




FCC CFR 47 Part 15 Subpart B Certification Test Report

For the

Product : 3D Printer
Model : A1+
Multiple Model : A1
FCC ID : 2AB83-A1
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-W1811-016**

Signature


Choi, Young-min / Technical Manager

Date: 2018-11-28

Test Laboratory: ENG Co., Ltd.

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Report No.: TR-W1811-016

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 : EA1810C-142
Test Report Number : TR-W1811-016
Type of Equipment : 3D Printer
Model Name : A1+
Multiple Model Name : A1
FCC ID : 2AB83-A1

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 : 71 pages
Date of Receipt : 2018-10-31
Date of Issue : 2018-11-28
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

2018-11-28

Date

Reviewed by Choi, Young-min / Technical Manager



Signature

2018-11-28

Date

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Release Control Record

Issue Report No.	Issued Date	Details/Revisions
TR-W1811-016	2018-11-28	Initial Release

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 18 03 94465 003	
Korean Agency for Technology and Standards	KT733	

2. EUT (Equipment Under Test) Description

2.1 General Description

The Sindoh Co., Ltd., Model A1+ (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.

Printing Method	SLA (Stereo Lithography Apparatus)
Max. Print Length(mm)	W(max):200, D(max):200, H(max):180
Layer Thickness Setting	0.025~0.100mm
Laser Wavelength	405nm
Laser Power	600mW
Resin	Acrylic, ABS-Like
Temperature Management	Fan Heater Type
Bed Leveling	Manual, Semi-Auto
Resin Supply	Air-Pump Type Automatic Supply with Level Sensor
Power	250W
Dimensions (mm)	449 x 501 x 600 (W x D x H)
Weight	44.3 Kg (excluding resin cartridge)
Ports	USB Device, USB Host, WiFi, Ethernet
Contained RF Module	FCC ID: 2AB83-TWFM-M311D IC : 2541A-TWFMM311D Model: TWFM-M311D Manufacturer: LG Innotek Co., Ltd.

2.2 Additional Model

Model Name	Model Difference
A1+	Basic Model
A1	Identical to the basic model except for the model designation, optional parts, such as Internal Camera, Playback, WiFi and SSD.

Note: The manufacturer has declared to all the additional model names into basic model name without any further evaluation by ENG Co., Ltd, but the model A1+ has internal camera, Playback, WiFi Module, and SSD, so it seems to model A1+ is worst case.

2.3 Description of supported units

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

Description	Model No.	FCC ID	Serial No	Manufacturer.
3D Printer (EUT) *	A1+	2AB83-A1	N/A	Sindoh Co., Ltd.
Notebook PC	TRN-C125	DoC	N/A	HP
Adapter for Notebook PC	HSTNN-CA40	N/A	N/A	CHICONY Power Technology
Mouse	M-U0026	DOC	N/A	Logitech
Access Point (AP)	AW-A1	N/A	ABRE400975NT	Unicorn Information System
Adapter for AP	K02-1201000	N/A	N/A	Shenzhen KeYu Power Supply Technology Co., Ltd.
USB Memory Stick	8GB-WJ004	DoC	N/A	SHENZHEN CHENGE ELECTRONICS CO., LTD.

2.4 Cable Description

Test Mode	Ports Name	Shielded (Y/N)	Ferrite Bead (Y/N)	Length (m)	Connected to
Mode #1 - #5	AC IN	N	N	1.8	AC Mains
	LAN	N	N	3.0	Notebook PC
	USB	Y	N	1.5	
	USB	-	-	-	USB Memory Stick
Mode #6 - #9	AC IN	N	N	1.8	AC Mains
	LAN	N	N	3.0	Line terminated
	USB	Y	N	1.5	Notebook PC
	USB	-	-	-	USB Memory Stick

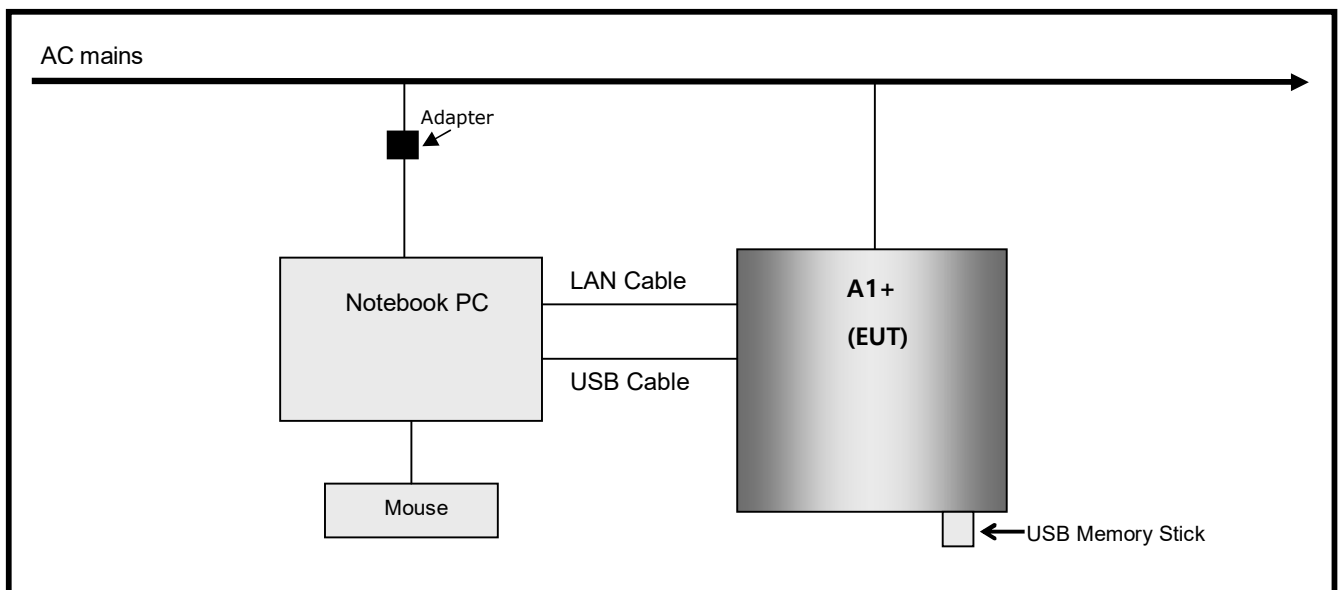
2.5 Mode of operation during the test

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

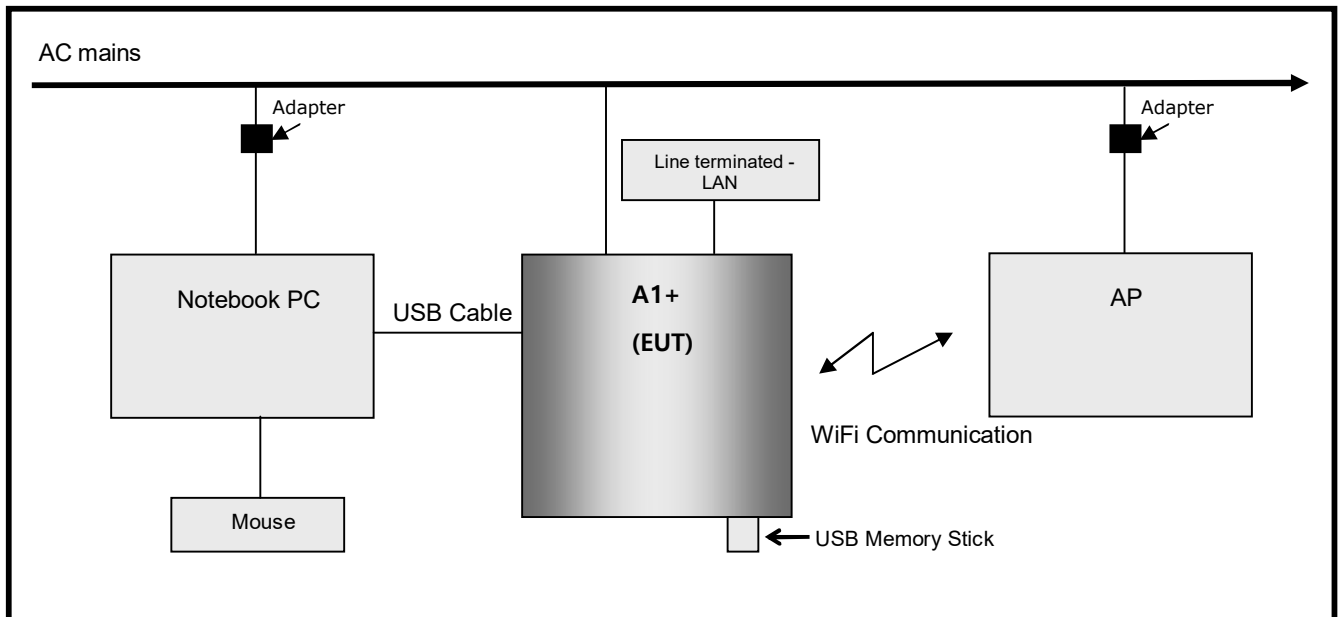
Test Mode	Description
# 1	The EUT was operated in standby mode
# 2	Printing mode using USB cable between the EUT and a Notebook PC
# 3	Printing mode using USB memory stick
# 4	Printing mode using Ethernet speed, 100 Mbps
# 5	Printing mode using Ethernet speed, 1 000 Mbps
# 6	Printing mode using Wi-Fi function, 802.11b
# 7	Printing mode using Wi-Fi function, 802.11g
# 8	Printing mode using Wi-Fi function, 802.11n HT20
# 9	Printing mode using Wi-Fi function, 802.11n 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	Uncertainty
150 kHz ~ 30 MHz	2.00 dB

The measurement uncertainties are given with 95 % confidence.

3.1.3 Test Result

Date of Test	2018-11-20		
Temperature	(18.2 ~ 20.1) °C	Relative humidity	(46.6 ~ 47.3) % R.H.
Operating Input Voltage	120 Vac	Input Frequency	60 Hz
Frequency range	RBW	VBW	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	Im, Jin-young 

3.1.4 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

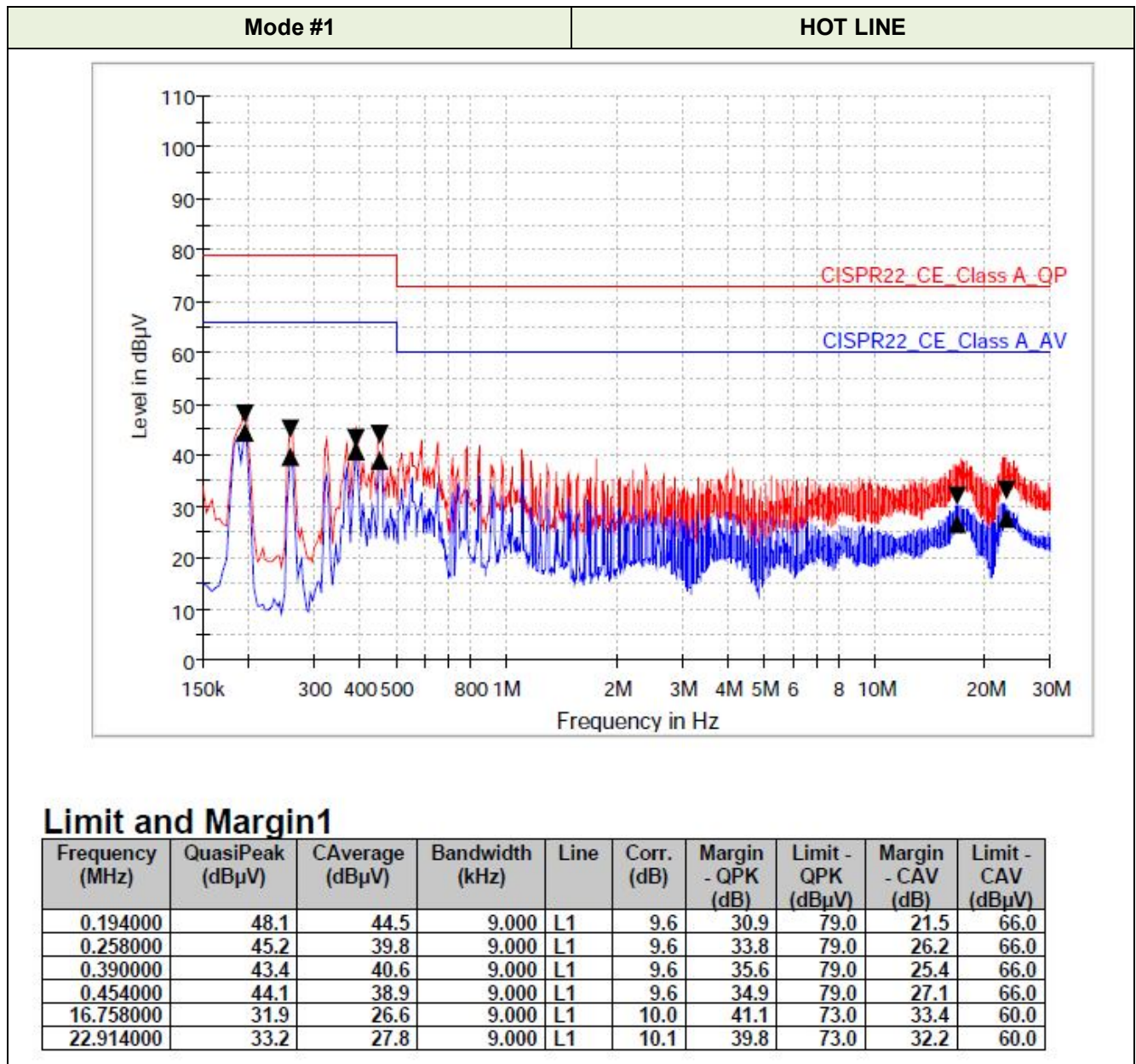
Q.P Reading from the Test receiver = 20.8 dBμV

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

Therefore Q.P Margin = 60 - 20.8 = 39.2

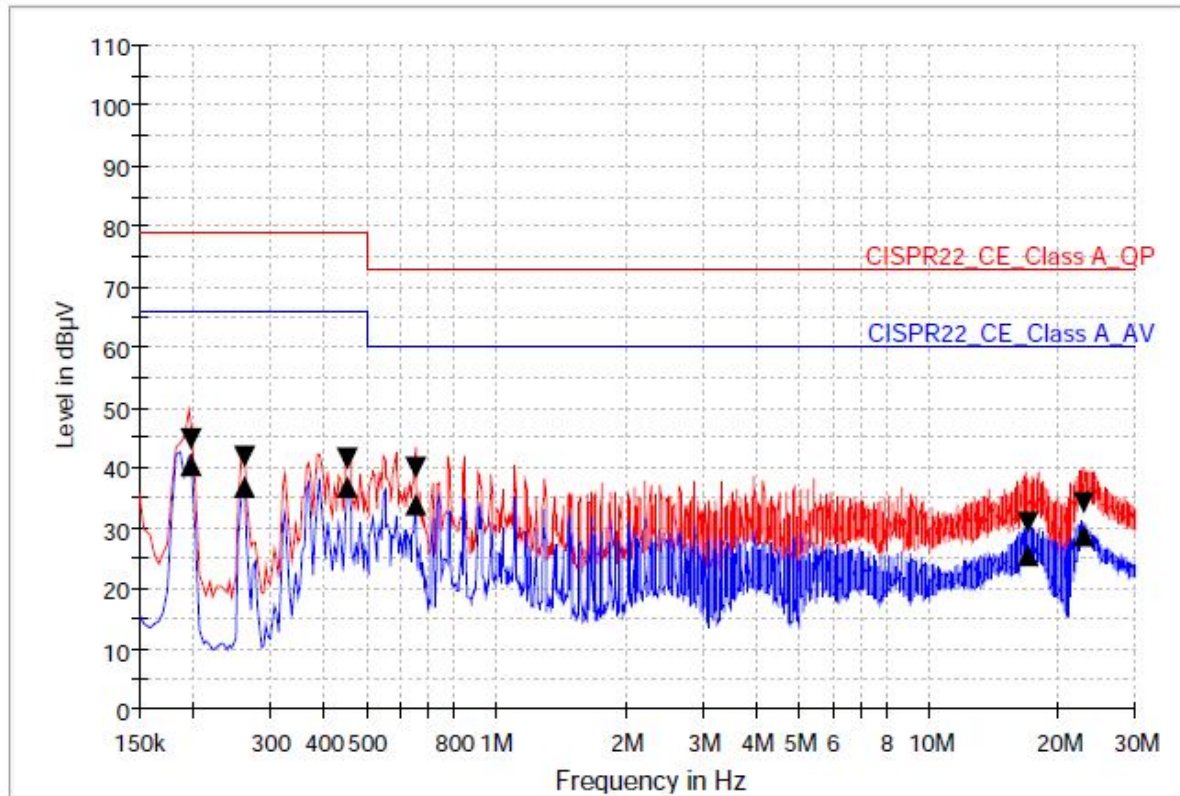
so the EUT has 39.2 dB margin at 5.31 MHz

