 % confidence.

3.2.4 Sample Calculated Example

At 80 MHz


Limit = 40.0 dB μ V/m

Result = Receiver reading value + Antenna Factor + Cable Loss - Pre-amplifier gain = 30 dB μ V/m

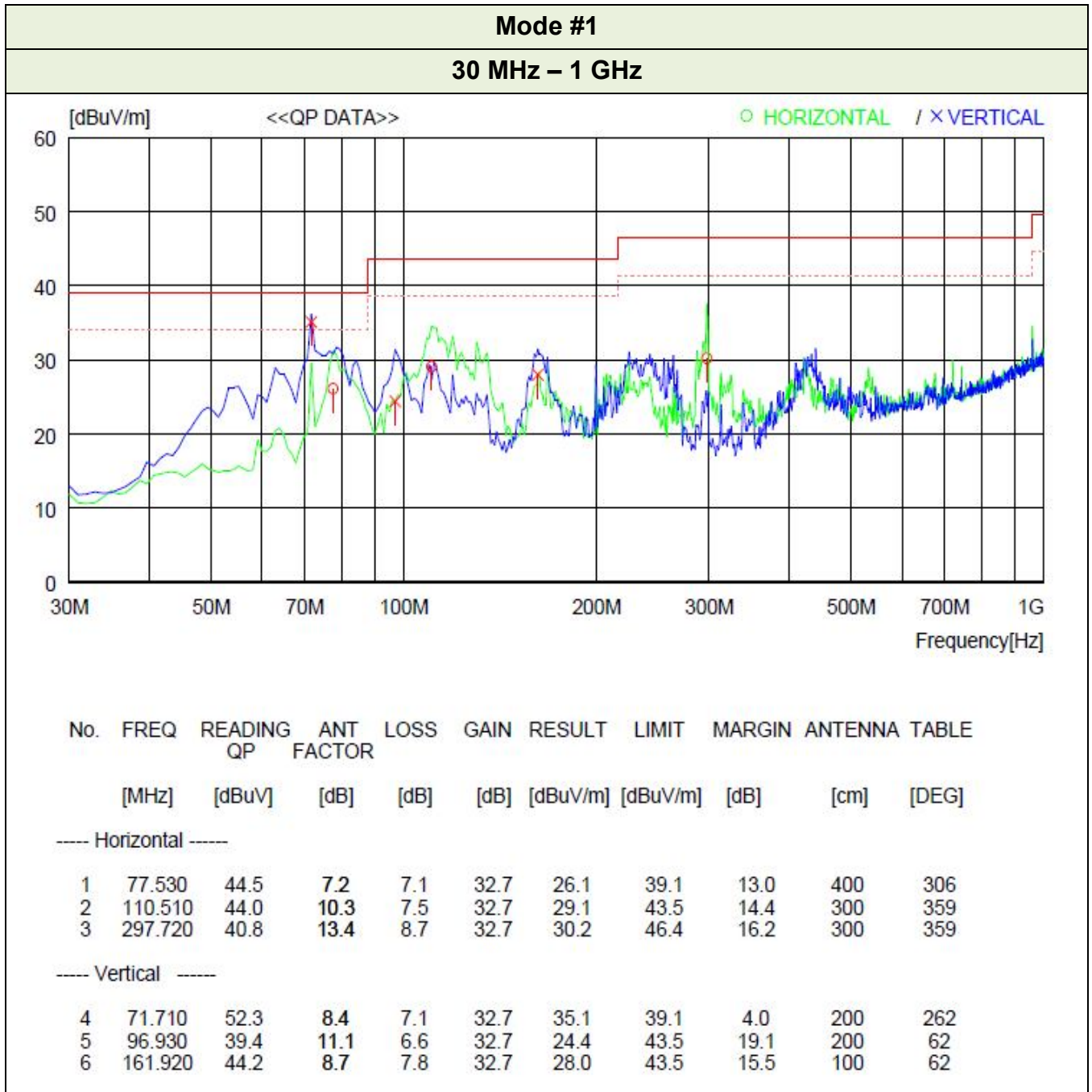
Margin = Limit - Result = 40 - 30 = 10

so the EUT has 10.0 dB margin at 80 MHz

3.2.5 Test result

Date of Test	2017-08-08 ~ 08-09			
Temperature	(23.3 ~ 23.5) °C	Relative humidity	(51.1 ~ 53.8) % R.H.	
Operating Input Voltage	120 Vac	Input Frequency	60 Hz	
Frequency range	Resolution Bandwidth	Video Bandwidth	Detector Mode	Measurement distance
Below 1 000 MHz	100 kHz or 120 kHz	300 kHz	Peak or Q.P.	10 m
Above 1 000 MHz	1 MHz	1 MHz or 10 Hz	Peak or Average	3 m
Test Mode	Mode #1 ~ #9			
Test Result	Pass	Tested By	Kim, Kwang-hyun 	

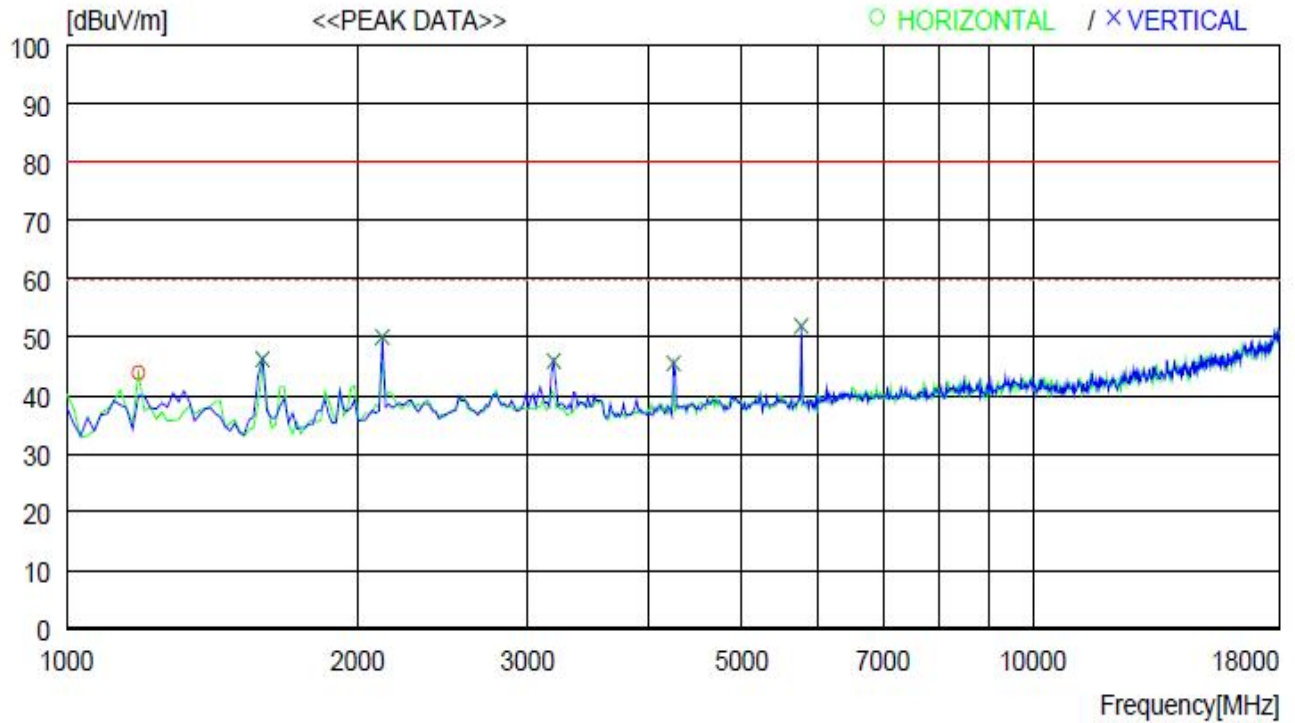
3.2.6 Test Data



NOTE: Quasi-Peak was not measured, because Peak values met Quasi-Peak limit.

