



FCC CFR47 Part 15 Subpart B Certification Test Report

For the

Product : 3D Printer
Model : 7X
Multiple Model : 5X, riZE 7XC
FCC ID : 2AB83-7X
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-W1811-009-01**

Signature



Choi, Young-min / Technical Manager
Date: 2020-04-01

Test Laboratory: ENG Co., Ltd.

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FCC/ISED CANADA TEST REPORT

Project Number : EA2003C-026
Test Report Number : TR-W1811-009-01
Type of Equipment : 3D Printer
Model Name : 7X
Multiple Model Name : 5X, riZE 7XC
FCC ID : 2AB83-7X
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 : 72 pages
Date of Receipt : 2020-03-06
Date of Issue : 2020-04-01
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

2020-04-01

Date

Reviewed by Choi, Young-min / Technical Manager

Signature

2020-04-01

Date

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Release Control Record

Issue Report No.	Issued Date	Details/Revisions
TR-W1811-009	2018-11-19	Initial Release
TR-W1811-009-01	2020-04-01	Motors and main board design changed. Added model name Class II Permissive Change

1. TEST SUMMARY

1.1 Test standards and results

The EUT (Equipment Under Test) 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 Related Authorization Procedure

Class II Permissive Change

Following modifications were occurred and/or added in the EUT.

1. Main board design was changed due to adding sensors.
2. X axis motor and Y axis motor was changed

1.6 Test Facility

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

Laboratory Qualification	Registration No.	Mark
FCC	KR0160	
ISED Canada	12721A	
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 7X (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	
Printing Method	Fused Filament Fabrication
Max. Print Length(mm)	5X : W(max):350, D(max):350, H(max):350 7X : W(max):370, D(max):390, H(max):450 riZE 7XC : W(max):370, D(max):390, H(max):450 W(max):380, D(max):390, H(max):450 (Expanded print mode)
Print Layer Thickness Setting	0.05~0.4mm
Basic Nozzle diameter	0.4mm
Filament width	1.75mm
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 leveling
Print Head	Two Nozzle
Temperature/Speed	
Continuous Nozzle Usage/ Maximum Temperature	Recommended Temperature(Nozzle): PLA 200°C, ABS 230°C, Flexible 235°C, PVA 215°C, PVA+ 200°C / Max 250°C
Continuous Bed Usage/ Maximum Temperature	Recommended Temperature(Bed): PLA 55°C, ABS(Side A) 90°C, ABS(Side B) 100°C, Flexible 55°C , PVA(PVA+) 55°C / Max 110°C
Recommended printing speed/ maximum speed	PLA 80mm/s, ABS 80mm/s, PVA(PVA+) 25mm/s, FLEXIBLE 30mm/s Recommended / 200mm/s max
Machine	
Power	Max. 1000 W
Dimensions	864 x 810 x 1690(W x D x H)
Weight	167 kg (excluding cartridge)
Port	USB Device, USB Host , Wifi, Ethernet
Cartridge	Auto Load / Unload

Software/Support	
Supported Software	Sindoh Exclusive Slicer
Supported File Format	*.stl, *.ply, *.obj, *.gcode, *.amf
Supported Operating System	Windows 7 or above, Mac OSX 10.10 or above
Recommended Memory Requirements	DRAM 8 GB+ / VRAM 2 GB+ (5X, 7X, RIZE 7XC model only)
Default Setting of Print layer width	
Nozzle Width	0.4mm
Print Layer Width	0.2mm
Contained RF Module	
Contained RF Module	FCC ID: 2AB83-TWFM-M311D IC : 2541A-TWFM311D Model: TWFM-M311D Manufacturer: LG Innotek Co., Ltd.

2.2 Additional Model

Model Name	Model Difference
7X	Basic Model
5X	Identical to the basic model except for the model designation and optional internal SSD.
riZE 7XC	Identical to the basic model except for the model designation
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.	FCC ID	Serial No	Manufacturer.
3D Printer (EUT) *	7X	2AB83-7X	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