3.1.5 Test Data



Mode #1

NEUTRAL LINE

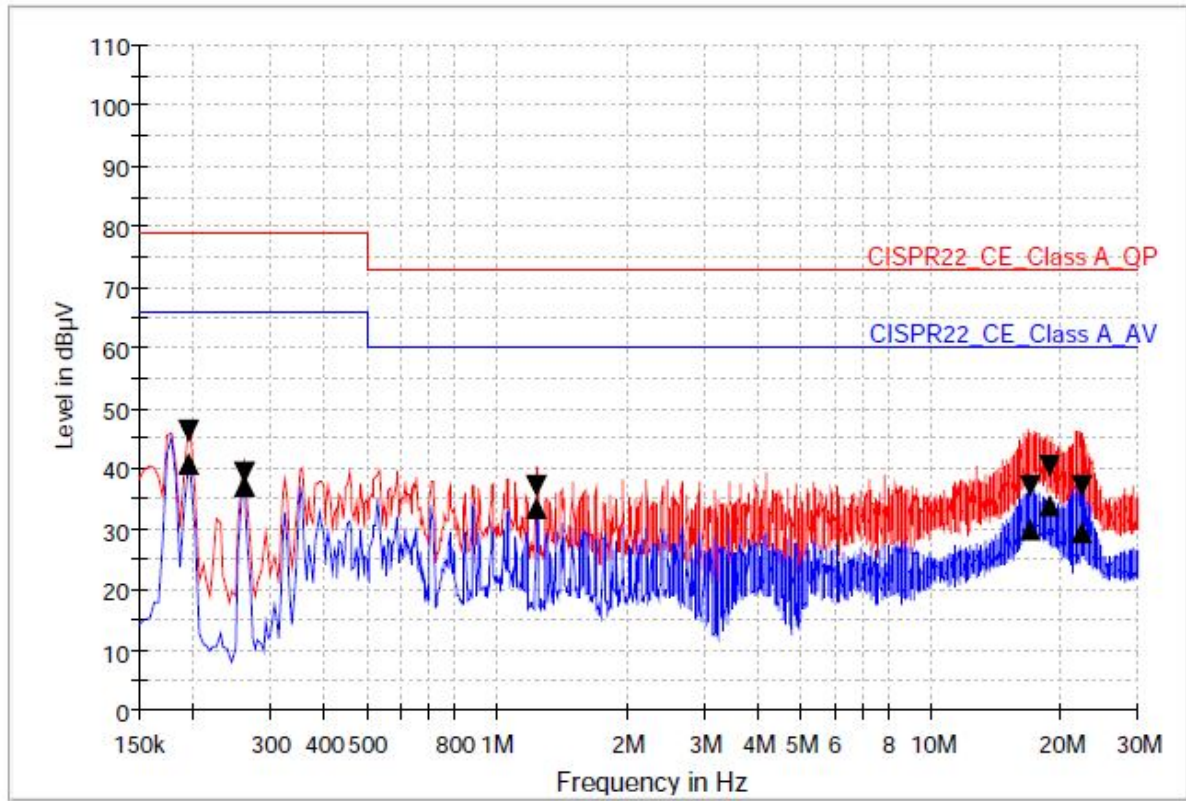


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.198000	44.8	40.5	9.000	N	9.6	34.2	79.0	25.5	66.0
0.262000	42.0	36.9	9.000	N	9.6	37.0	79.0	29.1	66.0
0.454000	41.5	36.7	9.000	N	9.6	37.5	79.0	29.3	66.0
0.650000	40.2	33.8	9.000	N	9.7	32.8	73.0	26.2	60.0
16.878000	30.9	25.4	9.000	N	10.0	42.1	73.0	34.6	60.0
22.886000	34.3	28.9	9.000	N	10.1	38.7	73.0	31.1	60.0

Mode #2

HOT LINE

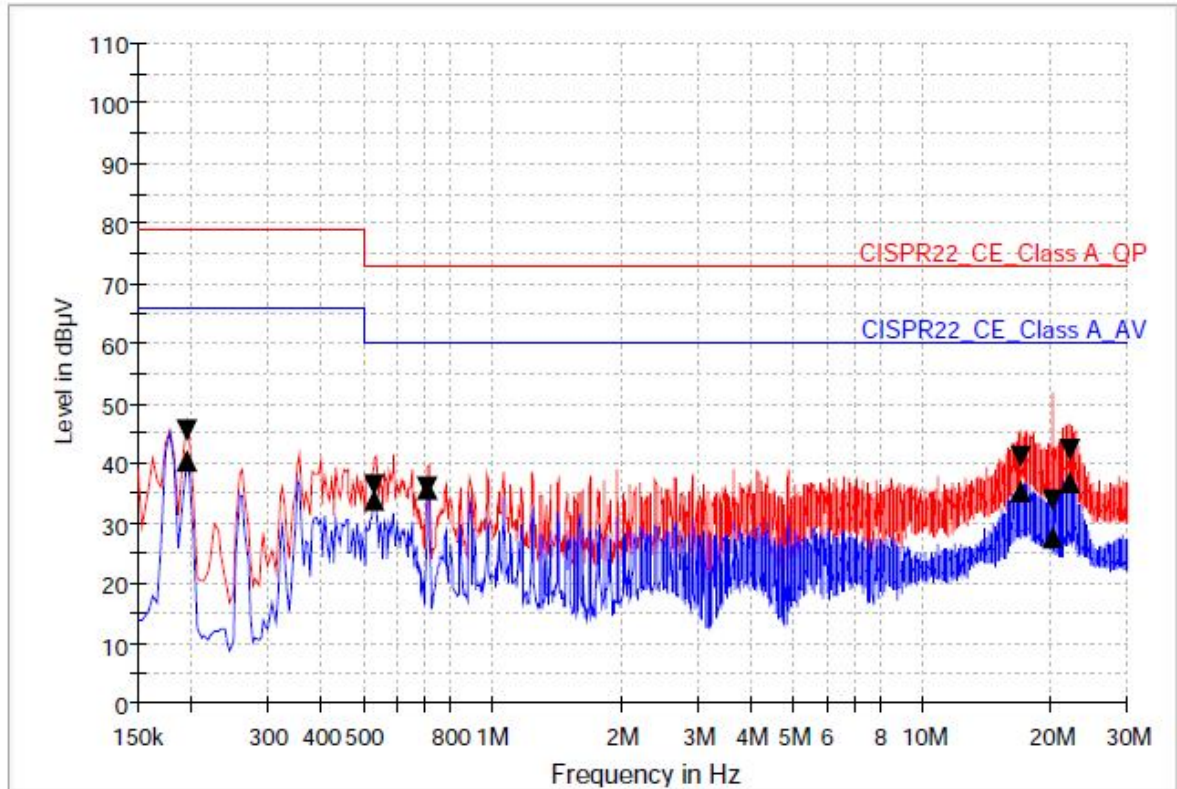


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.194000	46.2	40.8	9.000	L1	9.6	32.8	79.0	25.2	66.0
0.262000	39.3	37.2	9.000	L1	9.6	39.7	79.0	28.8	66.0
1.238000	37.3	33.4	9.000	L1	9.7	35.7	73.0	26.6	60.0
17.022000	37.2	29.9	9.000	L1	10.0	35.8	73.0	30.1	60.0
18.798000	40.4	33.8	9.000	L1	10.0	32.6	73.0	26.2	60.0
22.302000	37.2	29.6	9.000	L1	10.1	35.8	73.0	30.4	60.0

Mode #2

NEUTRAL LINE

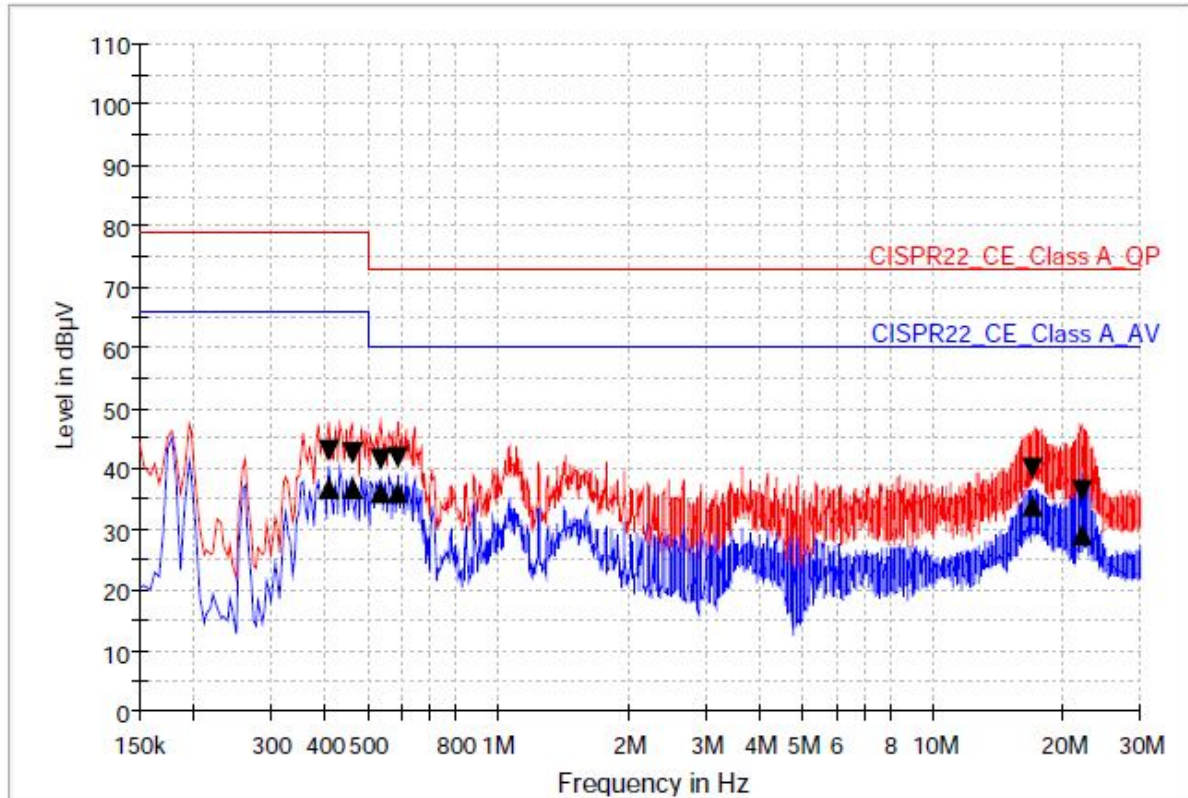


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.194000	45.6	40.5	9.000	N	9.6	33.4	79.0	25.5	66.0
0.534000	36.6	33.8	9.000	N	9.6	36.4	73.0	26.2	60.0
0.710000	36.2	35.7	9.000	N	9.7	36.8	73.0	24.3	60.0
16.902000	41.2	35.4	9.000	N	10.0	31.8	73.0	24.6	60.0
20.194000	34.0	27.7	9.000	N	10.1	39.0	73.0	32.3	60.0
22.106000	42.3	36.8	9.000	N	10.1	30.7	73.0	23.2	60.0

Mode #3

HOT LINE

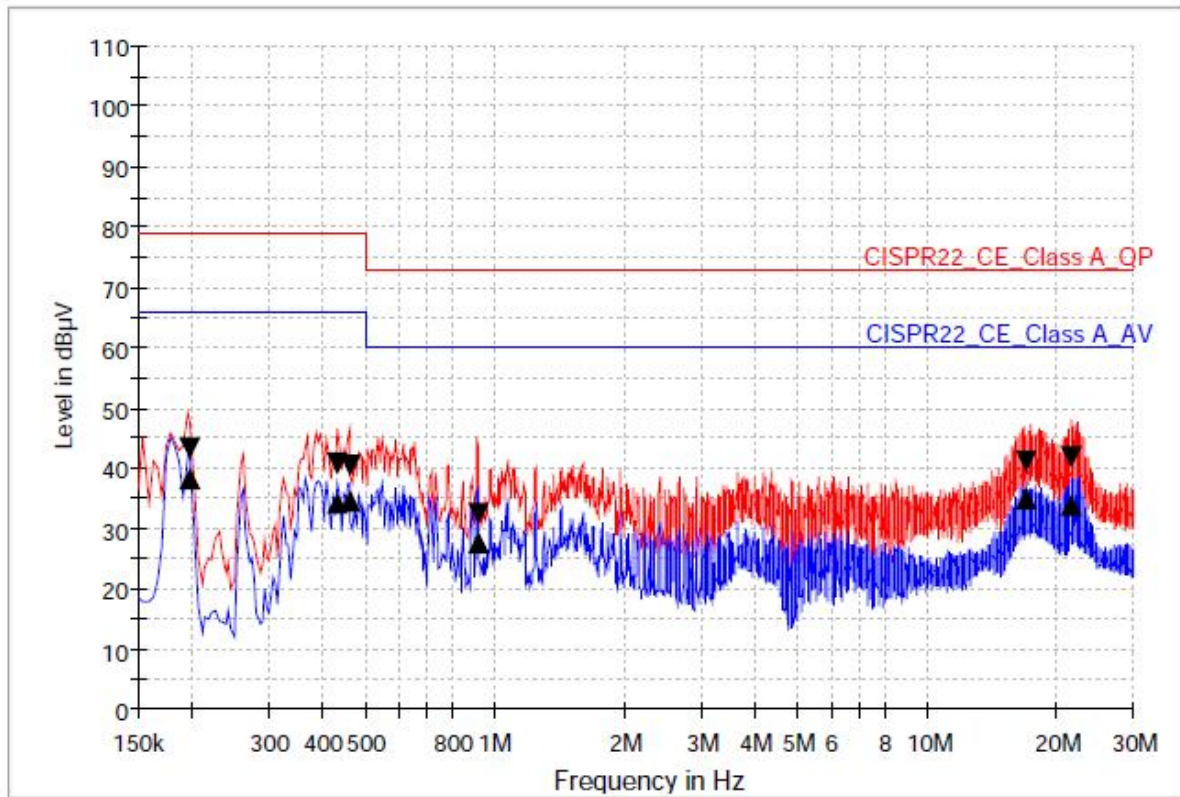


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.410000	42.8	36.8	9.000	L1	9.6	36.2	79.0	29.2	66.0
0.462000	42.7	36.9	9.000	L1	9.6	36.3	79.0	29.1	66.0
0.538000	41.4	36.0	9.000	L1	9.6	31.6	73.0	24.0	60.0
0.590000	41.8	36.0	9.000	L1	9.6	31.2	73.0	24.0	60.0
17.046000	40.2	33.9	9.000	L1	10.0	32.8	73.0	26.1	60.0
22.118000	36.3	29.1	9.000	L1	10.1	36.7	73.0	30.9	60.0

Mode #3

NEUTRAL LINE

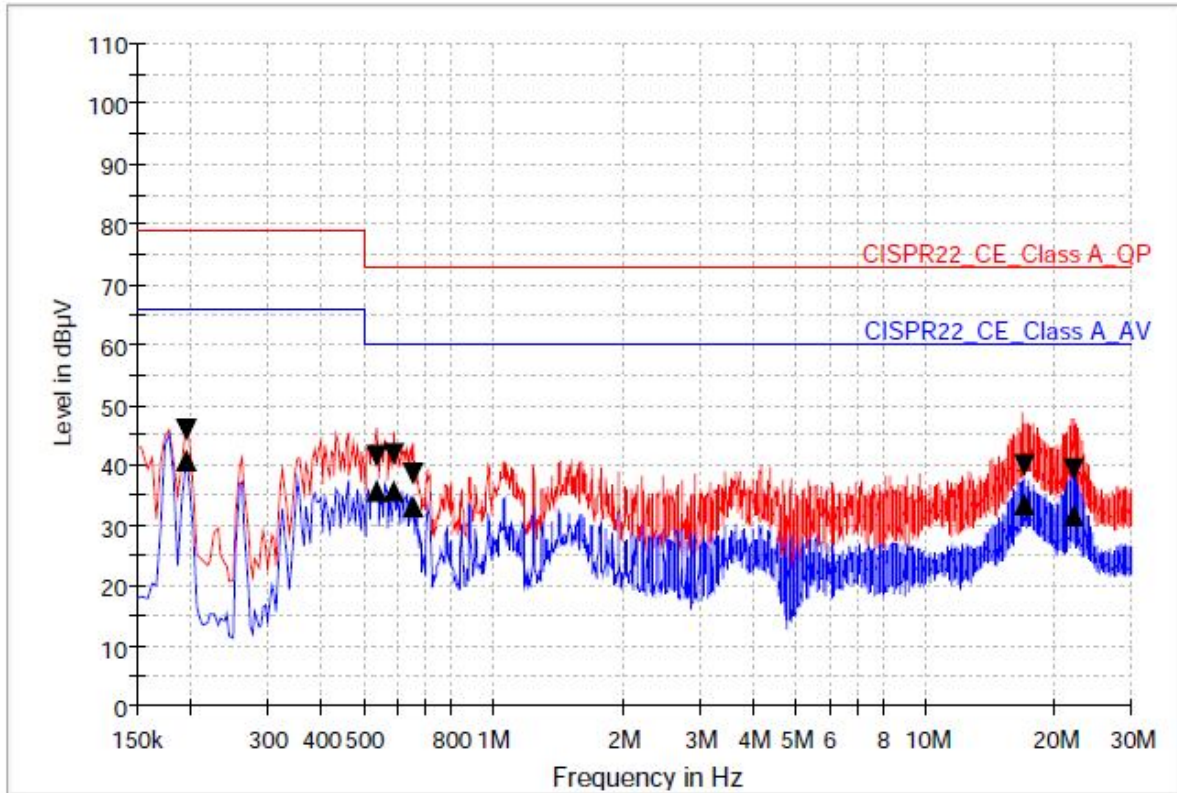


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.198000	43.3	38.2	9.000	N	9.6	35.7	79.0	27.8	66.0
0.434000	40.8	34.4	9.000	N	9.6	38.2	79.0	31.6	66.0
0.462000	40.5	34.5	9.000	N	9.6	38.5	79.0	31.5	66.0
0.914000	32.6	27.7	9.000	N	9.7	40.4	73.0	32.3	60.0
17.042000	41.1	35.1	9.000	N	10.0	31.9	73.0	24.9	60.0
21.606000	42.0	33.7	9.000	N	10.1	31.0	73.0	26.3	60.0