Mode #1

Above 1 000 MHz (Peak)

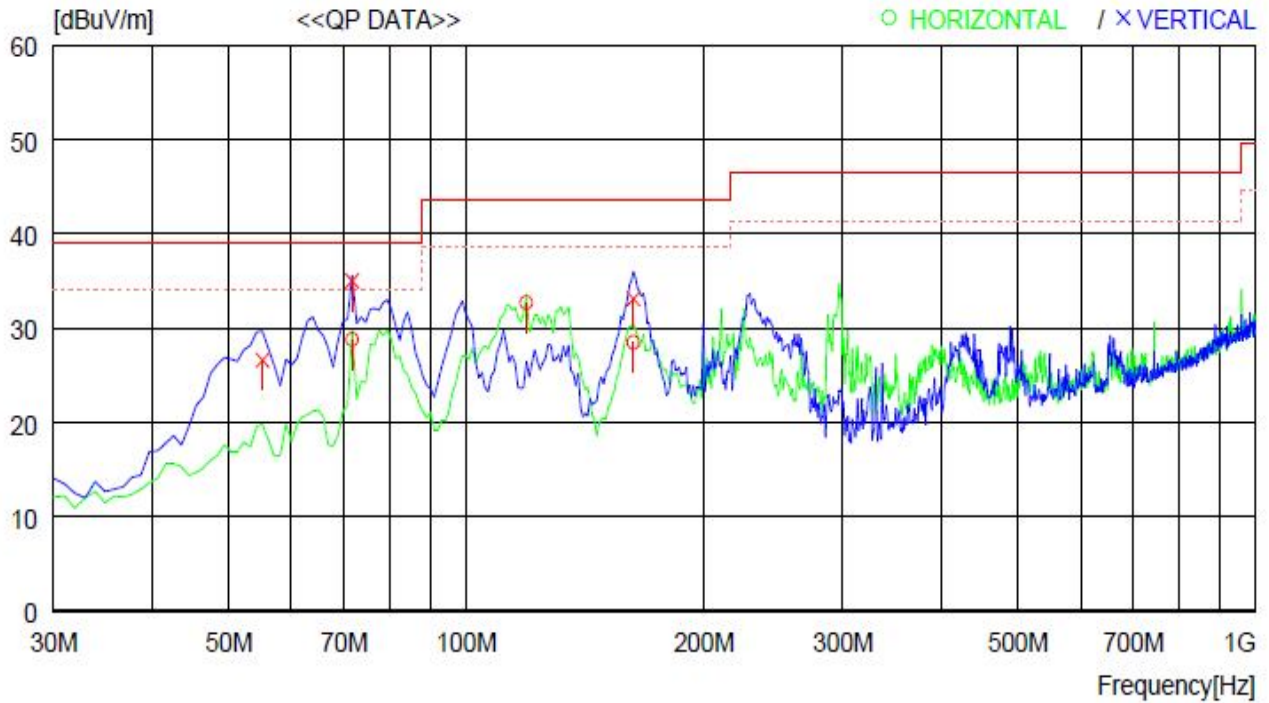


No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	1187.000	56.7	24.7	2.3	39.8	43.9	80.0	36.1	100	179
----- Vertical -----										
2	1595.000	57.1	26.0	2.8	39.7	46.2	80.0	33.8	100	359
3	2122.000	56.2	28.3	4.9	39.4	50.0	80.0	30	200	303
4	3193.000	51.0	30.8	3.7	39.6	45.9	80.0	34.1	300	287
5	4247.000	48.6	32.9	3.9	39.9	45.5	80.0	34.5	200	0
6	5760.000	53.2	34.1	4.4	39.8	51.9	80.0	28.1	200	264

NOTE: Average mode was not measured, because Peak values were under the Average limit.

Mode #2

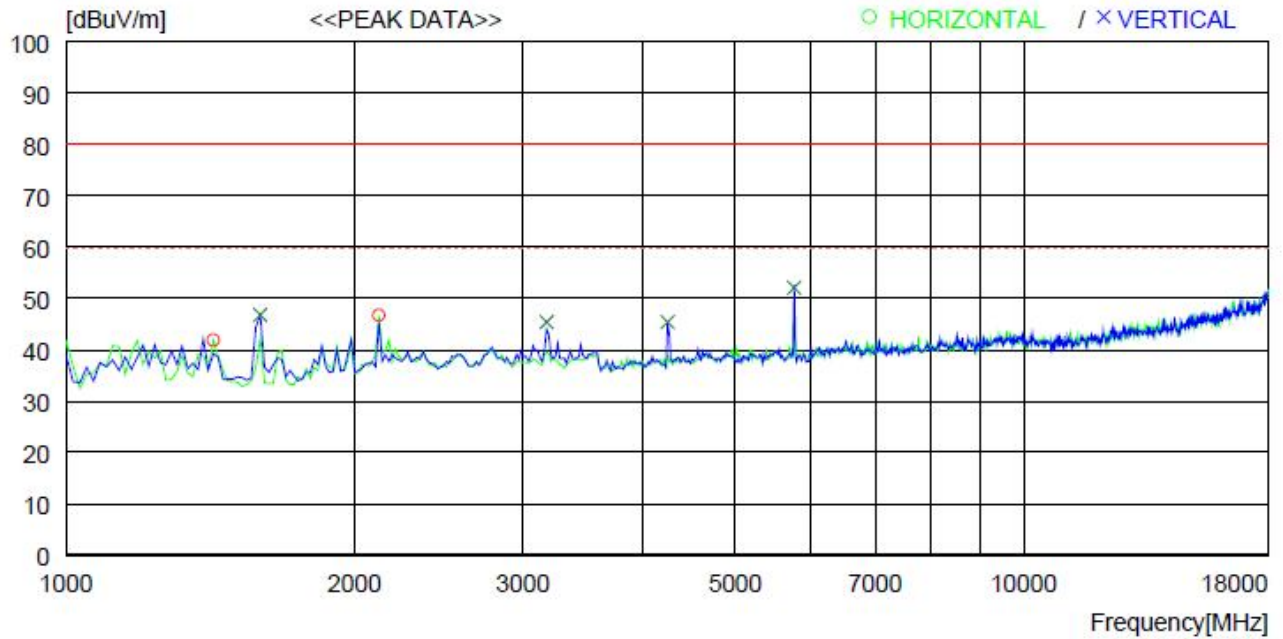
30 MHz – 1 GHz



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
---- Horizontal ----										
1	71.700	46.0	8.4	7.1	32.7	28.8	39.1	10.3	300	282
2	119.240	48.9	9.0	7.5	32.7	32.7	43.5	10.8	400	6
3	162.880	44.7	8.7	7.8	32.7	28.5	43.5	15.0	400	106
---- Vertical ----										
4	55.220	40.0	12.4	6.9	32.7	26.6	39.1	12.5	100	0
5	71.710	52.2	8.4	7.1	32.7	35.0	39.1	4.1	200	359
6	162.890	49.3	8.7	7.8	32.7	33.1	43.5	10.4	100	73

Mode #2

Above 1 000 MHz (Peak)