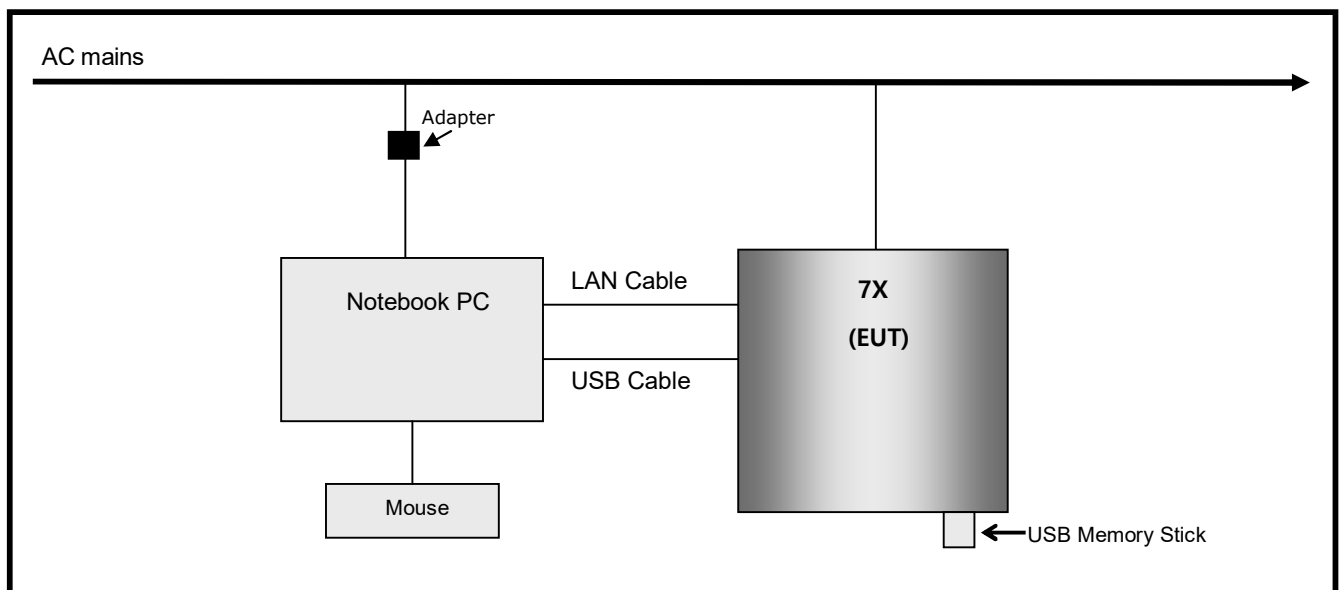
2.5 Mode of operation during the test

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

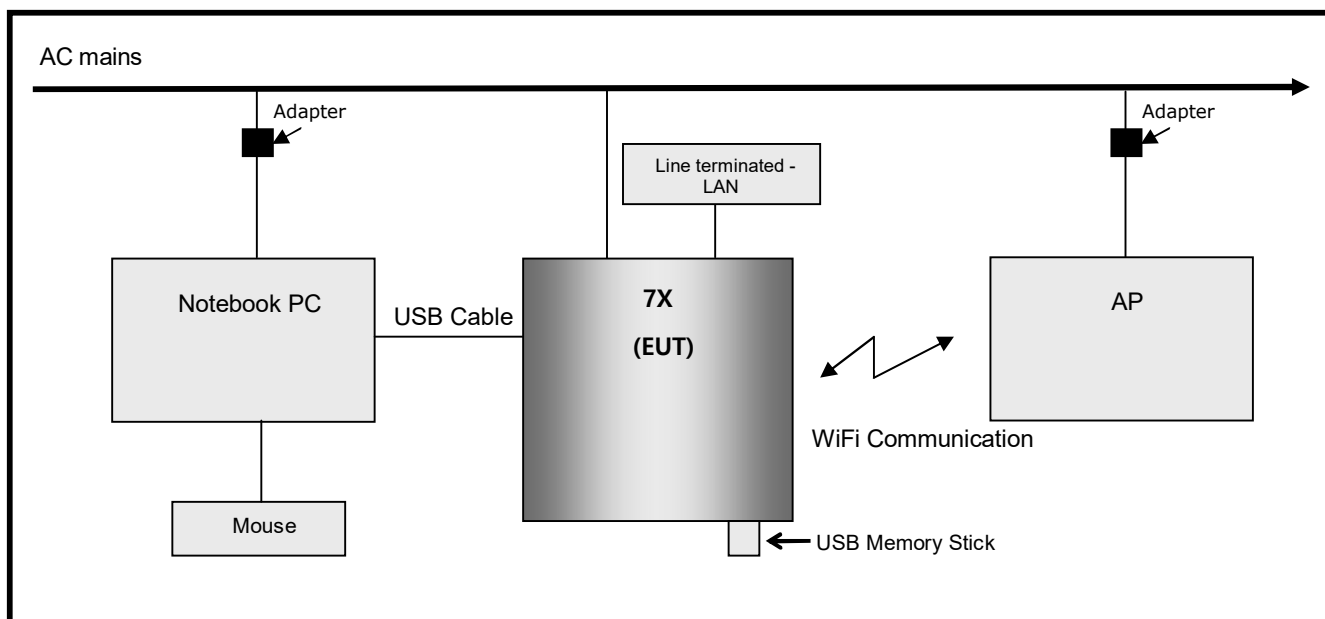
Test Mode	Description
# 1	The EUT was operated in standby mode
# 2	Printing mode using USB cable between the EUT and a Notebook PC
# 3	Printing mode using USB memory stick
# 4	Printing mode using Ethernet speed, 100 Mbps
# 5	Printing mode using Ethernet speed, 1 000 Mbps
# 6	Printing mode using Wi-Fi 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 $50 \Omega/50 \mu\text{H} + 5 \Omega$ 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.