Mode #4

HOT LINE

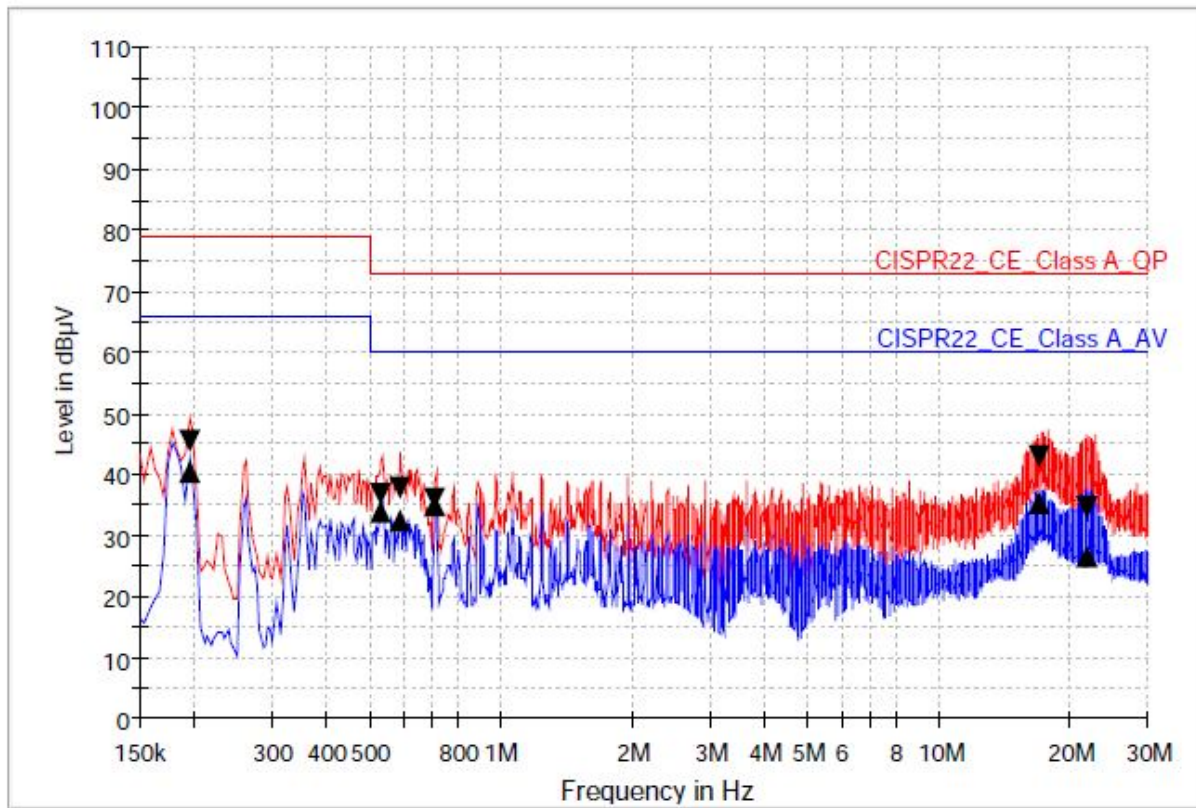


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.194000	46.0	40.9	9.000	L1	9.6	33.0	79.0	25.1	66.0
0.538000	41.5	35.8	9.000	L1	9.6	31.5	73.0	24.2	60.0
0.590000	41.9	35.9	9.000	L1	9.6	31.1	73.0	24.1	60.0
0.654000	38.5	33.0	9.000	L1	9.7	34.5	73.0	27.0	60.0
17.042000	39.9	33.5	9.000	L1	10.0	33.1	73.0	26.5	60.0
22.050000	39.5	31.9	9.000	L1	10.1	33.5	73.0	28.1	60.0

Mode #4

NEUTRAL LINE

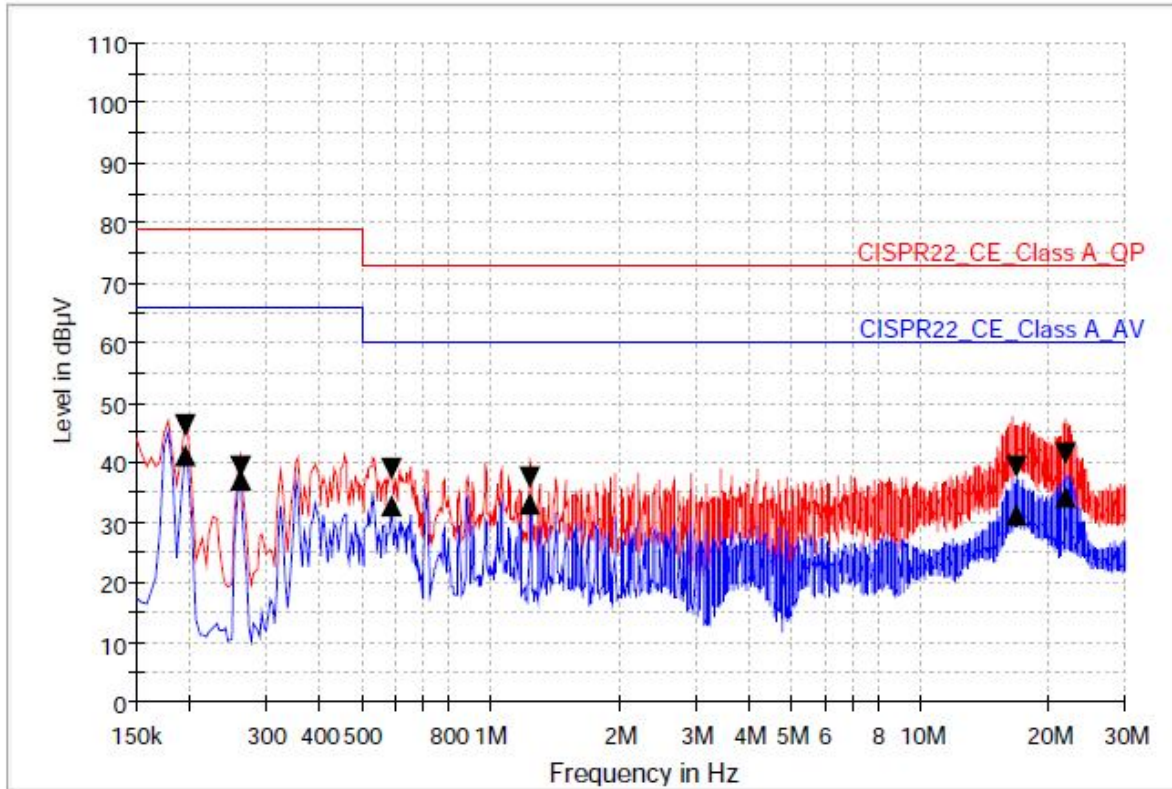


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.194000	45.4	40.3	9.000	N	9.6	33.6	79.0	25.7	66.0
0.534000	36.9	34.0	9.000	N	9.6	36.1	73.0	26.0	60.0
0.590000	38.0	32.5	9.000	N	9.6	35.0	73.0	27.5	60.0
0.710000	35.9	35.1	9.000	N	9.7	37.1	73.0	24.9	60.0
16.986000	43.1	35.5	9.000	N	10.0	29.9	73.0	24.5	60.0
21.754000	34.4	26.5	9.000	N	10.1	38.6	73.0	33.6	60.0

Mode #5

HOT LINE

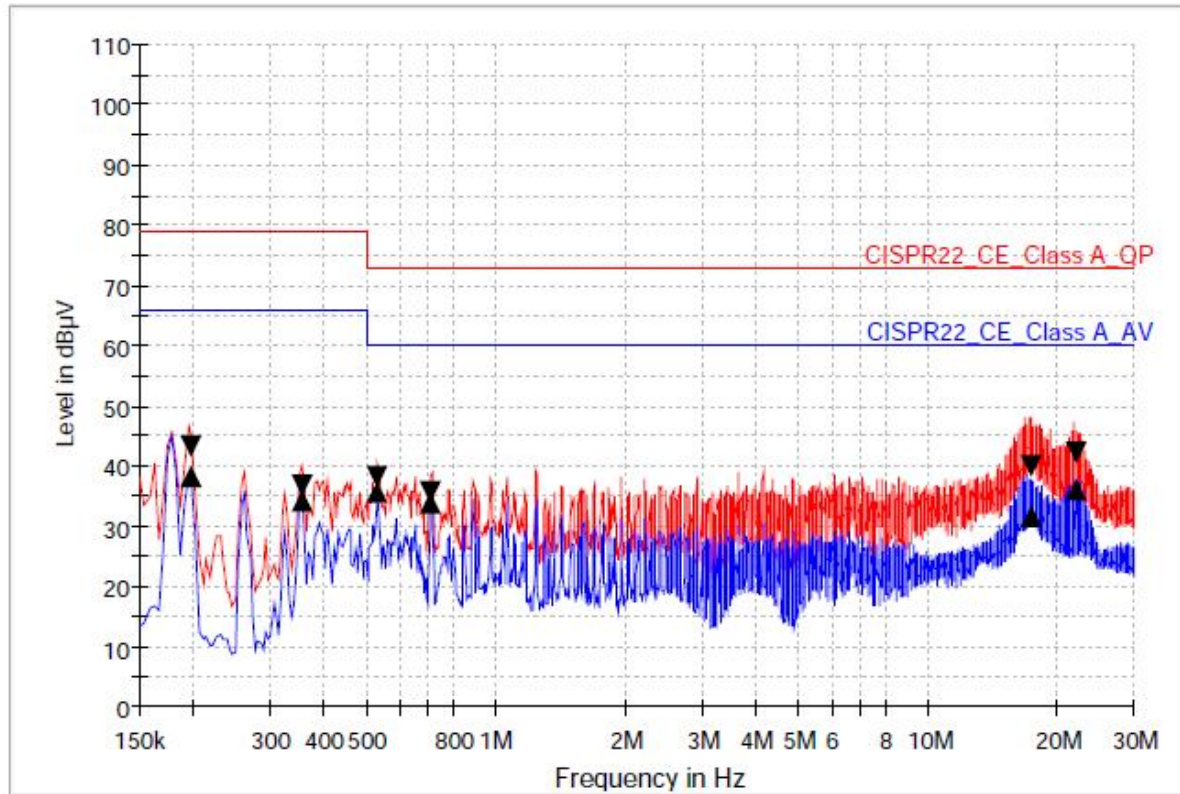


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.194000	46.1	41.3	9.000	L1	9.6	32.9	79.0	24.7	66.0
0.262000	39.4	37.2	9.000	L1	9.6	39.6	79.0	28.8	66.0
0.586000	38.9	32.8	9.000	L1	9.6	34.1	73.0	27.2	60.0
1.238000	37.6	33.2	9.000	L1	9.7	35.4	73.0	26.8	60.0
16.834000	39.4	31.2	9.000	L1	10.0	33.6	73.0	28.8	60.0
21.734000	41.7	34.3	9.000	L1	10.1	31.3	73.0	25.7	60.0

Mode #5

NEUTRAL LINE

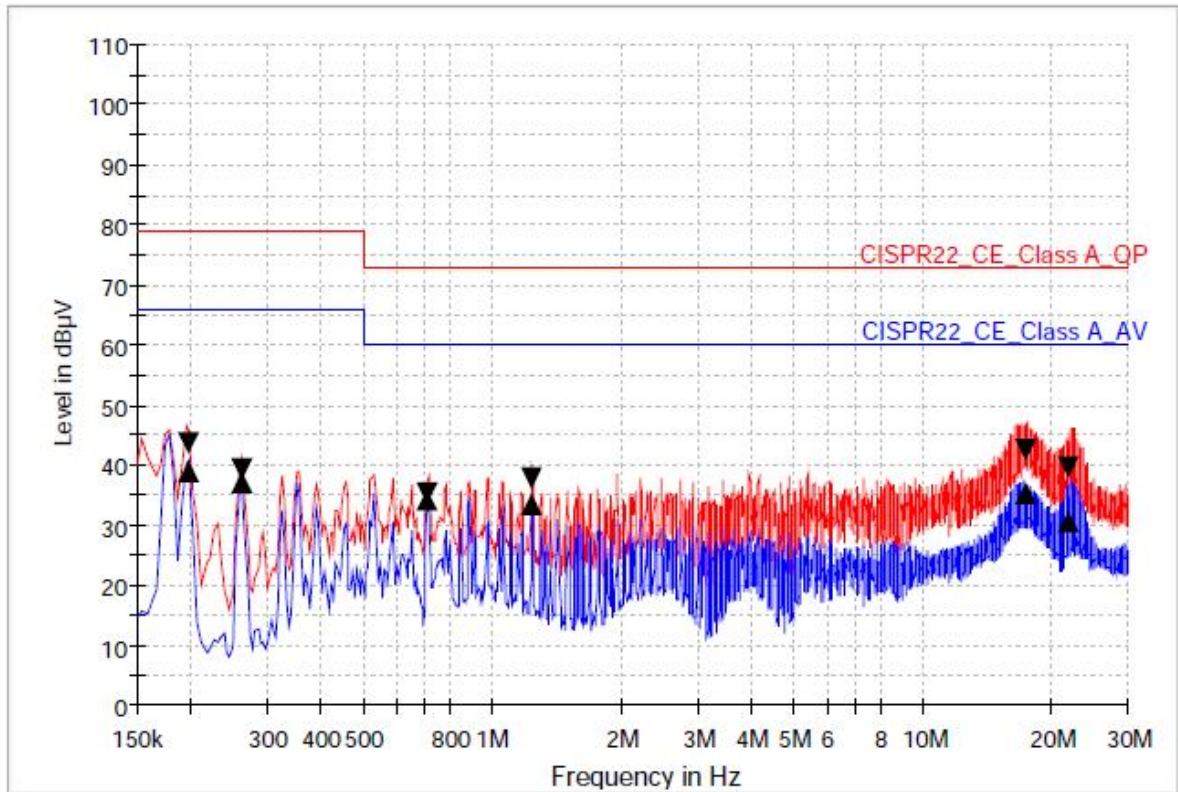


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.198000	43.3	38.1	9.000	N	9.6	35.7	79.0	27.9	66.0
0.358000	36.9	34.3	9.000	N	9.6	42.1	79.0	31.7	66.0
0.534000	38.3	35.8	9.000	N	9.6	34.7	73.0	24.2	60.0
0.710000	35.6	33.8	9.000	N	9.7	37.4	73.0	26.2	60.0
17.290000	40.2	31.5	9.000	N	10.0	32.8	73.0	28.5	60.0
22.058000	42.2	35.9	9.000	N	10.1	30.8	73.0	24.1	60.0

Mode #6

HOT LINE

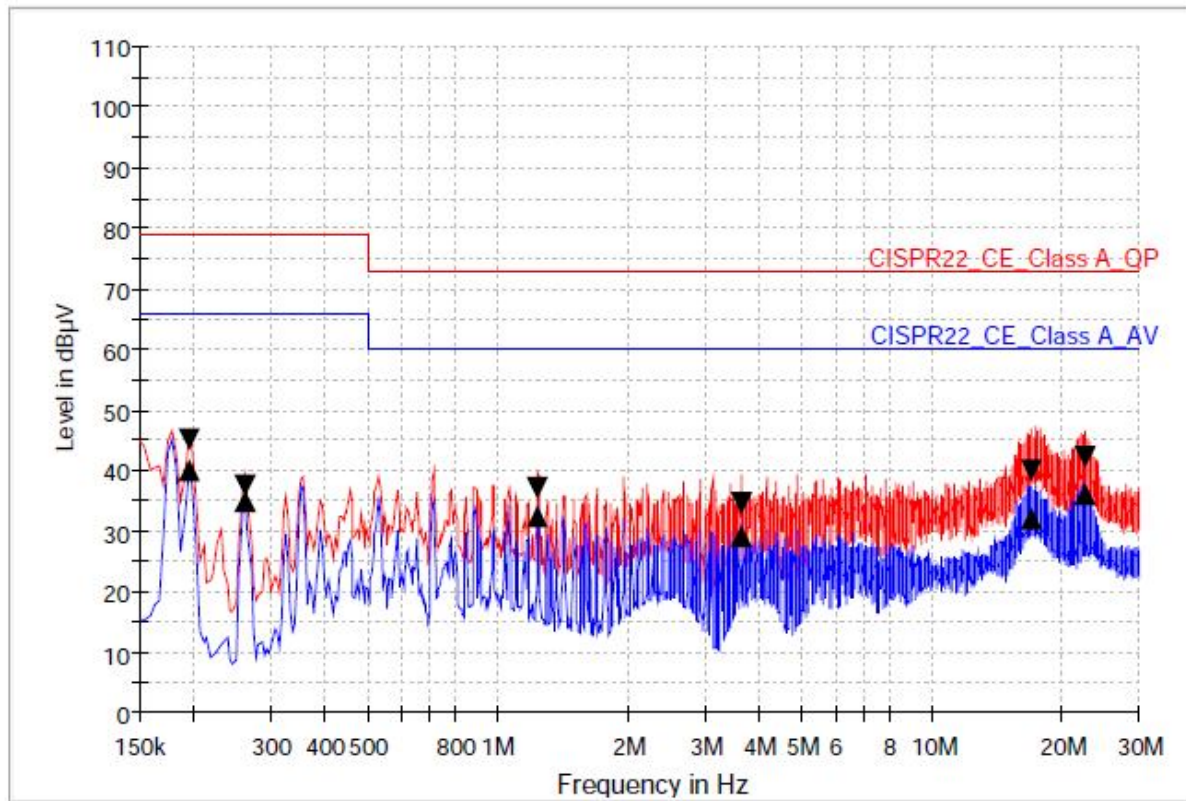


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.198000	43.9	39.1	9.000	L1	9.6	35.1	79.0	26.9	66.0
0.262000	39.3	37.1	9.000	L1	9.6	39.7	79.0	28.9	66.0
0.710000	35.3	34.4	9.000	L1	9.7	37.7	73.0	25.6	60.0
1.238000	37.8	33.4	9.000	L1	9.7	35.2	73.0	26.6	60.0
17.382000	42.5	35.5	9.000	L1	10.0	30.5	73.0	24.5	60.0
21.878000	39.6	30.4	9.000	L1	10.1	33.4	73.0	29.6	60.0

Mode #6

NEUTRAL LINE

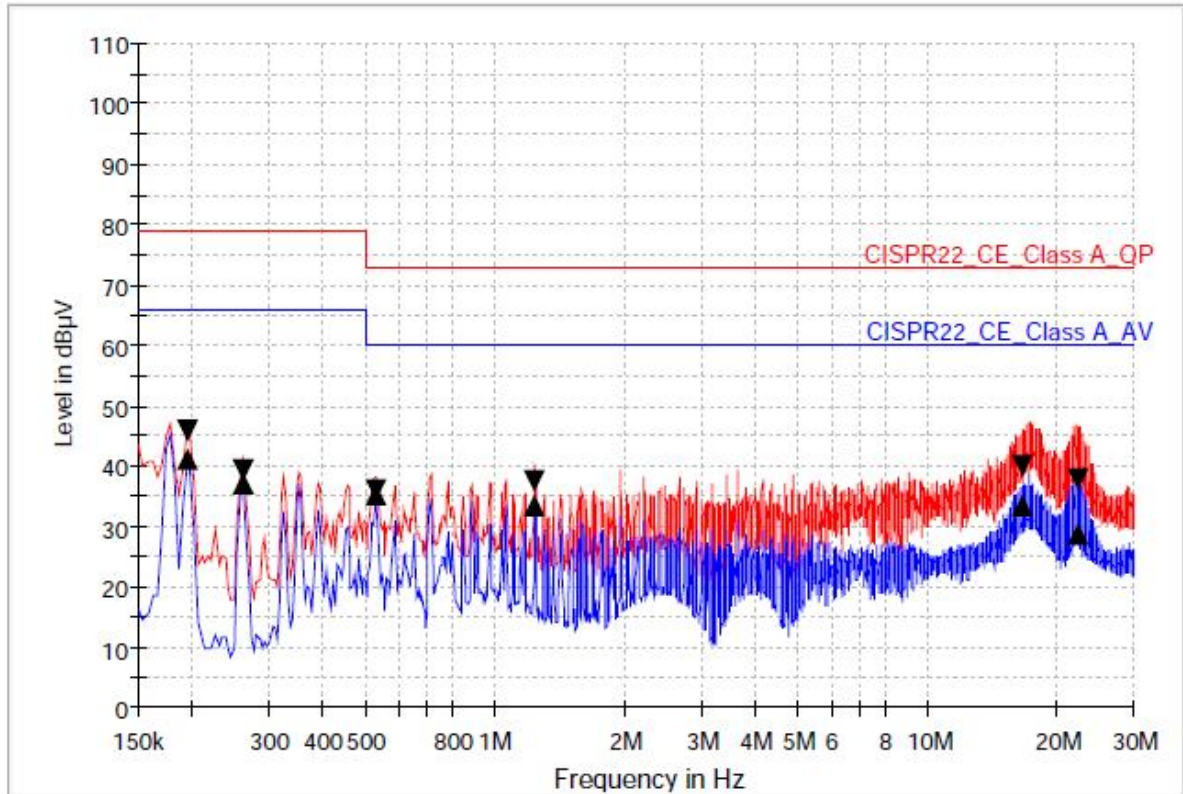


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.194000	45.2	40.1	9.000	N	9.6	33.8	79.0	25.9	66.0
0.262000	37.5	35.1	9.000	N	9.6	41.5	79.0	30.9	66.0
1.238000	37.3	32.6	9.000	N	9.7	35.7	73.0	27.4	60.0
3.646000	34.7	29.2	9.000	N	9.7	38.3	73.0	30.8	60.0
17.062000	40.0	32.0	9.000	N	10.0	33.0	73.0	28.0	60.0
22.454000	42.4	36.2	9.000	N	10.1	30.6	73.0	23.8	60.0