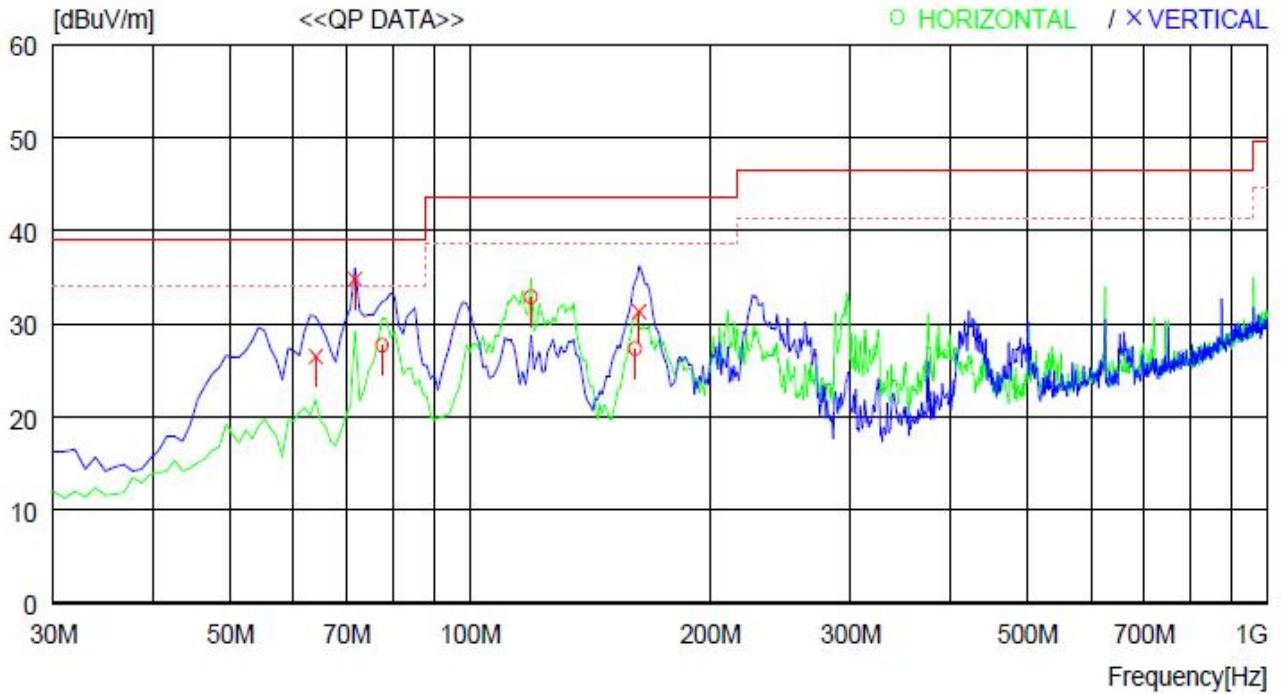


No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	1425.000	53.8	25.3	2.6	39.8	41.9	80.0	38.1	300	171
2	2122.000	52.9	28.3	4.9	39.4	46.7	80.0	33.3	100	0
----- Vertical -----										
3	1595.000	57.7	26.0	2.8	39.7	46.8	80.0	33.2	300	359
4	3176.000	49.1	30.8	4.9	39.4	45.4	80.0	34.6	300	50
5	4247.000	48.4	32.9	3.7	39.6	45.4	80.0	34.6	100	344
6	5760.000	54.0	34.1	3.9	39.9	52.1	80.0	27.9	200	0

NOTE: Average mode was not measured, because Peak values were under the Average limit.

Mode #3

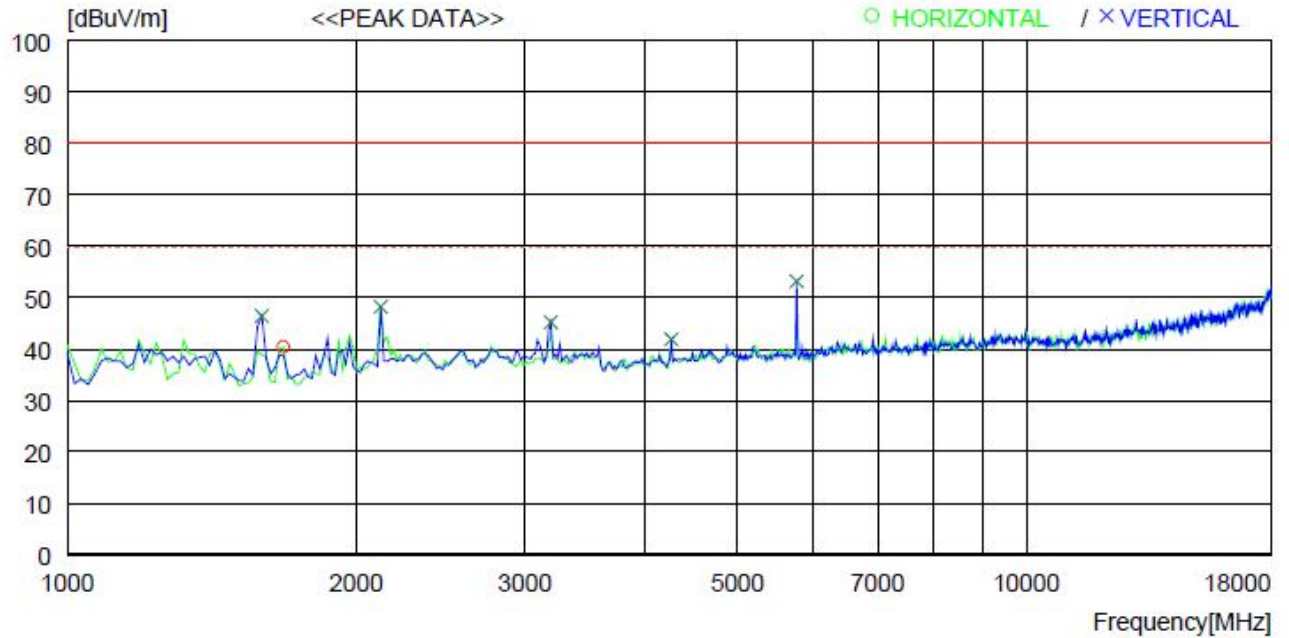
30 MHz – 1 GHz



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
---- Horizontal ----										
1	77.530	46.1	7.2	7.1	32.7	27.7	39.1	11.4	400	261
2	119.240	49.1	9.0	7.5	32.7	32.9	43.5	10.6	400	0
3	160.950	43.5	8.7	7.8	32.7	27.3	43.5	16.2	400	353
---- Vertical ----										
4	64.060	41.6	10.6	7.0	32.7	26.5	39.1	12.6	200	359
5	71.710	52.0	8.4	7.1	32.7	34.8	39.1	4.3	200	359
6	162.890	47.5	8.7	7.8	32.7	31.3	43.5	12.2	200	62

Mode #3

Above 1 000 MHz (Peak)

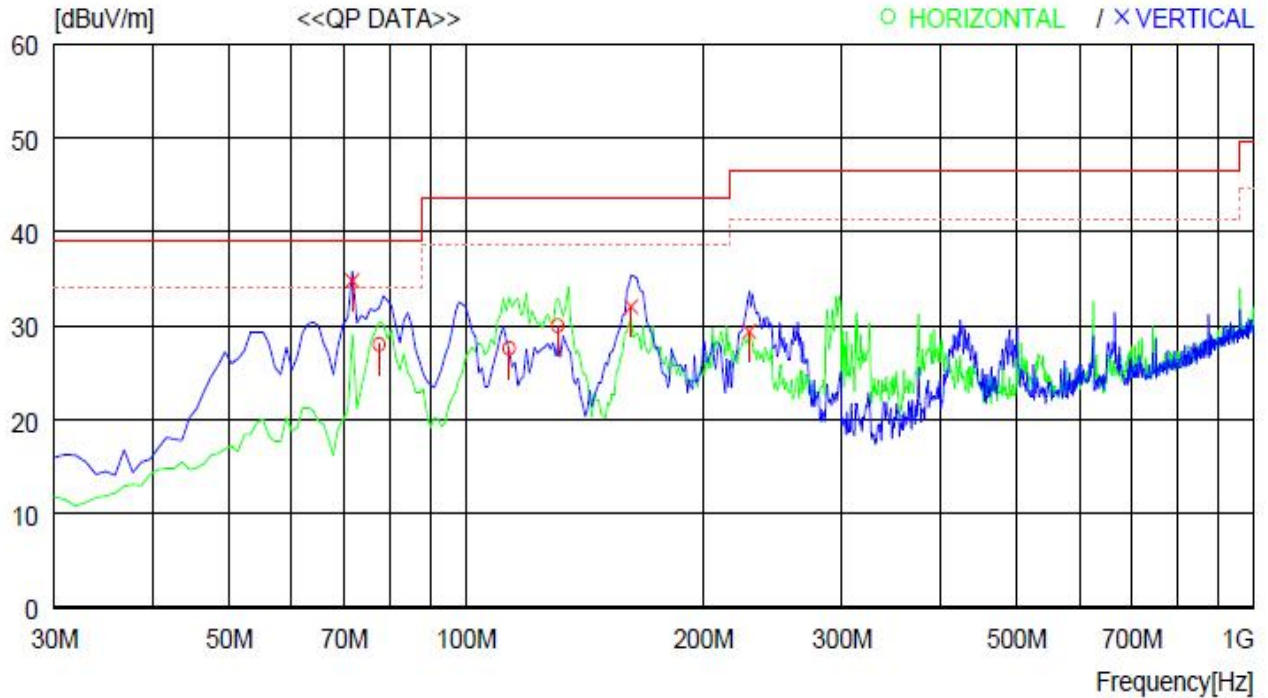


No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	1680.000	50.6	26.5	2.9	39.6	40.4	80.0	39.6	200	212
----- Vertical -----										
2	1595.000	57.3	26.0	2.8	39.7	46.4	80.0	33.6	200	287
3	2122.000	54.4	28.3	4.9	39.4	48.2	80.0	31.8	300	8
4	3193.000	50.3	30.8	3.7	39.6	45.2	80.0	34.8	300	300
5	4264.000	45.0	32.9	3.9	39.9	41.9	80.0	38.1	100	224
6	5760.000	54.5	34.1	4.4	39.8	53.2	80.0	26.8	200	0

NOTE: Average mode was not measured, because Peak values were under the Average limit.