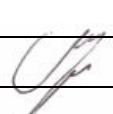
Used Software for measurement is EMC 32 supplied by Rohde&Schwarz.

3.1.2 Measurement uncertainty

Frequency range	Uncertainty
150 kHz ~ 30 MHz	2.01 dB

The measurement uncertainties are given with 95 % confidence.

3.1.3 Test Result

Date of Test	2020-03-25		
Temperature	(19.95 ± 0.05) °C	Relative humidity	(39.2 ± 0.2) % 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	Chu, Woo-Sik 

3.1.4 Sample Calculated Example

At 5.31 MHz

QP Limit = 60.0 dB μ V

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

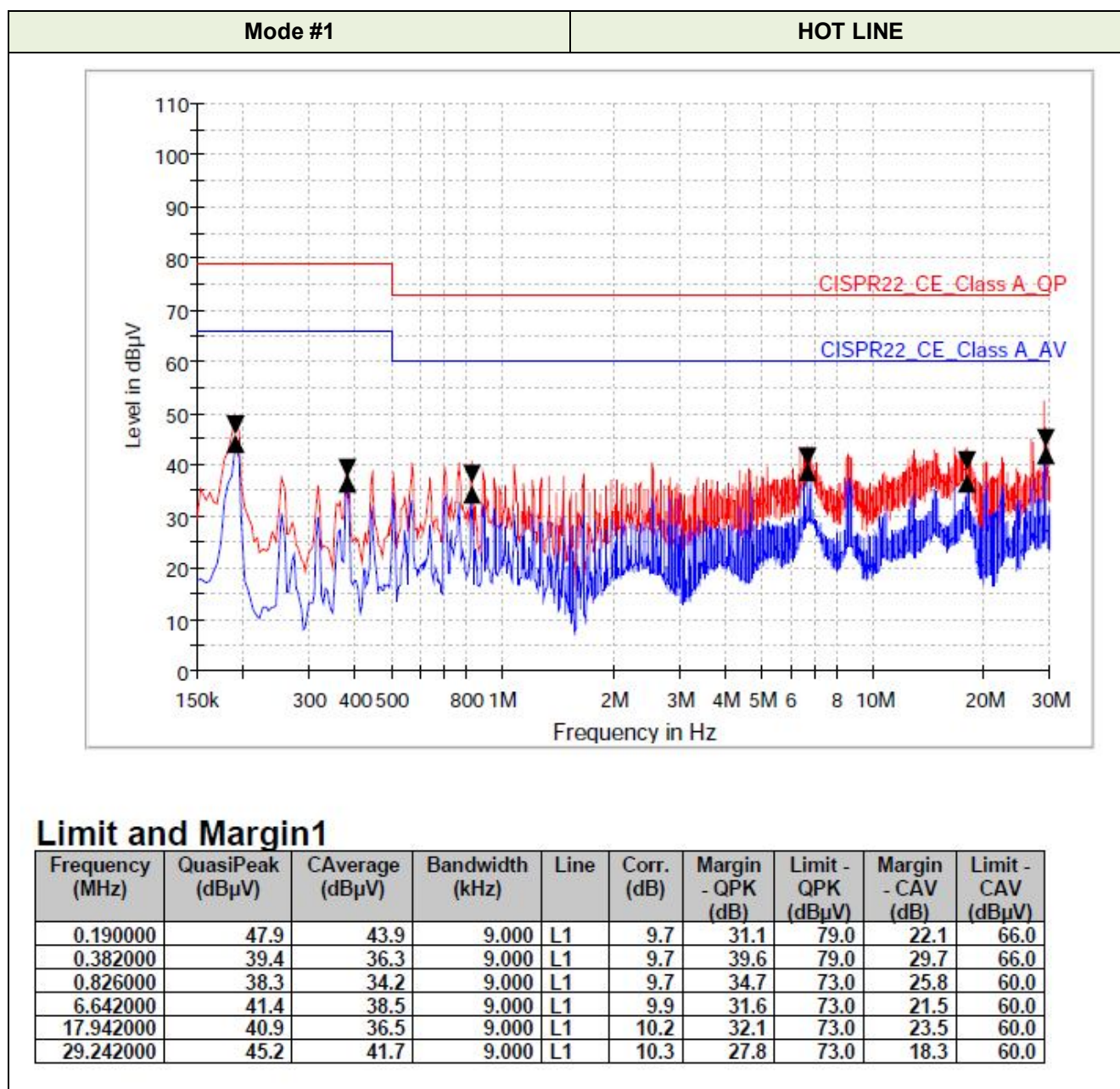
Q.P Reading from the Test receiver = 20.8 dB μ V