Mode #7

HOT LINE

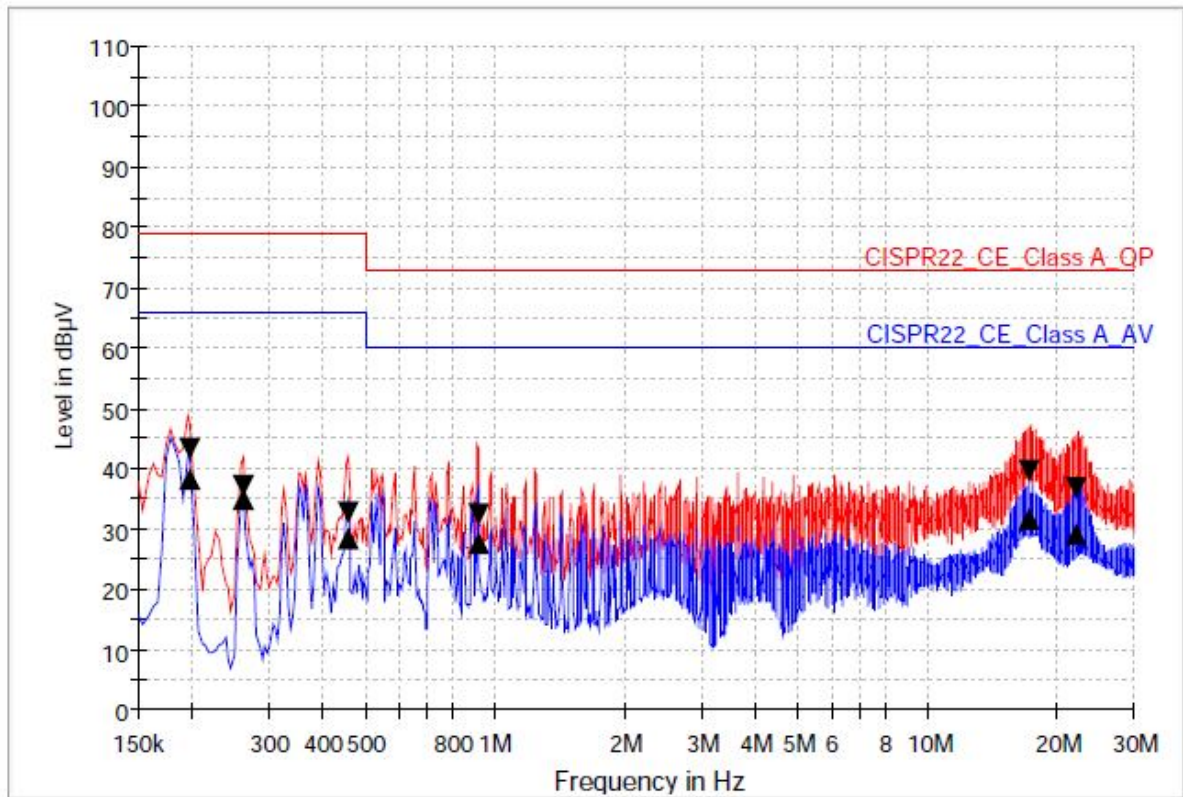


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.194000	45.8	41.0	9.000	L1	9.6	33.2	79.0	25.0	66.0
0.262000	39.3	37.1	9.000	L1	9.6	39.7	79.0	28.9	66.0
0.530000	36.2	35.2	9.000	L1	9.6	36.8	73.0	24.8	60.0
1.238000	37.5	33.4	9.000	L1	9.7	35.5	73.0	26.6	60.0
16.658000	39.9	33.5	9.000	L1	10.0	33.1	73.0	26.5	60.0
22.334000	37.7	28.9	9.000	L1	10.1	35.3	73.0	31.1	60.0

Mode #7

NEUTRAL LINE

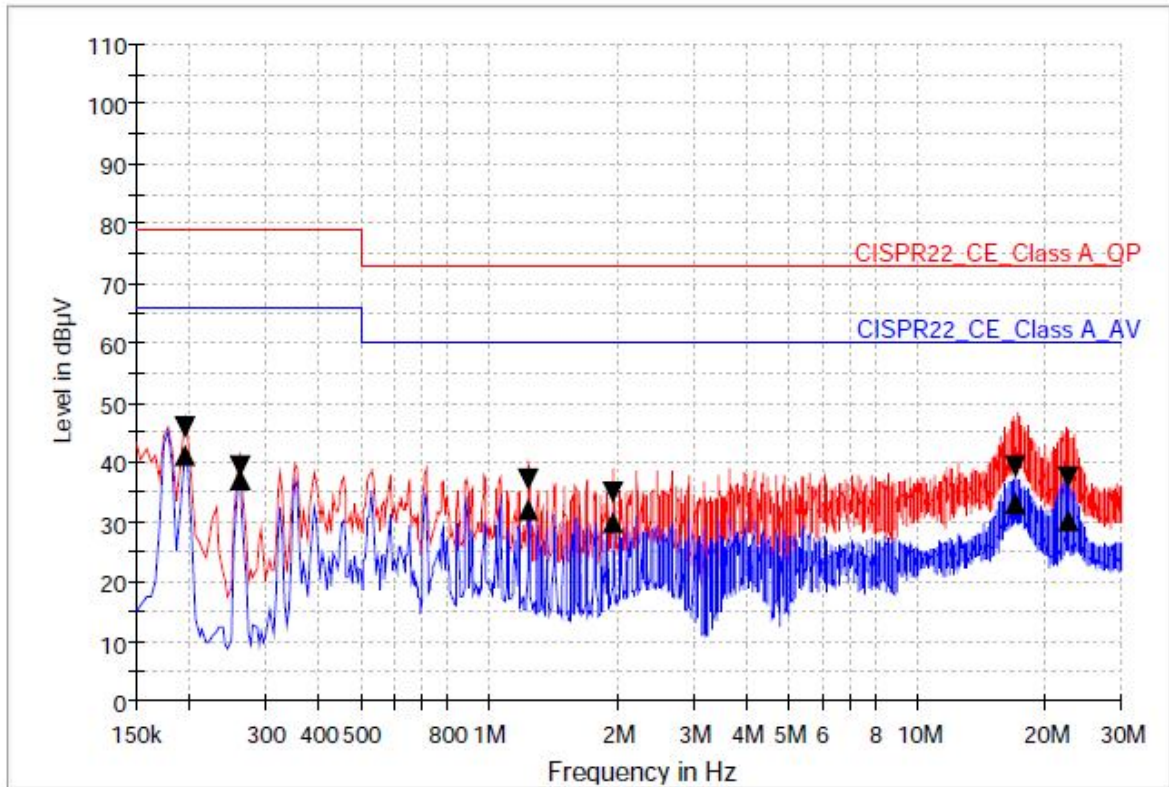


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.198000	43.4	38.3	9.000	N	9.6	35.6	79.0	27.7	66.0
0.262000	37.0	34.9	9.000	N	9.6	42.0	79.0	31.1	66.0
0.458000	32.6	28.5	9.000	N	9.6	46.4	79.0	37.5	66.0
0.914000	32.6	27.8	9.000	N	9.7	40.4	73.0	32.2	60.0
17.178000	39.5	31.6	9.000	N	10.0	33.5	73.0	28.4	60.0
21.994000	36.8	29.3	9.000	N	10.1	36.2	73.0	30.7	60.0

Mode #8

HOT LINE

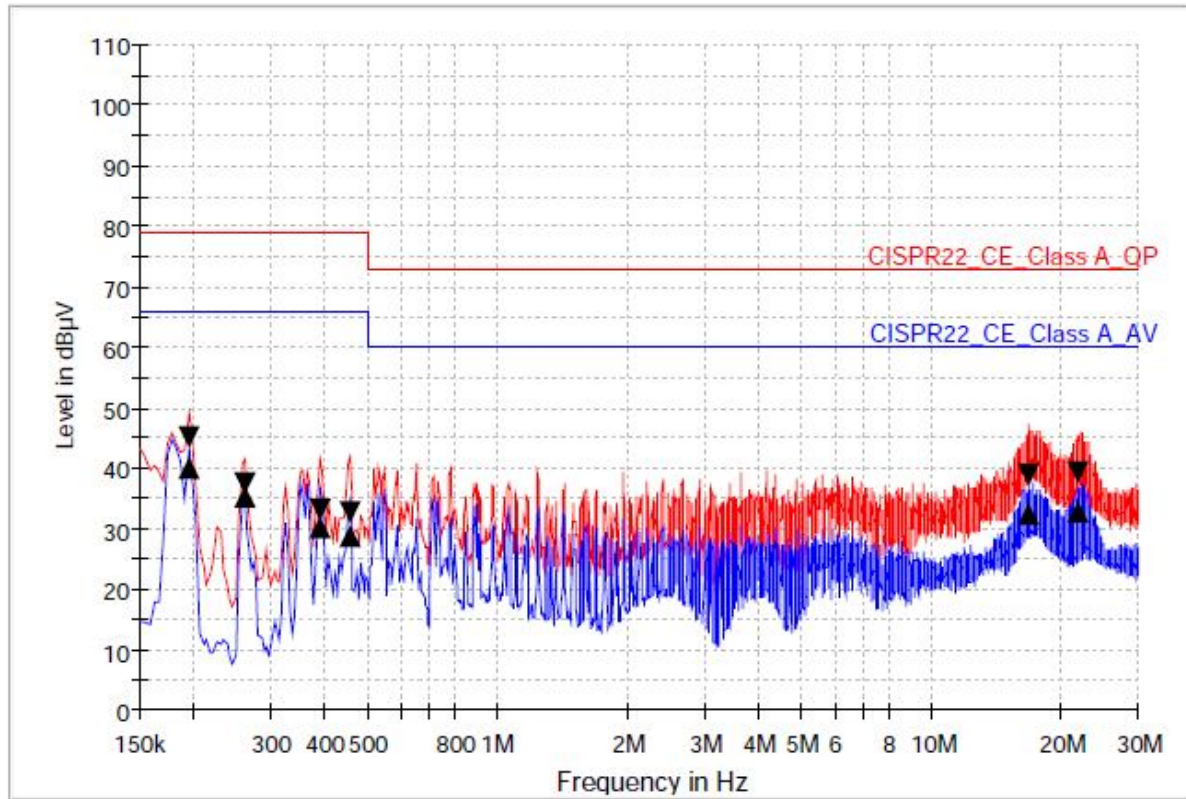


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.194000	45.9	41.1	9.000	L1	9.6	33.1	79.0	24.9	66.0
0.262000	39.4	37.2	9.000	L1	9.6	39.6	79.0	28.8	66.0
1.238000	37.0	32.2	9.000	L1	9.7	36.0	73.0	27.8	60.0
1.954000	35.1	29.8	9.000	L1	9.7	37.9	73.0	30.2	60.0
16.982000	39.5	33.1	9.000	L1	10.0	33.5	73.0	26.9	60.0
22.642000	37.4	30.2	9.000	L1	10.1	35.6	73.0	29.8	60.0

Mode #8

NEUTRAL LINE

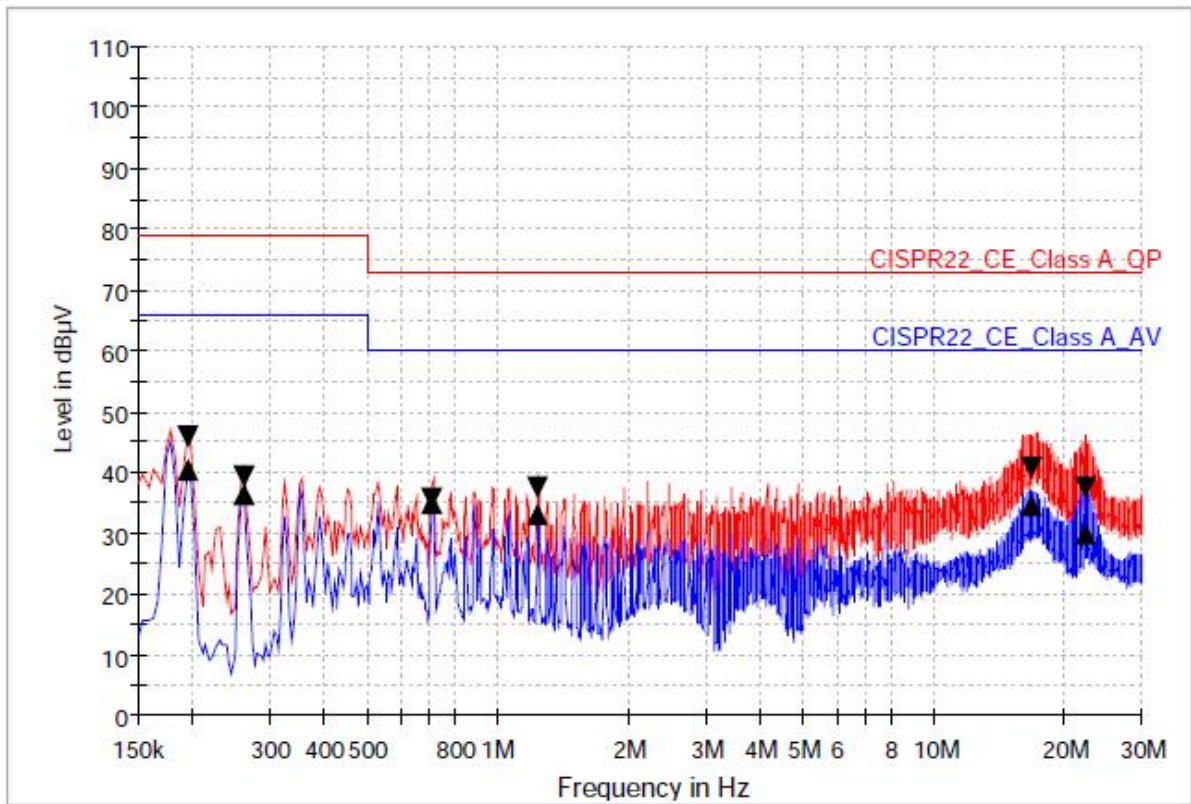


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.194000	45.3	40.2	9.000	N	9.6	33.7	79.0	25.8	66.0
0.262000	37.5	35.2	9.000	N	9.6	41.5	79.0	30.8	66.0
0.390000	33.1	30.4	9.000	N	9.6	45.9	79.0	35.6	66.0
0.458000	32.9	28.7	9.000	N	9.6	46.1	79.0	37.3	66.0
16.794000	38.9	32.5	9.000	N	10.0	34.1	73.0	27.5	60.0
21.798000	39.3	32.9	9.000	N	10.1	33.7	73.0	27.1	60.0

Mode #9

HOT LINE

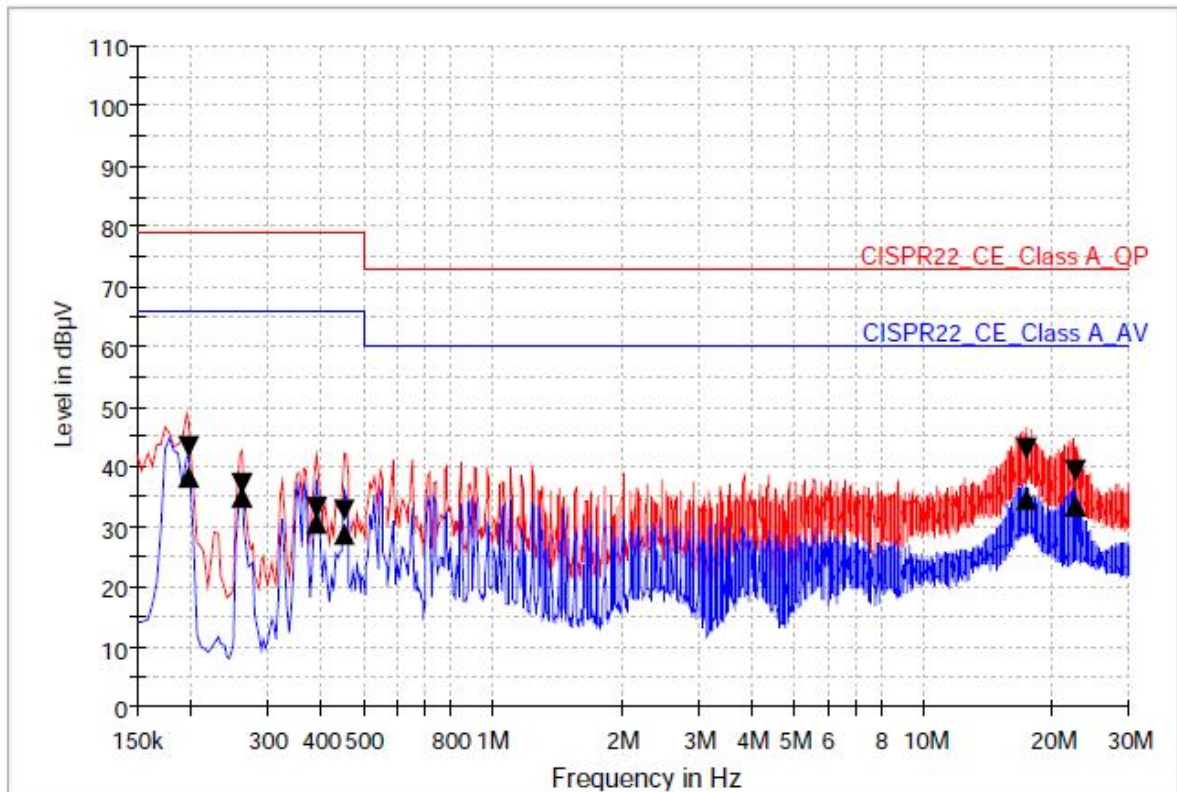


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.194000	46.0	40.3	9.000	L1	9.6	33.0	79.0	25.7	66.0
0.262000	39.3	36.5	9.000	L1	9.6	39.7	79.0	29.5	66.0
0.710000	35.6	34.9	9.000	L1	9.7	37.4	73.0	25.1	60.0
1.238000	37.5	33.0	9.000	L1	9.7	35.5	73.0	27.0	60.0
16.718000	40.8	34.7	9.000	L1	10.0	32.2	73.0	25.3	60.0
22.378000	37.5	29.8	9.000	L1	10.1	35.5	73.0	30.2	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)
0.198000	43.2	38.1	9.000	N	9.6	35.8	79.0	27.9	66.0
0.262000	37.1	35.0	9.000	N	9.6	41.9	79.0	31.0	66.0
0.390000	33.2	30.4	9.000	N	9.6	45.8	79.0	35.6	66.0
0.454000	32.8	28.8	9.000	N	9.6	46.2	79.0	37.2	66.0
17.306000	42.9	34.5	9.000	N	10.0	30.1	73.0	25.5	60.0
22.570000	39.5	33.3	9.000	N	10.1	33.5	73.0	26.7	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 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	4.79 dB

The measurement uncertainties are given with 95 % confidence.