Mode #4

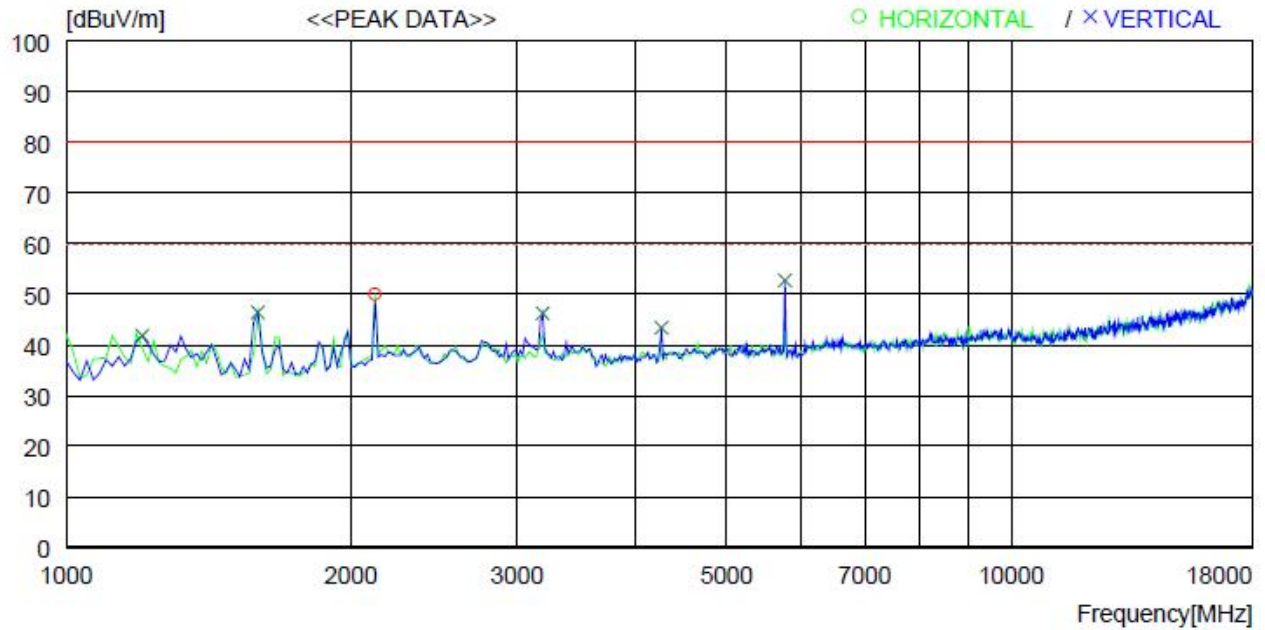
30 MHz – 1 GHz



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
---- Horizontal ----										
1	77.530	46.4	7.2	7.1	32.7	28.0	39.1	11.1	400	359
2	113.420	42.9	9.9	7.5	32.7	27.6	43.5	15.9	300	349
3	130.670	46.8	8.3	7.6	32.7	30.0	43.5	13.5	400	359
---- Vertical ----										
4	71.710	52.0	8.4	7.1	32.7	34.8	39.1	4.3	200	343
5	161.920	48.2	8.7	7.8	32.7	32.0	43.5	11.5	100	359
6	228.850	41.4	12.3	8.3	32.6	29.4	46.4	17.0	100	359

Mode #4

Above 1 000 MHz (Peak)

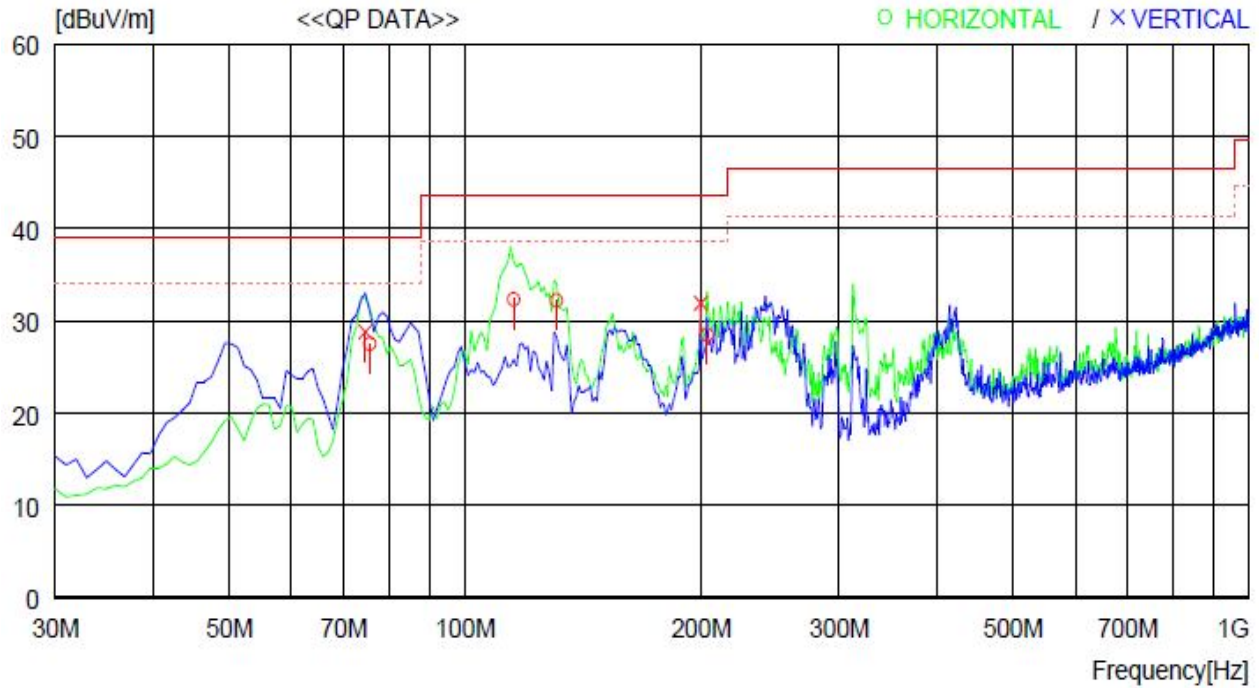


No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	2122.000	56.2	28.3	4.9	39.4	50.0	80.0	30	300	324
----- Vertical -----										
2	1204.000	54.5	24.8	2.3	39.8	41.8	80.0	38.2	300	359
3	1595.000	57.3	26.0	2.8	39.7	46.4	80.0	33.6	200	348
4	3193.000	51.3	30.8	3.7	39.6	46.2	80.0	33.8	300	283
5	4264.000	46.5	32.9	3.9	39.9	43.4	80.0	36.6	300	359
6	5760.000	54.0	34.1	4.4	39.8	52.7	80.0	27.3	200	0

NOTE: Average mode was not measured, because Peak values were under the Average limit