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

Therefore Q.P Margin = 60 - 20.8 = 39.2

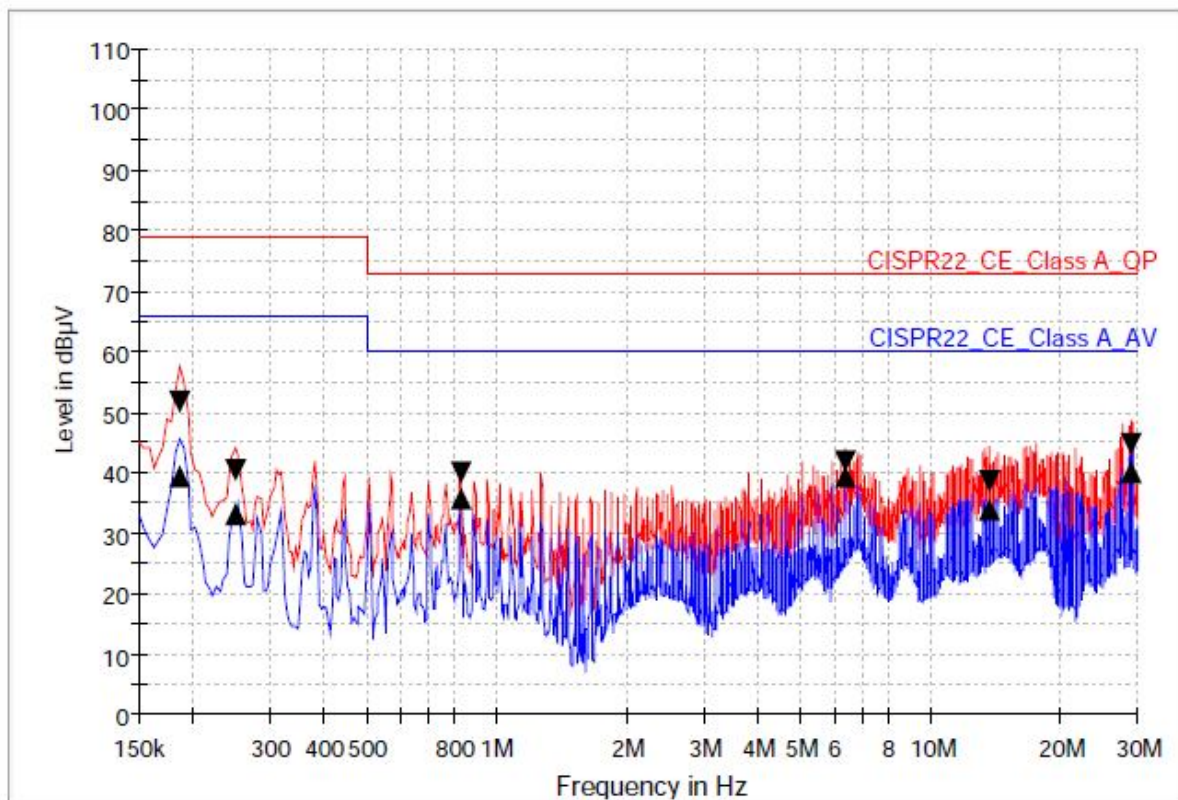
so the EUT has 39.2 dB margin at 5.31 MHz