3.2.4 Test result

Date of Test		2018-11-19			
Temperature		(17.1 ~ 19.6) °C		Relative humidity	(48.2 ~ 49.2) % R.H.
Operating Input Voltage		120 Vac		Input Frequency	60 Hz
Frequency range	RBW	VBW	Detector Mode	Measurement distance	
Below 1 000 MHz	120 kHz	300 kHz	Peak or Q.P.	10 m	
Date of Test		2018-11-19			
Temperature		(17.9 ~ 20.4) °C		Relative humidity	(47.6 ~ 48.7) % R.H.
Frequency range	RBW	VBW	Detector Mode	Measurement distance	
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	Im, Jin-young 		

3.2.5 Sample Calculated Example

At 80 MHz

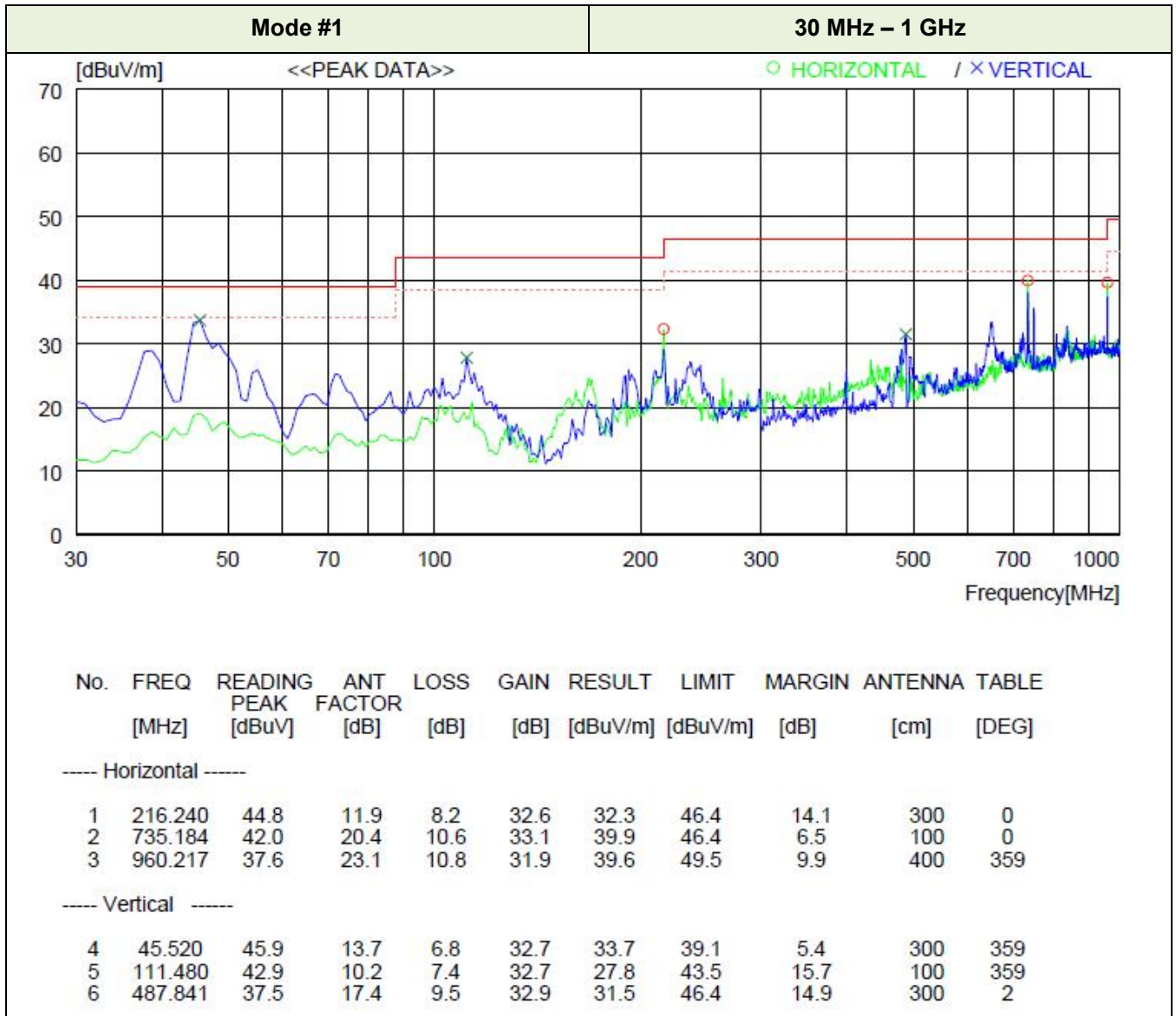
Limit = 40.0 dB μ V/m

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

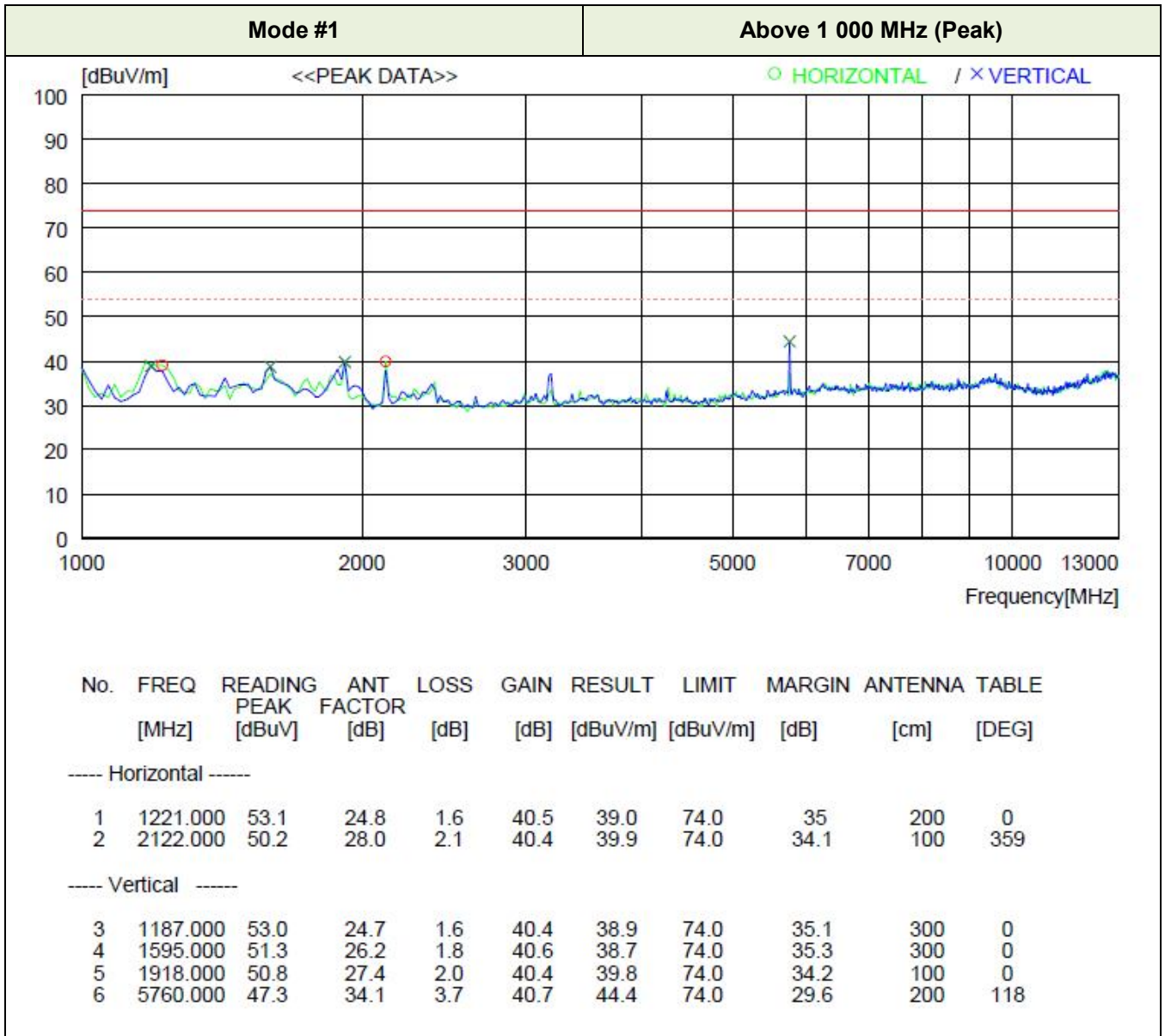
Margin = Limit - Result = 40 - 30 = 10

so the EUT has 10.0 dB margin at 80 MHz

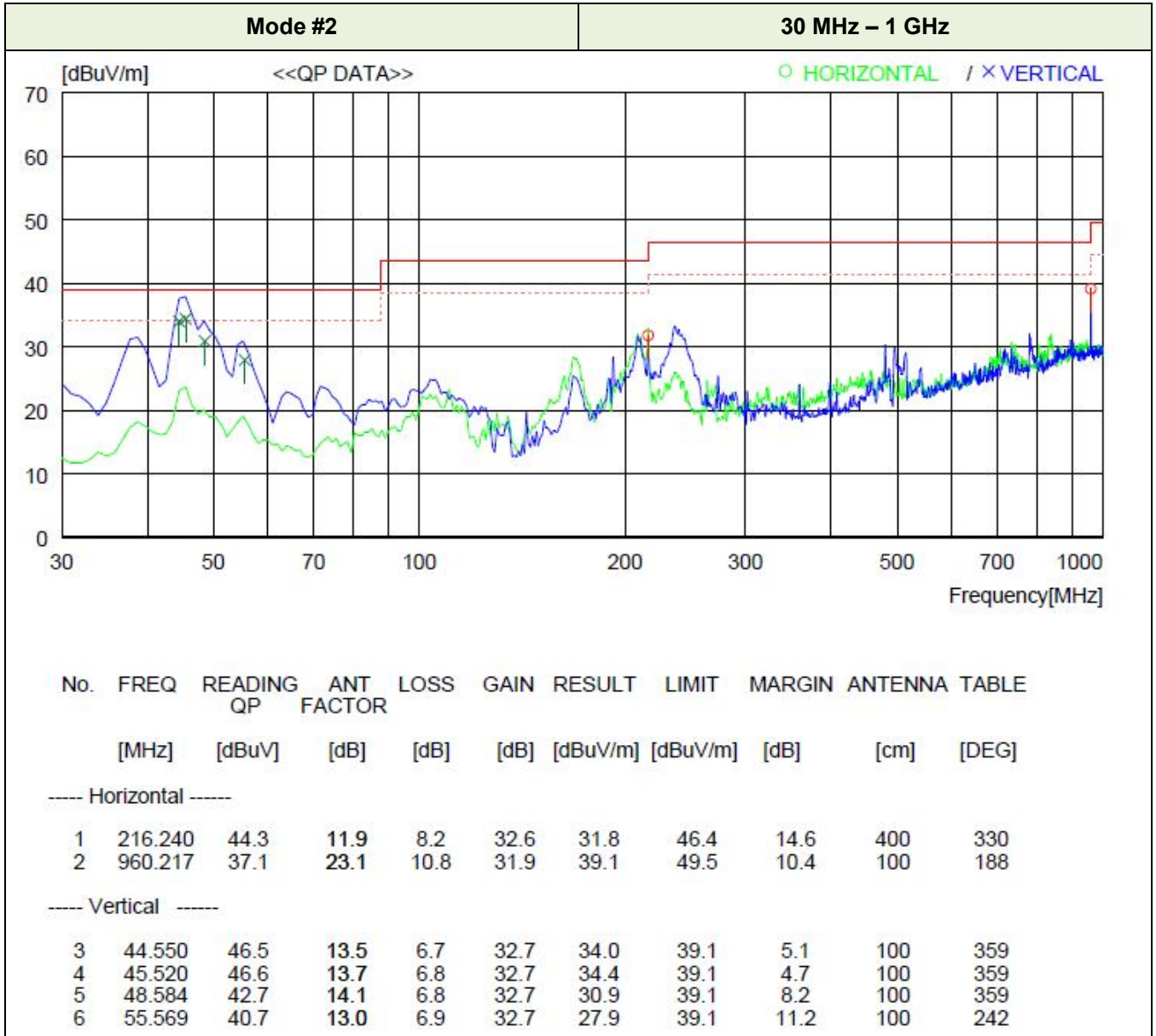
3.2.6 Test Data

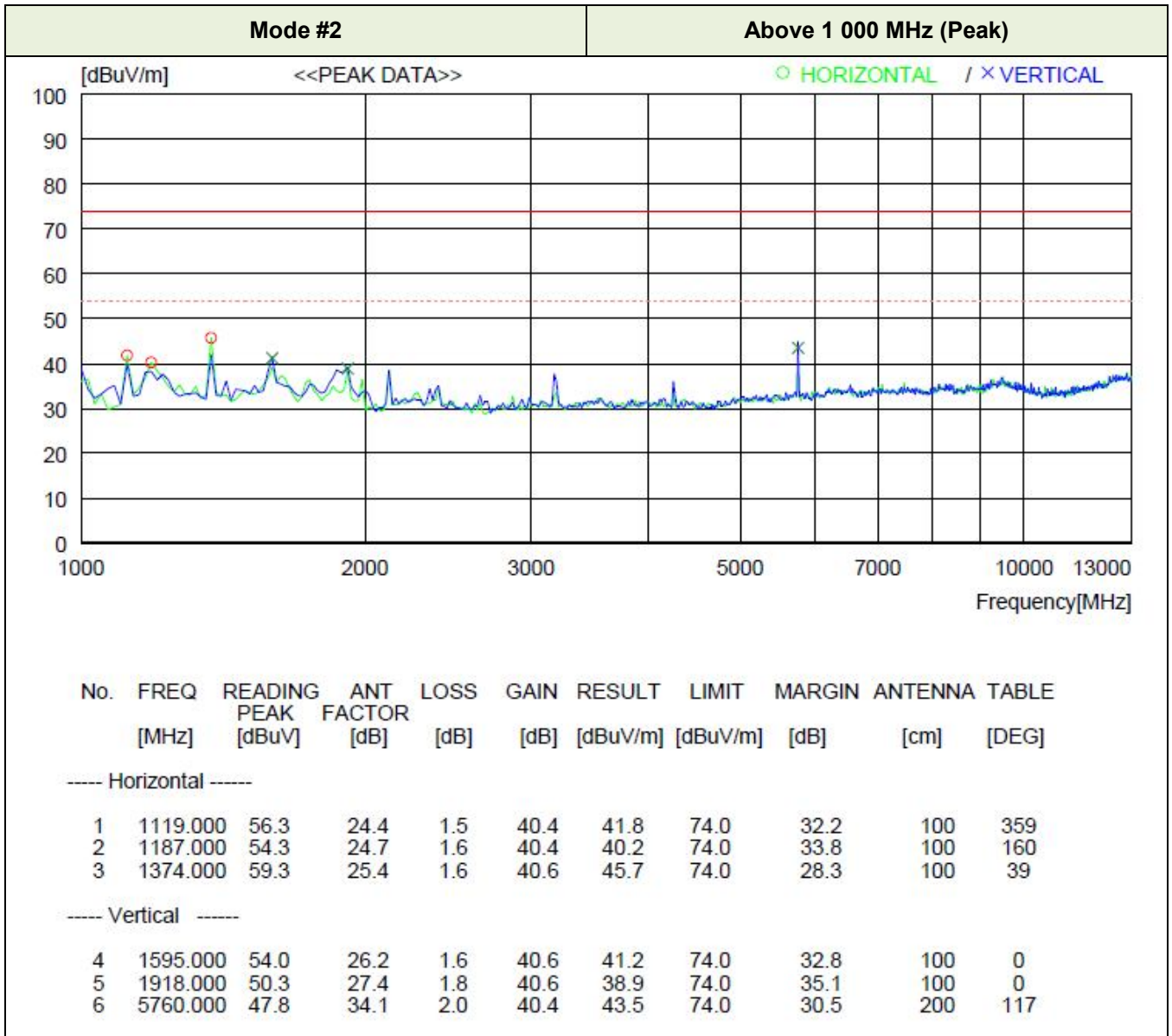


NOTE: Quasi-Peak was not measured, because Peak values met Quasi-Peak limit.