Mode #5

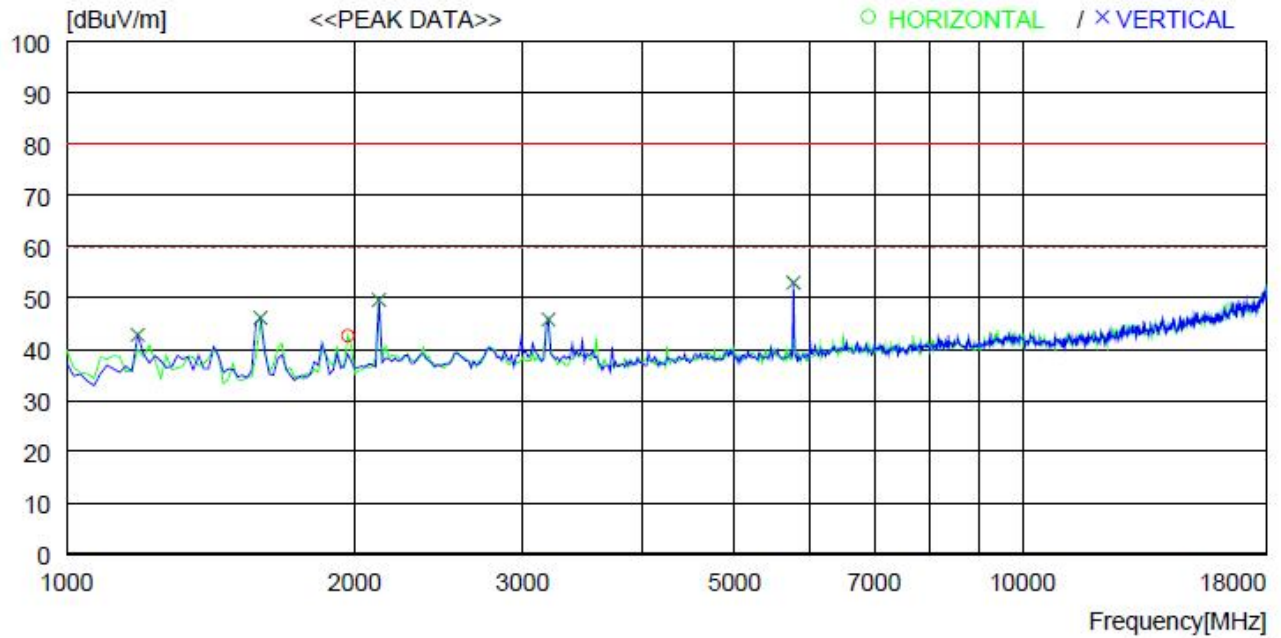
30 MHz – 1 GHz



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
---- Horizontal ----										
1	75.590	45.5	7.6	7.1	32.7	27.5	39.1	11.6	400	262
2	115.410	47.9	9.6	7.5	32.7	32.3	43.5	11.2	300	359
3	130.730	49.0	8.3	7.6	32.7	32.2	43.5	11.3	400	2
4	203.630	41.1	11.9	8.1	32.6	28.5	43.5	15.0	300	359
---- Vertical ----										
5	74.620	46.6	7.8	7.1	32.7	28.8	39.1	10.3	300	136
6	200.010	44.7	11.8	8.1	32.7	31.9	43.5	11.6	100	19

Mode #5

Above 1 000 MHz (Peak)

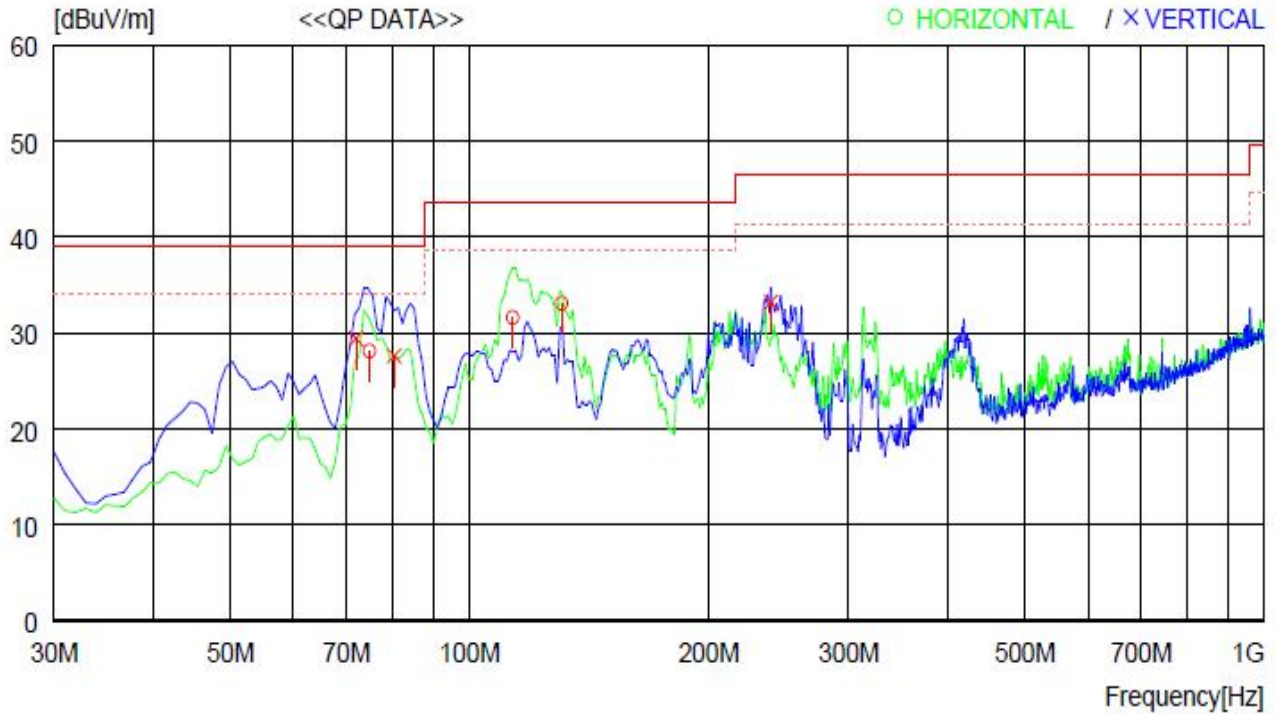


No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	1969.000	50.3	28.1	3.6	39.4	42.6	80.0	37.4	100	202
----- Vertical -----										
2	1187.000	55.6	24.7	2.3	39.8	42.8	80.0	37.2	300	183
3	1595.000	57.0	26.0	2.8	39.7	46.1	80.0	33.9	200	0
4	2122.000	55.8	28.3	4.9	39.4	49.6	80.0	30.4	300	359
5	3193.000	50.9	30.8	3.7	39.6	45.8	80.0	34.2	300	7
6	5760.000	54.3	34.1	4.4	39.8	53.0	80.0	27	200	264

NOTE: Average mode was not measured, because Peak values were under the Average limit

Mode #6

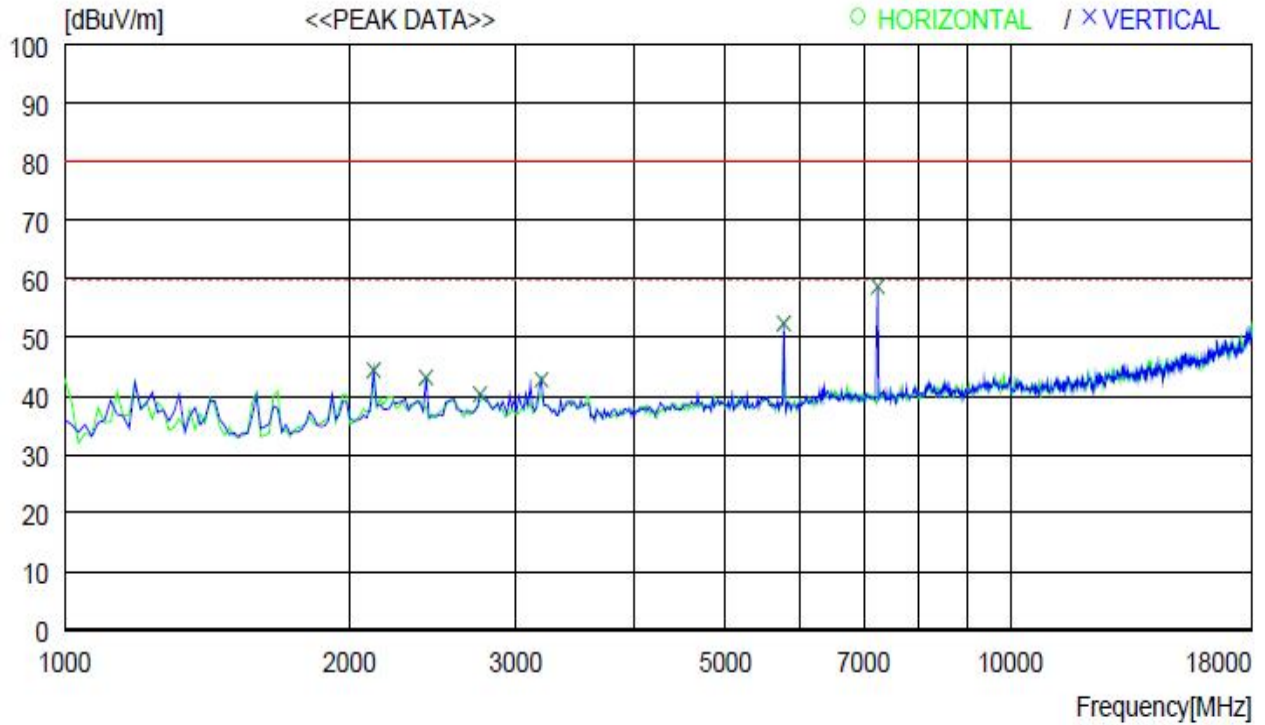
30 MHz – 1 GHz



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
---- Horizontal ----										
1	74.920	45.9	7.8	7.1	32.7	28.1	39.1	11.0	400	75
2	113.420	46.9	9.9	7.5	32.7	31.6	43.5	11.9	400	0
3	130.700	49.9	8.3	7.6	32.7	33.1	43.5	10.4	400	0
---- Vertical ----										
4	72.020	46.6	8.4	7.1	32.7	29.4	39.1	9.7	200	359
5	80.480	46.2	6.9	7.2	32.7	27.6	39.1	11.5	300	305
6	239.520	45.0	12.5	8.3	32.6	33.2	46.4	13.2	100	349

Mode #6

Above 1 000 MHz (Peak)

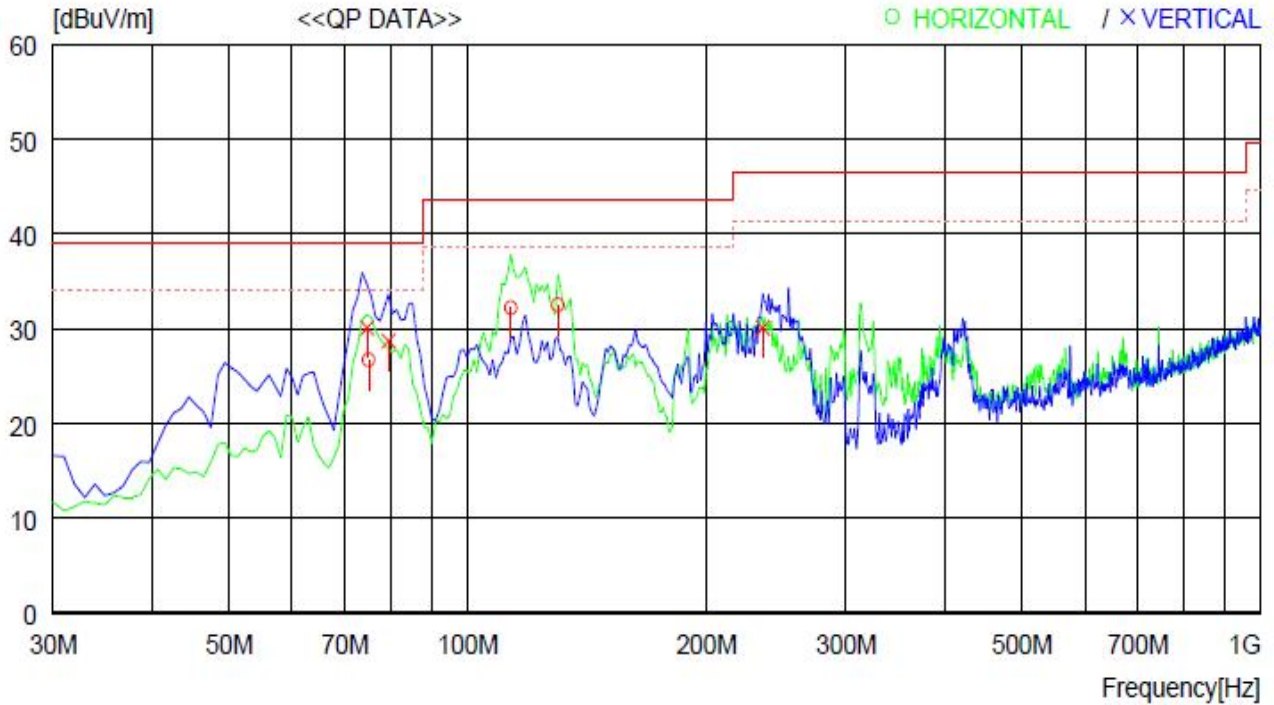


No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Vertical -----										
1	2122.000	50.6	28.3	4.9	39.4	44.4	80.0	35.6	300	258
2	2411.000	47.5	28.6	6.6	39.5	43.2	80.0	36.8	200	0
3	2751.000	43.8	29.6	6.4	39.5	40.3	80.0	39.7	200	0
4	3193.000	47.9	30.8	3.7	39.6	42.8	80.0	37.2	100	330
5	5760.000	53.7	34.1	4.4	39.8	52.4	80.0	27.6	200	262
6	7239.000	58.3	35.1	4.9	39.6	58.7	80.0	21.3	300	359

Remark. Notch Filter was used during the test.

Mode #7

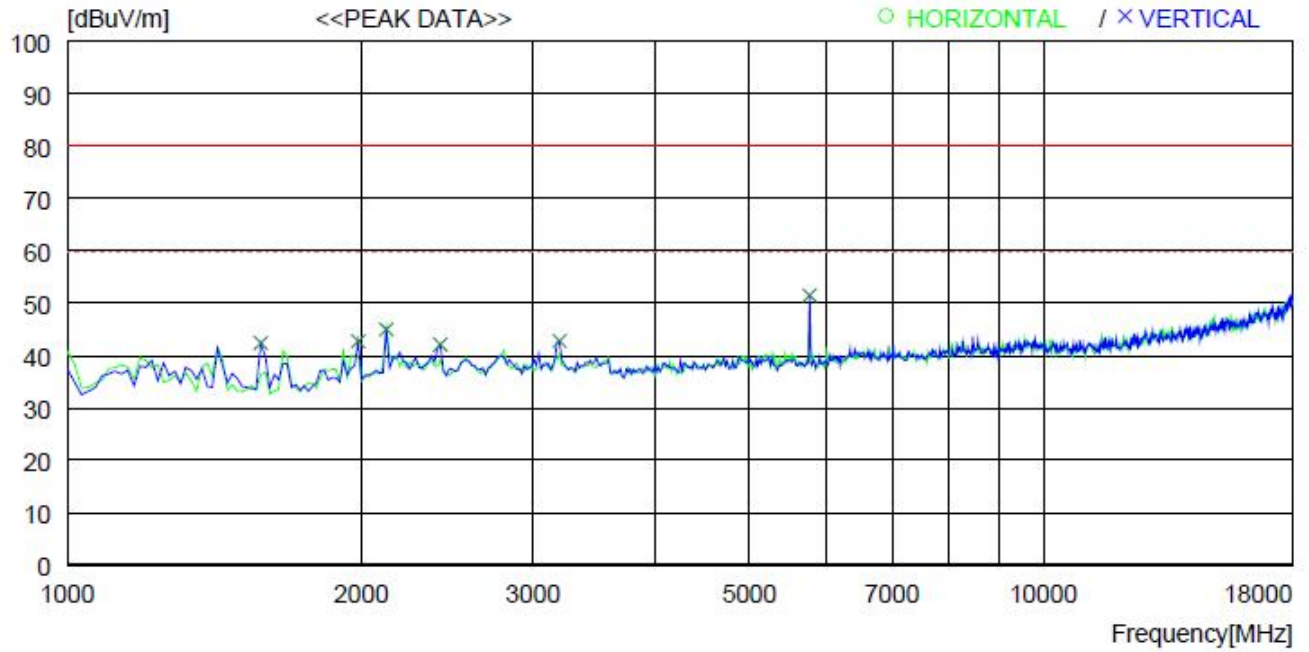
30 MHz – 1 GHz



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
---- Horizontal ----										
1	75.060	44.6	7.7	7.1	32.7	26.7	39.1	12.4	300	299
2	113.420	47.5	9.9	7.5	32.7	32.2	43.5	11.3	300	359
3	129.910	49.3	8.3	7.6	32.7	32.5	43.5	11.0	400	0
---- Vertical ----										
4	74.700	47.9	7.8	7.1	32.7	30.1	39.1	9.0	200	359
5	79.470	47.3	6.9	7.2	32.7	28.7	39.1	10.4	200	65
6	235.640	42.0	12.4	8.3	32.6	30.1	46.4	16.3	100	2