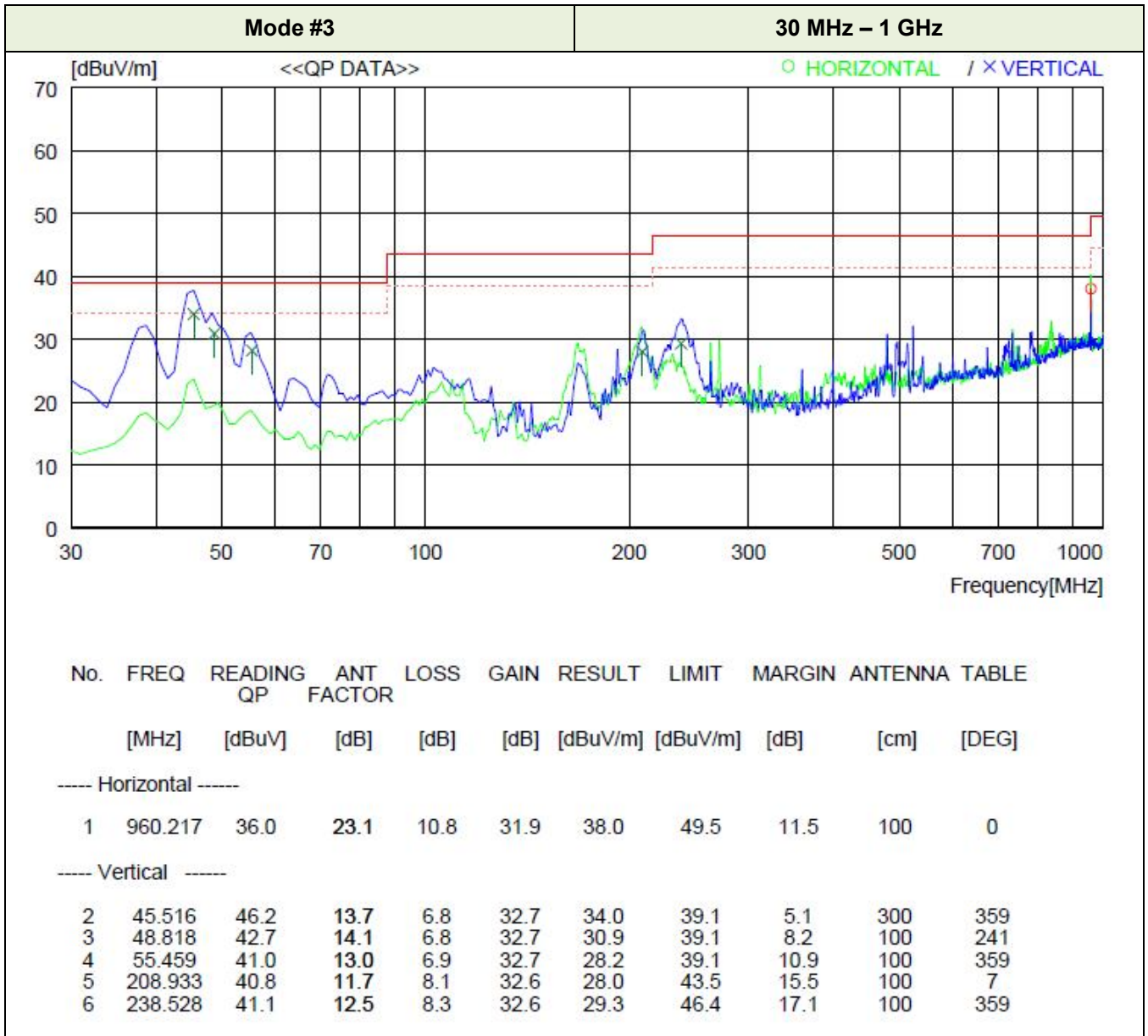


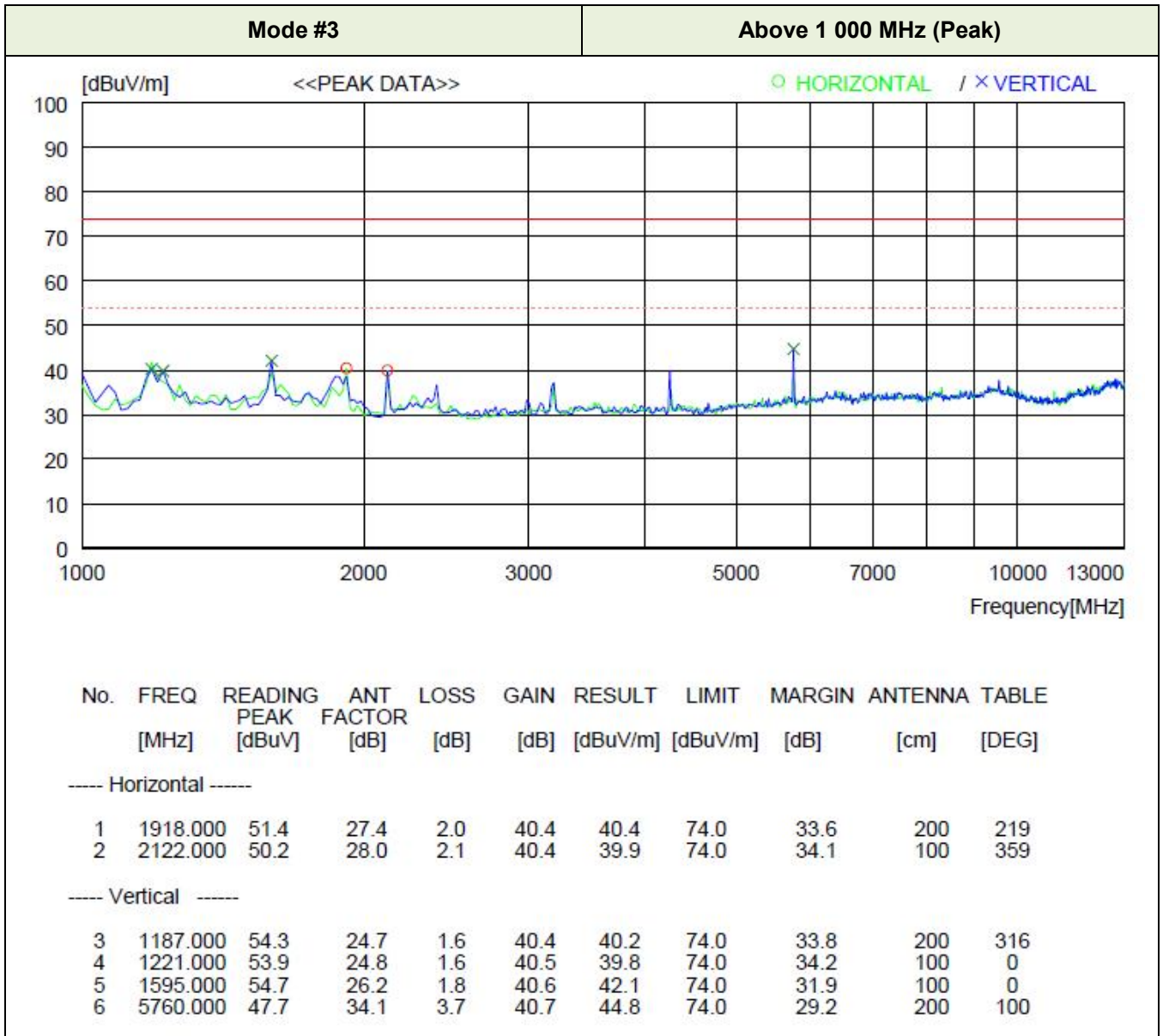
NOTE: Average mode was not measured, because Peak values were under the Average limit.



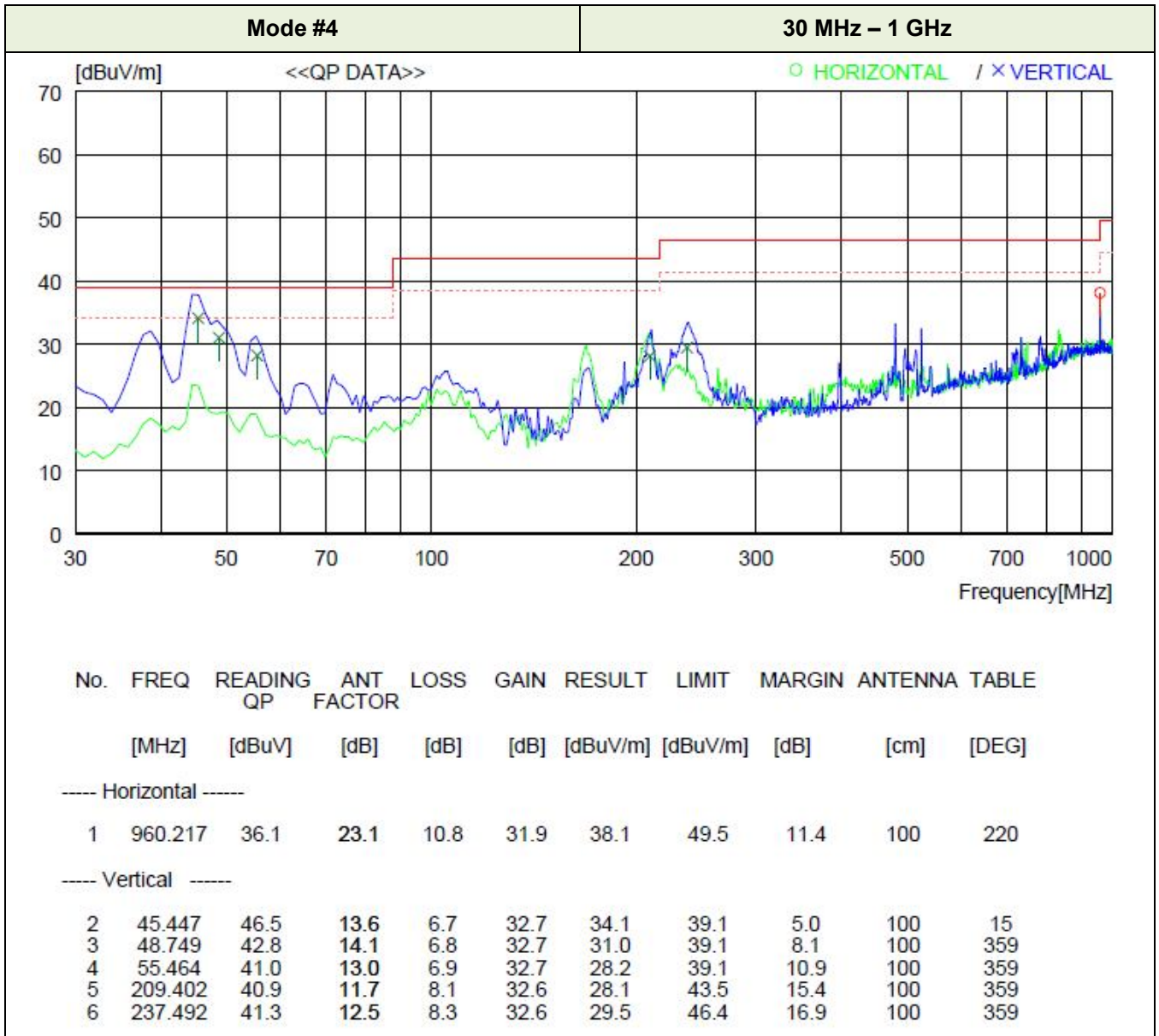


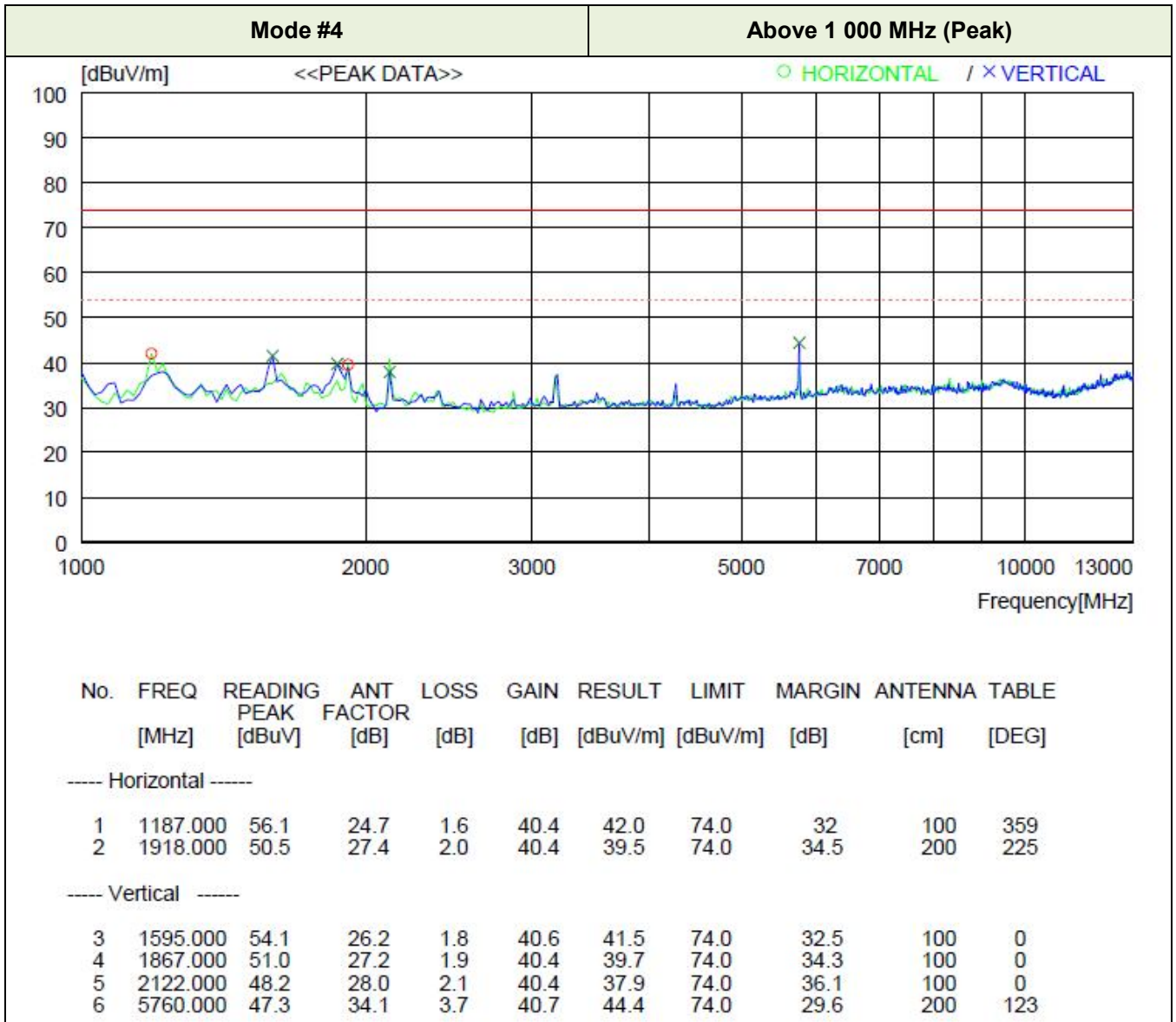
NOTE: Average mode was not measured, because Peak values were under the Average limit.