Mode #7

Above 1 000 MHz (Peak)

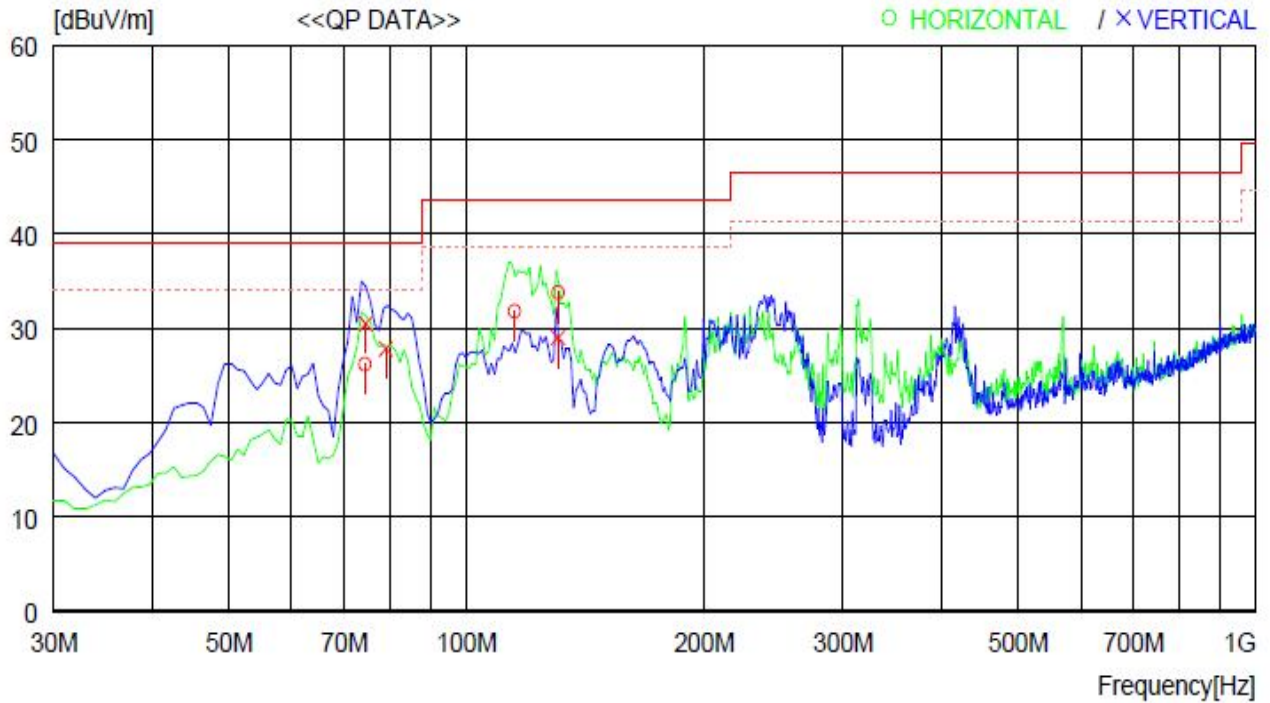


No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Vertical -----										
1	1578.000	53.5	25.9	2.7	39.7	42.4	80.0	37.6	300	359
2	1986.000	50.3	28.1	3.7	39.4	42.7	80.0	37.3	200	0
3	2122.000	51.2	28.3	4.9	39.4	45.0	80.0	35	200	348
4	2411.000	46.4	28.6	6.6	39.5	42.1	80.0	37.9	200	0
5	3193.000	47.9	30.8	3.7	39.6	42.8	80.0	37.2	200	0
6	5760.000	52.8	34.1	4.4	39.8	51.5	80.0	28.5	200	0

Remark. Notch Filter was used during the test.

Mode #8

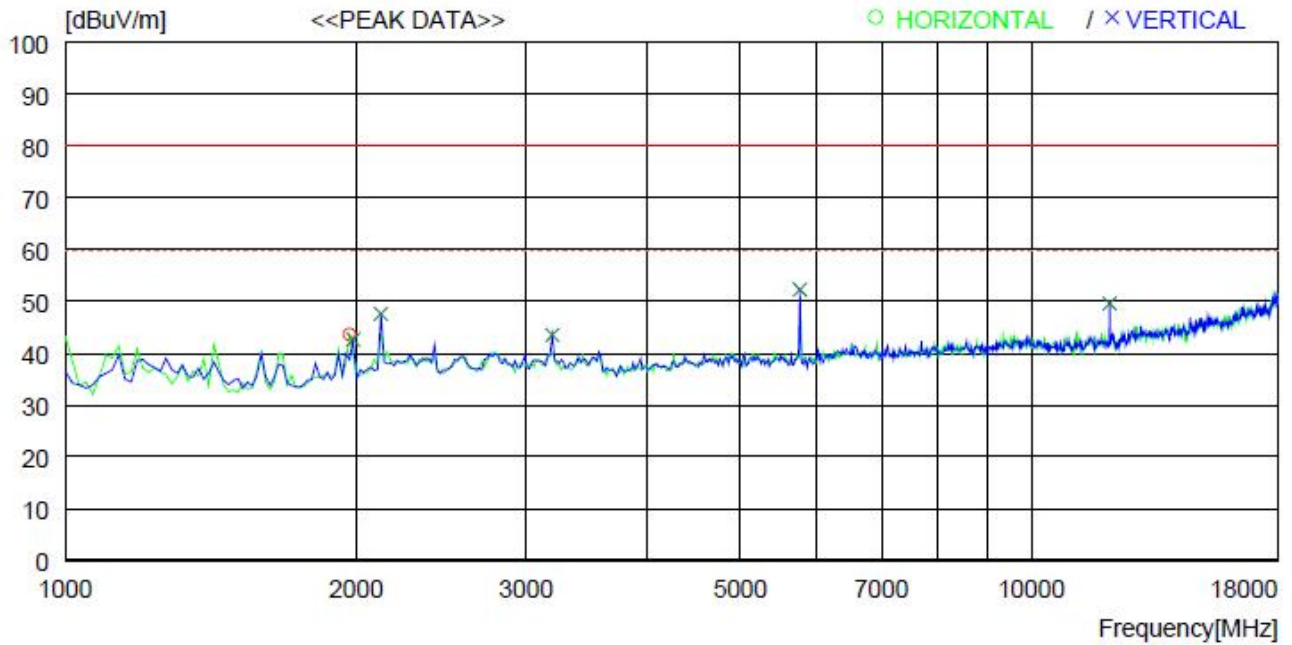
30 MHz – 1 GHz



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
---- Horizontal ----										
1	74.410	43.9	7.9	7.1	32.7	26.2	39.1	12.9	300	268
2	115.110	47.4	9.6	7.5	32.7	31.8	43.5	11.7	400	11
3	130.710	50.6	8.3	7.6	32.7	33.8	43.5	9.7	400	0
---- Vertical ----										
4	74.570	48.3	7.8	7.1	32.7	30.5	39.1	8.6	200	289
5	79.070	46.4	6.9	7.2	32.7	27.8	39.1	11.3	300	90
6	130.700	45.8	8.3	7.6	32.7	29.0	43.5	14.5	100	0

Mode #8

Above 1 000 MHz (Peak)

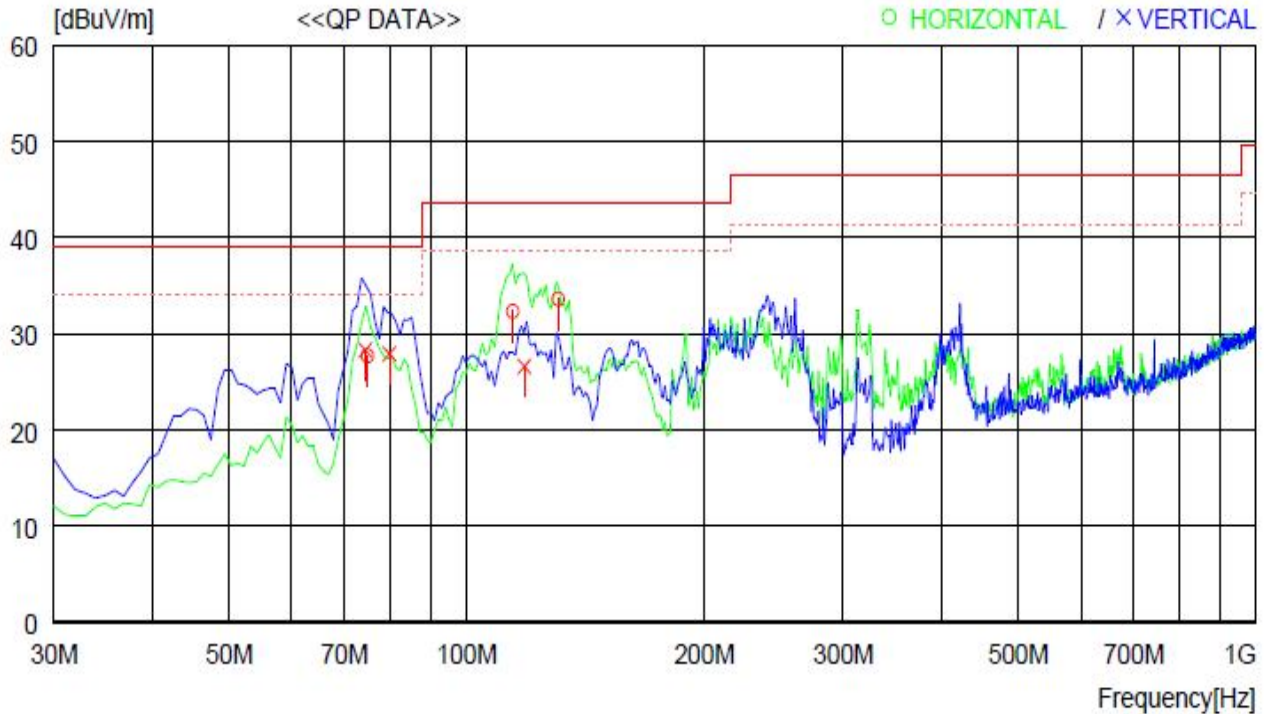


No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	1969.000	51.3	28.1	3.6	39.4	43.6	80.0	36.4	200	359
----- Vertical -----										
2	1986.000	50.2	28.1	3.7	39.4	42.6	80.0	37.4	300	359
3	2122.000	53.8	28.3	4.9	39.4	47.6	80.0	32.4	200	343
4	3193.000	48.6	30.8	3.7	39.6	43.5	80.0	36.5	300	359
5	5760.000	53.6	34.1	4.4	39.8	52.3	80.0	27.7	100	359
6	12050.000	45.6	36.9	6.6	39.5	49.6	80.0	30.4	300	359

Remark. Notch Filter was used during the test.

Mode #9

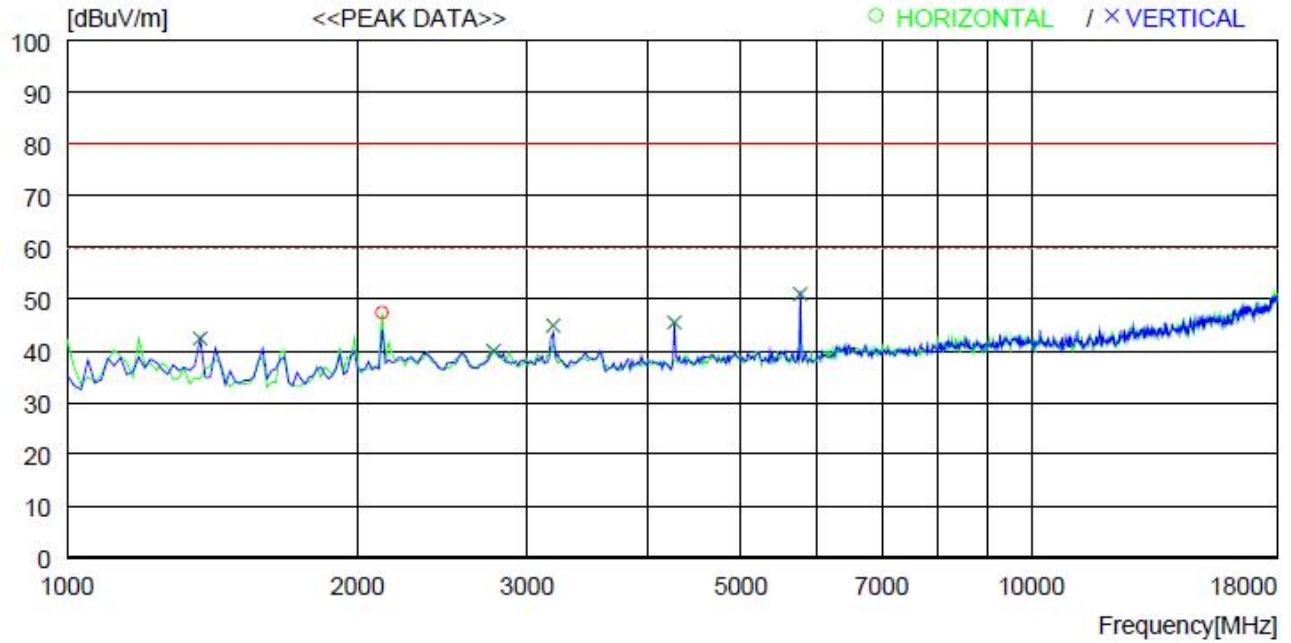
30 MHz – 1 GHz



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
---- Horizontal ----										
1	74.990	45.5	7.8	7.1	32.7	27.7	39.1	11.4	400	90
2	114.500	47.8	9.7	7.5	32.7	32.3	43.5	11.2	400	0
3	130.680	50.4	8.3	7.6	32.7	33.6	43.5	9.9	400	0
---- Vertical ----										
4	74.470	46.0	7.9	7.1	32.7	28.3	39.1	10.8	200	359
5	79.890	46.6	6.8	7.2	32.7	27.9	39.1	11.2	300	0
6	118.380	42.6	9.2	7.5	32.7	26.6	43.5	16.9	100	0

Mode #9

Above 1 000 MHz (Peak)



Remark. Notch Filter was used during the test.

Appendix I - Test Instrumentation

Name of Equipment	Model Number	Manufacturer	Serial Number	Last Cal.(Interval)	USE
EMI Test Receiver	ESCI 7	Rohde & Schwarz	100722	2017-01-19(1Y)	■
LISN	ENV4200	Rohde & Schwarz	100203	2017-01-19(1Y)	□
LISN	ENV216	Rohde & Schwarz	100110	2017-07-28(1Y)	■
LISN	LS16C	AFJ	16011403310	2017-07-28(1Y)	■
Loop Antenna	HFH2-Z2	Rohde & Schwarz	100341	2017-06-15(2Y)	□
8-Wire ISN CAT 3	CAT3 8158	Schwarzbeck	CAT3 8158 #70	2017-01-24(1Y)	□
8-Wire ISN CAT 5	CAT5 8158	Schwarzbeck	CAT5 8158 #126	2017-01-24(1Y)	□
8-Wire ISN CAT 6	NTFM 8158	Schwarzbeck	NTFM 8158 #95	2017-01-24(1Y)	□
Test Receiver	ESU	Rohde & Schwarz	100303	2017-01-19(1Y)	■
TRILog Broadband	VULB9163	Schwarzbeck	9163-770	2017-02-13(2Y)	■
DOPPEL STEG HORN	HF 907	Rohde & Schwarz	102426	2017-01-06(2Y)	■
Preamp (1-18) GHz	SCU 18D	Rohde & Schwarz	19006450	2017-04-24(1Y)	■
Preamp (30-1000) MHz	310N	Sonoma	344015	2017-01-19(1Y)	■
Attenuators	6 dB	Rohde & Schwarz	272.4110.50	2017-01-19(1Y)	■
Notch Filter	BRM50702	MICRO-TRONICS	318	2016-11-11(1Y)	■
Antenna Master	MA4000-EP	INNCO SYSTEM	4600814	N/A	■
Turn Table	DT3000-3t	INNCO SYSTEM	1310814	N/A	■
CO3000 Controller	CO3000-	INNCO SYSTEM	CO3000/806/34130814/L	N/A	■
Digital Power Analyzer	DPA 500	EM Test	V0713102356	2017-01-20(1Y)	□
AC Power Source	ACS 500	EM Test	V0713102357	2017-08-04(1Y)	□

The above measuring equipments have been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.