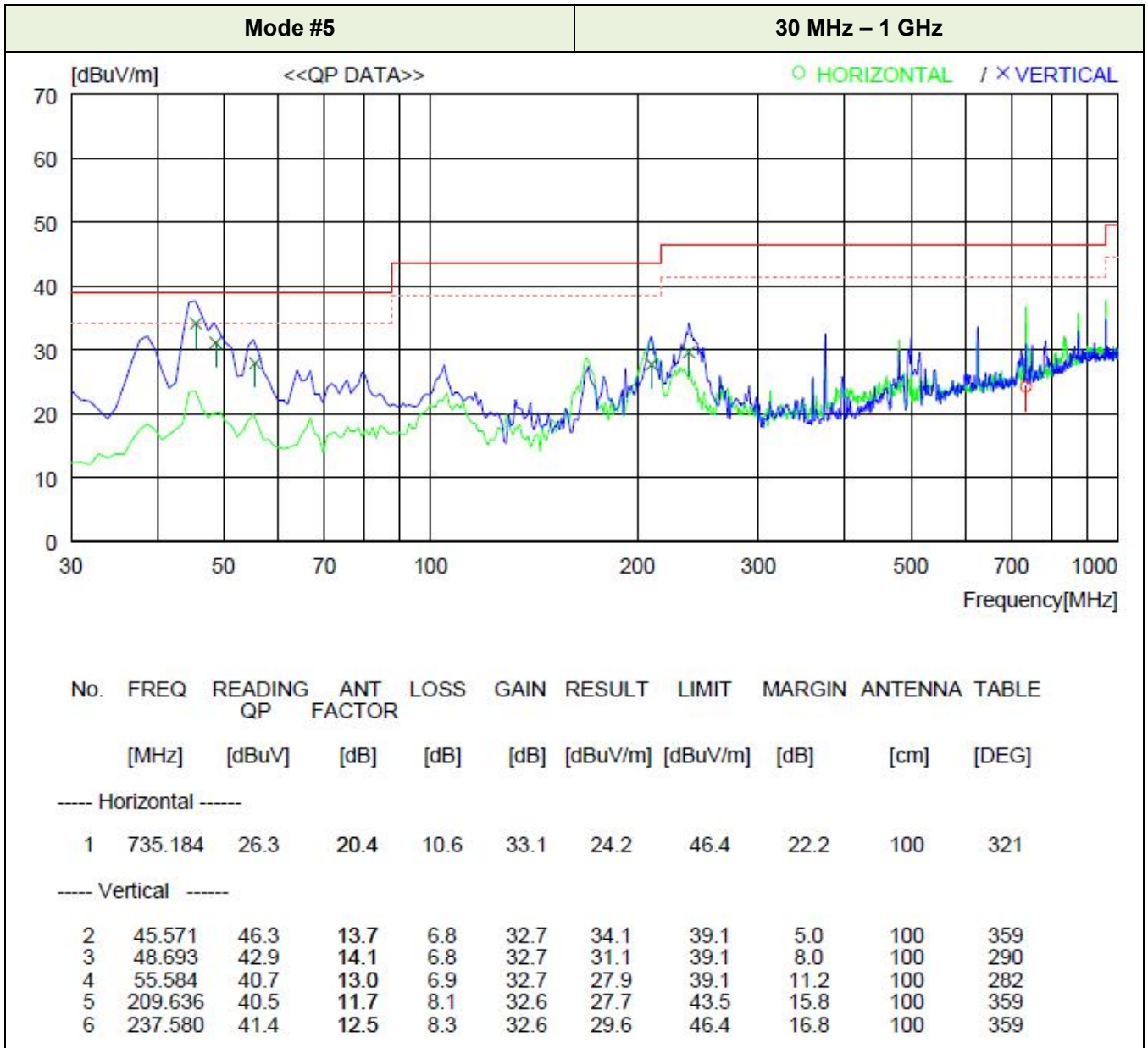


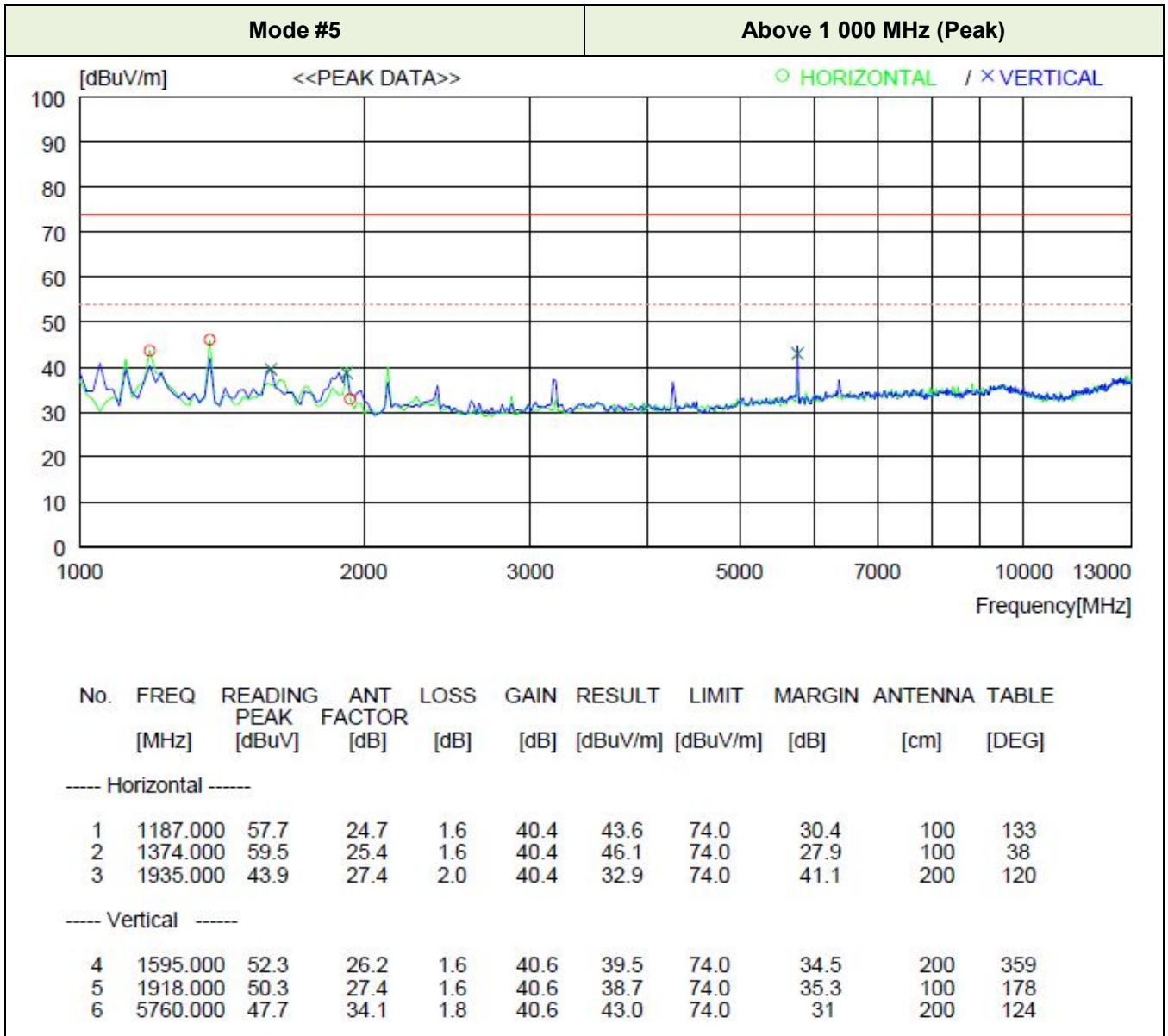
NOTE: Average mode was not measured, because Peak values were under the Average limit.





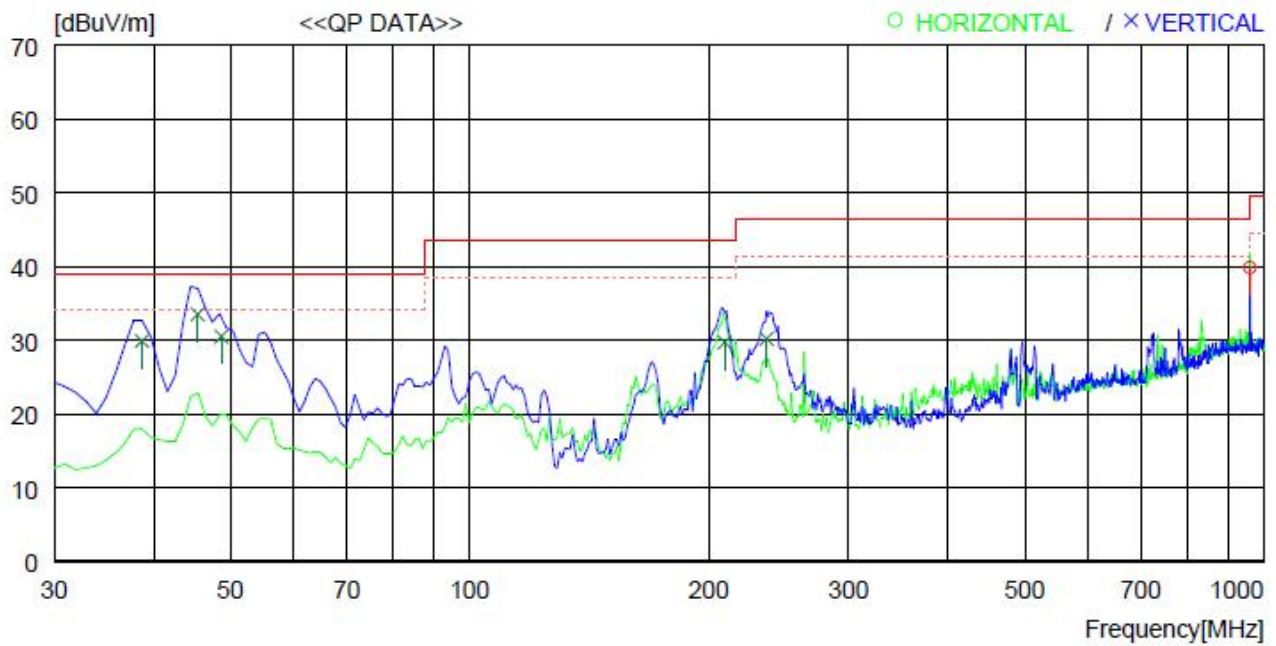
NOTE: Average mode was not measured, because Peak values were under the Average limit.



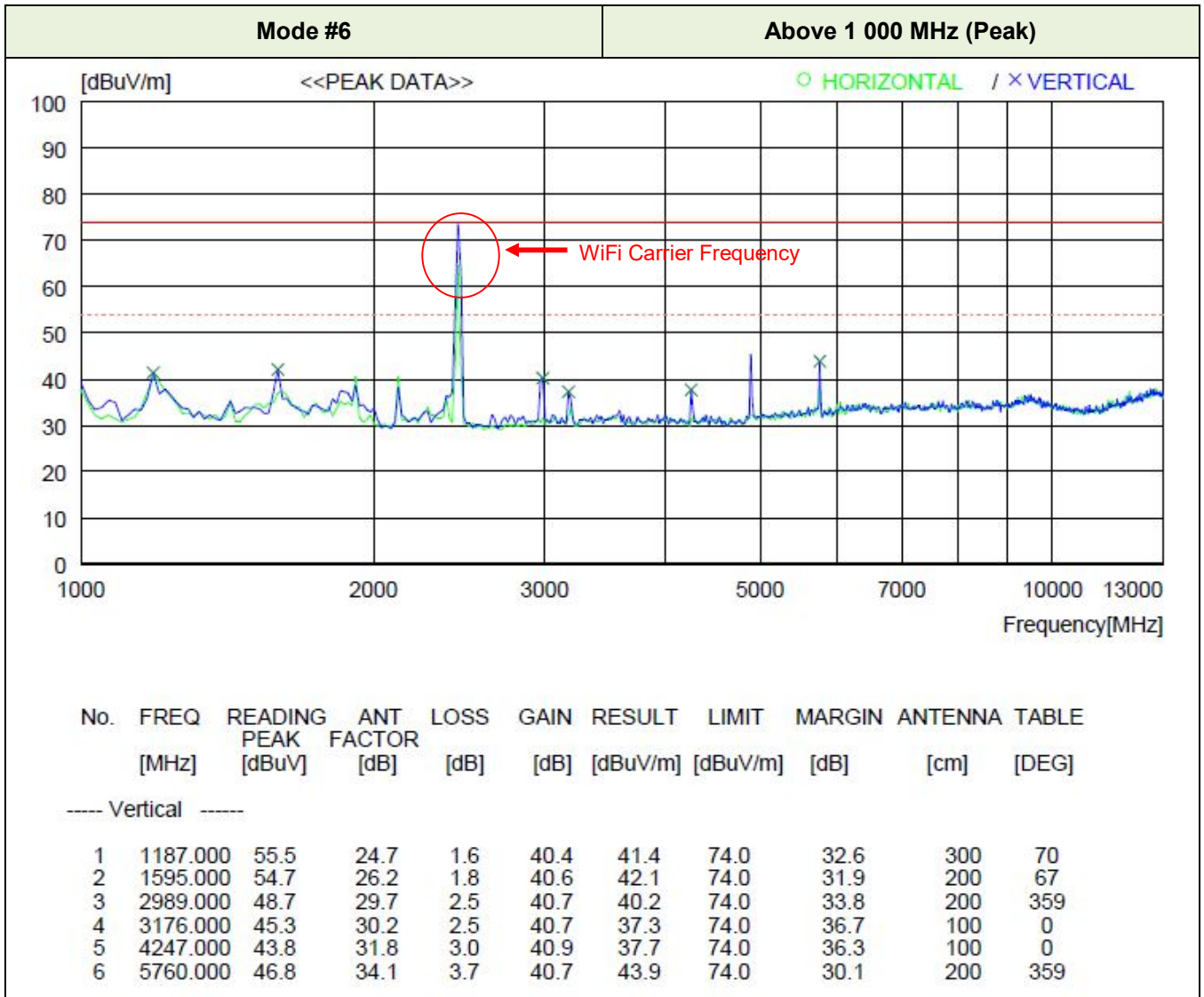


NOTE: Average mode was not measured, because Peak values were under the Average limit.

Mode #6 **30 MHz – 1 GHz**

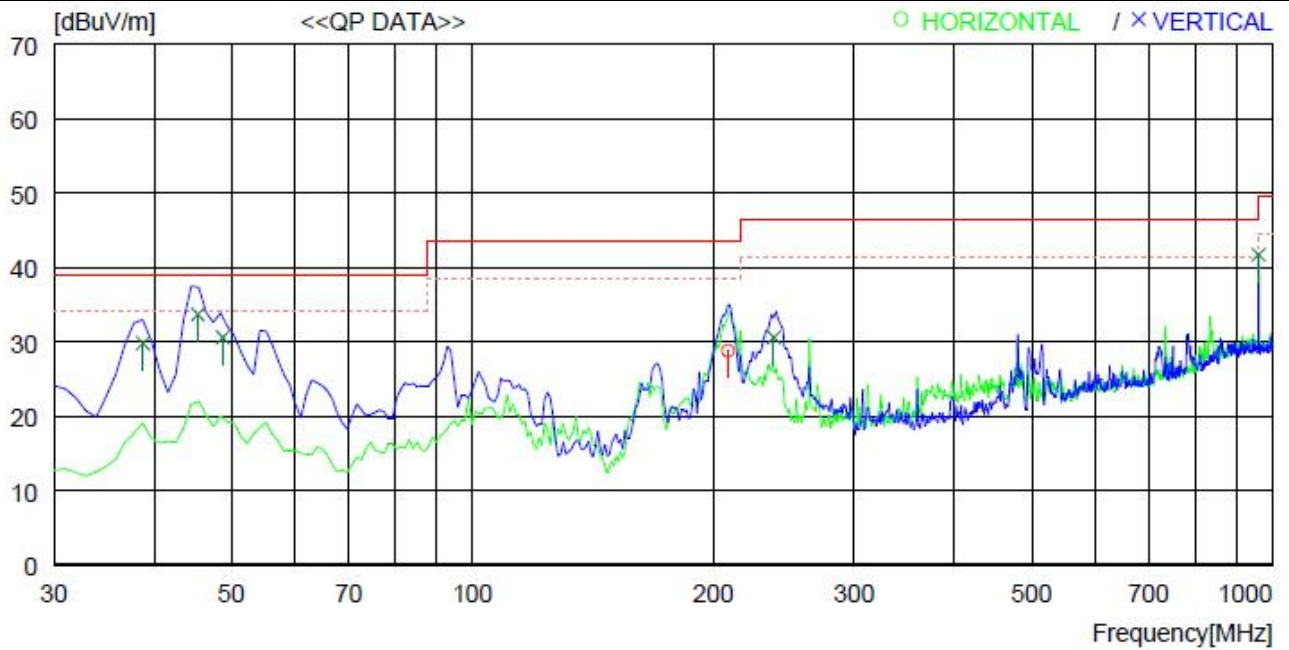


No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
---- Horizontal ----										
1	959.998	37.8	23.1	10.8	31.9	39.8	46.4	6.6	200	11
---- Vertical ----										
2	38.689	43.6	12.3	6.7	32.7	29.9	39.1	9.2	300	92
3	45.457	45.9	13.6	6.7	32.7	33.5	39.1	5.6	100	62
4	48.705	42.3	14.1	6.8	32.7	30.5	39.1	8.6	100	359
5	209.431	42.5	11.7	8.1	32.6	29.7	43.5	13.8	100	172
6	236.463	42.1	12.4	8.3	32.6	30.2	46.4	16.2	100	7

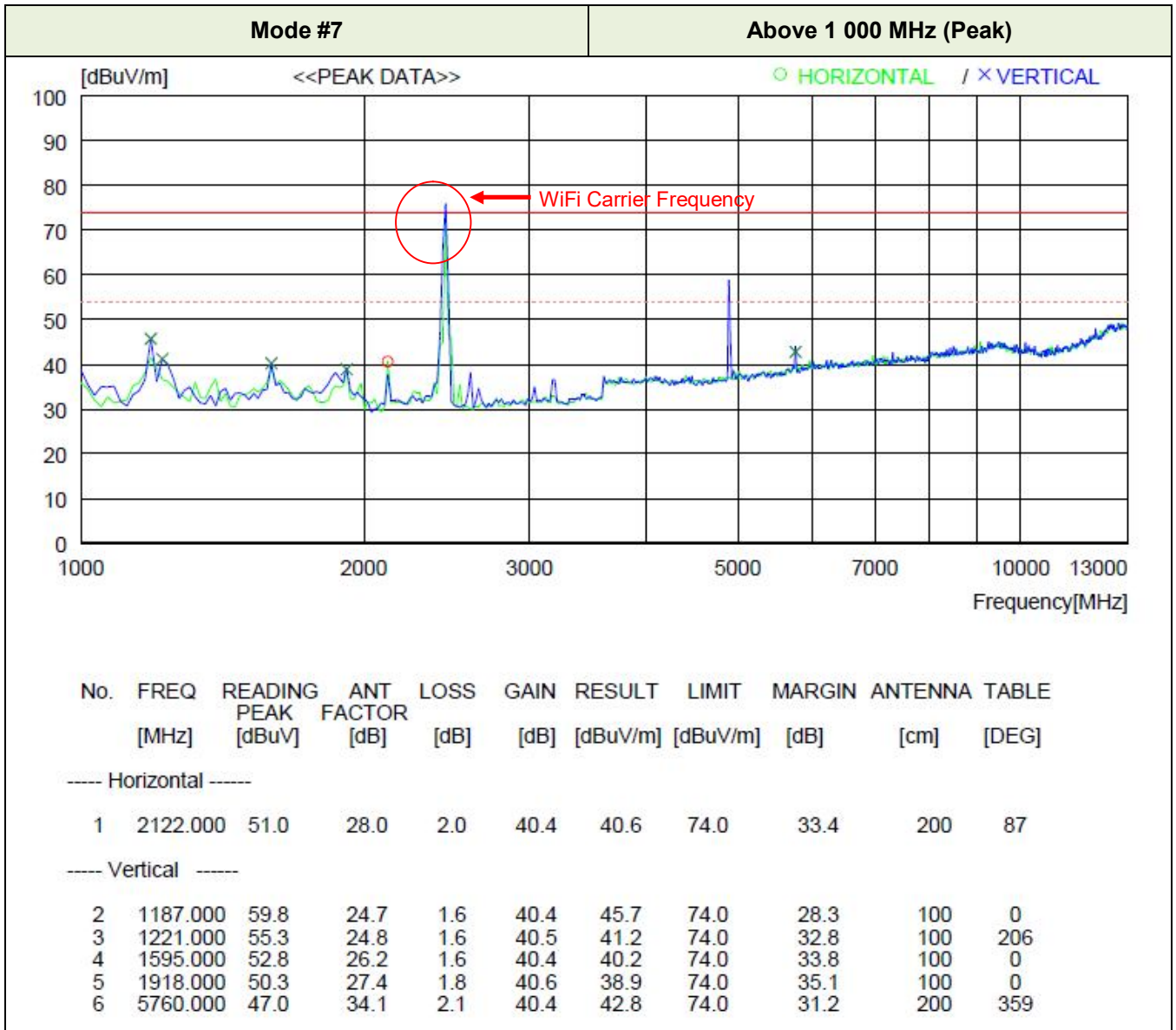


NOTE: Average mode was not measured, because Peak values were under the Average limit.

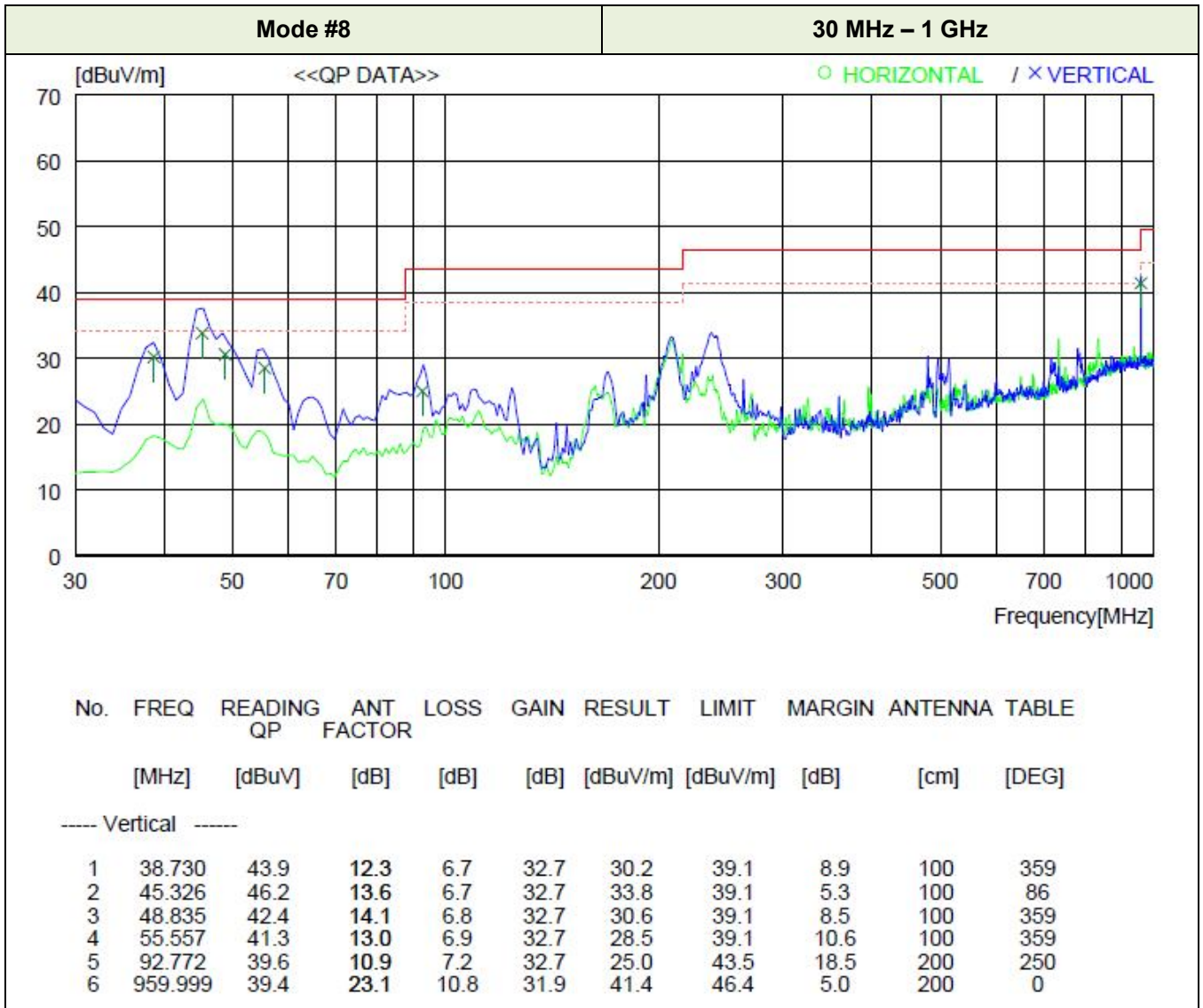
Mode #7 **30 MHz – 1 GHz**

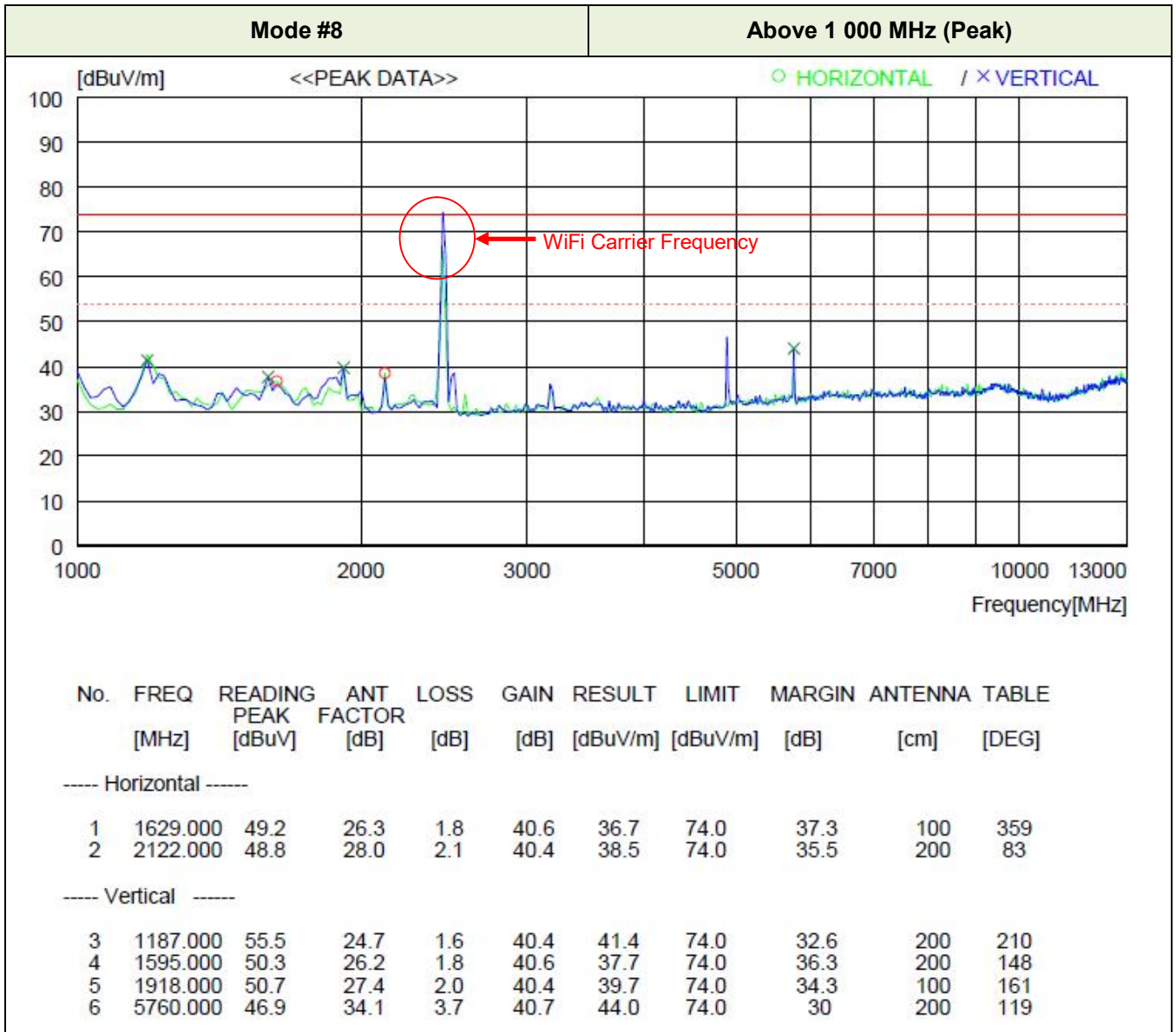


No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	208.836	41.6	11.7	8.1	32.6	28.8	43.5	14.7	400	359
----- Vertical -----										
2	38.758	43.5	12.3	6.7	32.7	29.8	39.1	9.3	300	14
3	45.391	46.1	13.6	6.7	32.7	33.7	39.1	5.4	100	87
4	48.783	42.4	14.1	6.8	32.7	30.6	39.1	8.5	100	26
5	238.047	42.4	12.5	8.3	32.6	30.6	46.4	15.8	100	359
6	960.217	39.7	23.1	10.8	31.9	41.7	49.5	7.8	200	25

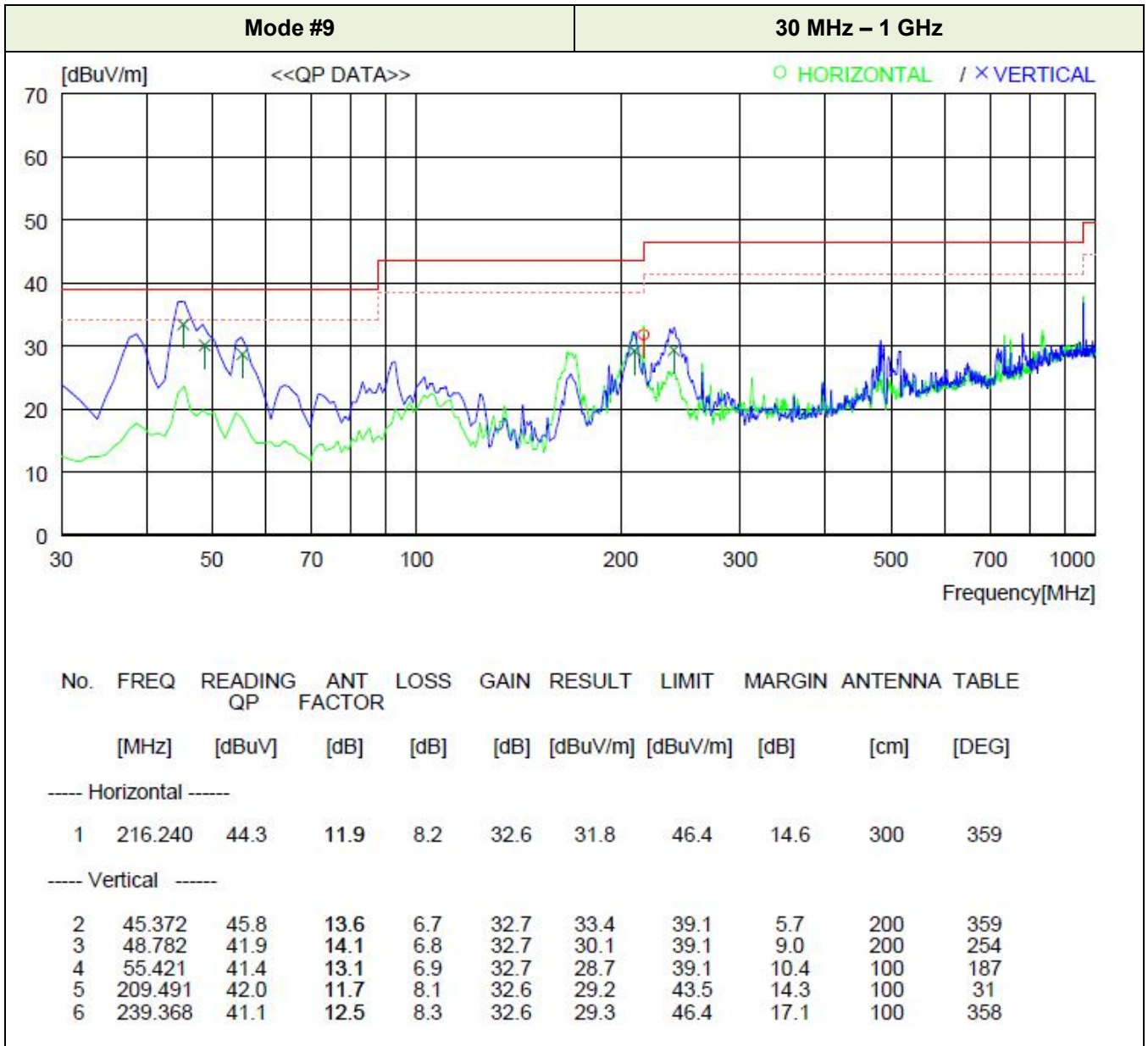


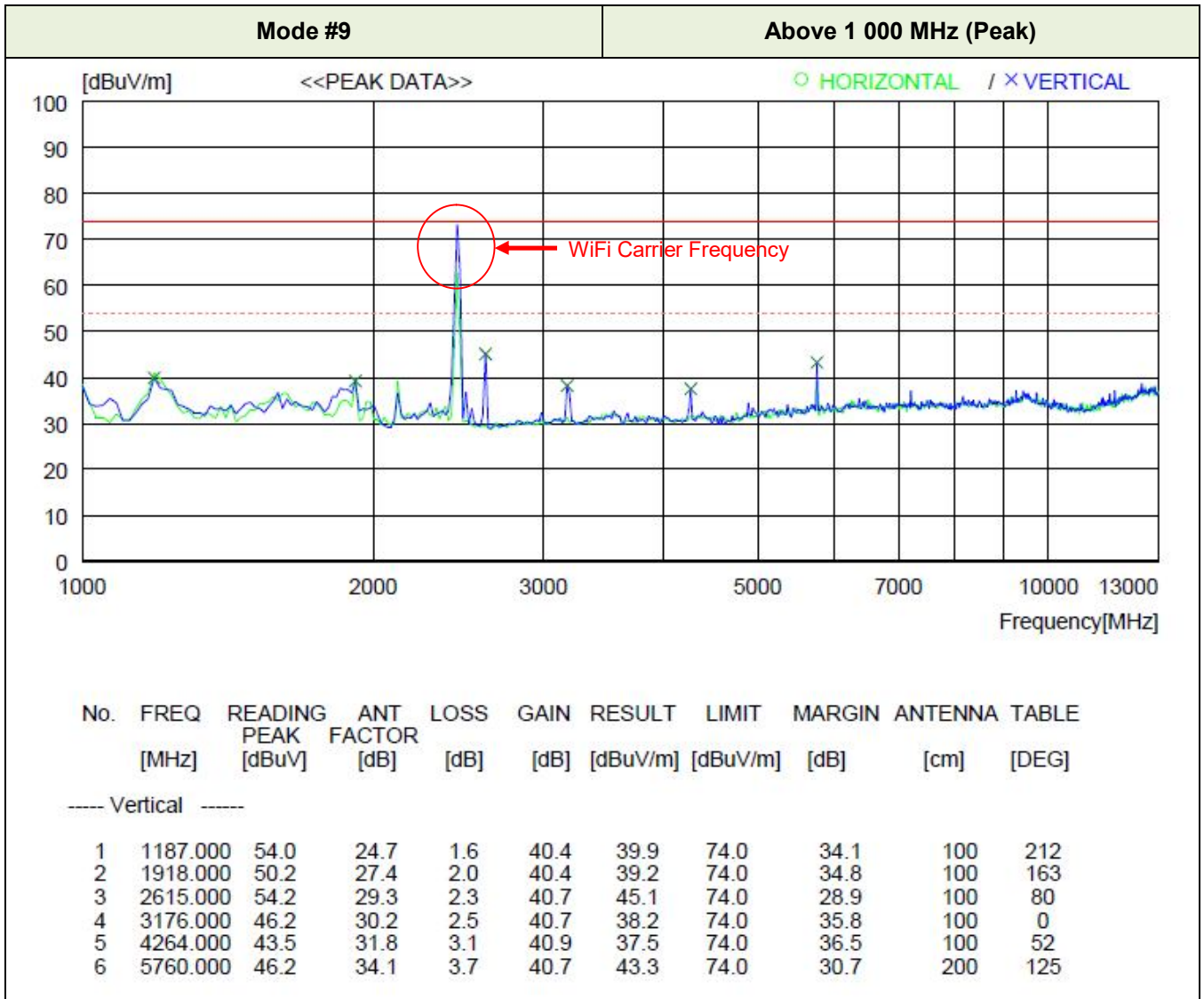
NOTE: Average mode was not measured, because Peak values were under the Average limit.





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





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

Appendix I - Test Instrumentation

Name of Equipment	Model Number	Manufacturer	Serial Number	Last Cal. (Interval)	USE
For EMISSION					
EMI Test Receiver	ESCI 7	Rohde & Schwarz	100722	2018-02-12(1Y)	■
Test Receiver	ESIB 26	Rohde & Schwarz	100298	2018-01-18(1Y)	□
LISN	ENV4200	Rohde & Schwarz	100203	2018-01-18(1Y)	□
LISN	ENV216	Rohde & Schwarz	100110	2018-07-27(1Y)	■
LISN	LS16C	AFJ	16011403310	2018-07-27(1Y)	■
LISN	NNLK8121	SchwarzBeck	8121-163	2018-07-27(1Y)	□
Voltage Probe	TK9420	Schwarzbeck	9420-165	2018-01-18(1Y)	□
Loop Antenna	HFH2-Z2	Rohde & Schwarz	100341	2017-06-15(2Y)	□
8-Wire ISN CAT 3	CAT3 8158	Schwarzbeck	CAT3 8158 #70	2018-01-22(1Y)	□
8-Wire ISN CAT 5	CAT5 8158	Schwarzbeck	CAT5 8158 #126	2018-01-22(1Y)	□
8-Wire ISN CAT 6	NTFM 8158	Schwarzbeck	NTFM 8158 #95	2018-01-22(1Y)	□
Test Receiver	ESU	Rohde & Schwarz	100303	2018-01-18(1Y)	■
TRILog Broadband Antenna	VULB9163	Schwarzbeck	9163-799	2017-10-23(2Y)	■
DOPPEL STEG HORN Antenna	HF 907	Rohde & Schwarz	102426	2017-01-06(2Y)	□
DOPPEL STEG HORN Antenna	HF 906	Rohde & Schwarz	100332	2017-02-13(2Y)	■
Preamp (1-18) GHz	SCU 18D	Rohde & Schwarz	19006450	2018-04-23(1Y)	■
Preamp 9 kHz-1 GHz	310N	Sonoma Instrument	344015	2018-01-18(1Y)	■
Attenuators	6 dB	Rohde & Schwarz	272.4110.50	2018-01-18(1Y)	■
Antenna Master (Below 1 GHz)	MA4000-EP	INNCO SYSTEM	4600814	N/A	■
Antenna Master (Above 1 GHz)	MA4000-XP-ET	INNCO SYSTEM	N/A	N/A	■
Turn Table	DT3000-3t	INNCO SYSTEM	1310814	N/A	■
CO3000 Controller (Below 1 GHz)	CO3000-4PORT	INNCO SYSTEM	CO3000/806/34130 814/L	N/A	■
CO3000 Controller (Above 1 GHz)	CO3000-4PORT	INNCO SYSTEM	CO3000/807/34130 814/L	N/A	■
Digital Power Analyzer For Harmonic & Flicker	DPA 500	EM Test	V0713102356	2018-01-25(1Y)	□
AC Power Source	ACS 500	EM Test	V0713102357	2018-07-27(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.