3.1.5 Test Data



Mode #1

NEUTRAL LINE

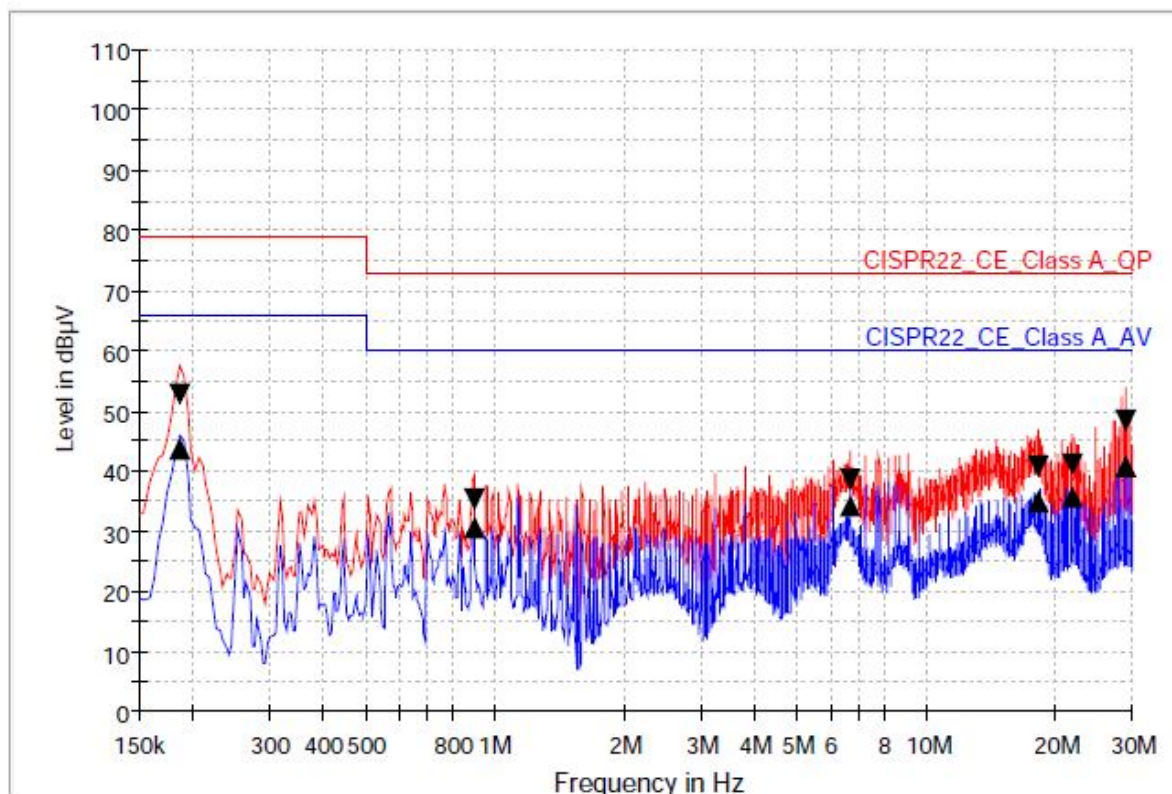


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)	Margin - CAV (dB)	Limit - CAV (dBμV)
0.186000	51.7	39.3	9.000	N	9.7	27.3	79.0	26.7	66.0
0.250000	40.3	33.0	9.000	N	9.7	38.7	79.0	33.0	66.0
0.826000	40.2	35.9	9.000	N	9.7	32.8	73.0	24.1	60.0
6.358000	41.9	39.4	9.000	N	9.9	31.1	73.0	20.6	60.0
13.706000	38.8	34.0	9.000	N	10.1	34.2	73.0	26.0	60.0
29.102000	44.6	40.1	9.000	N	10.3	28.4	73.0	19.9	60.0

Mode #2

HOT LINE

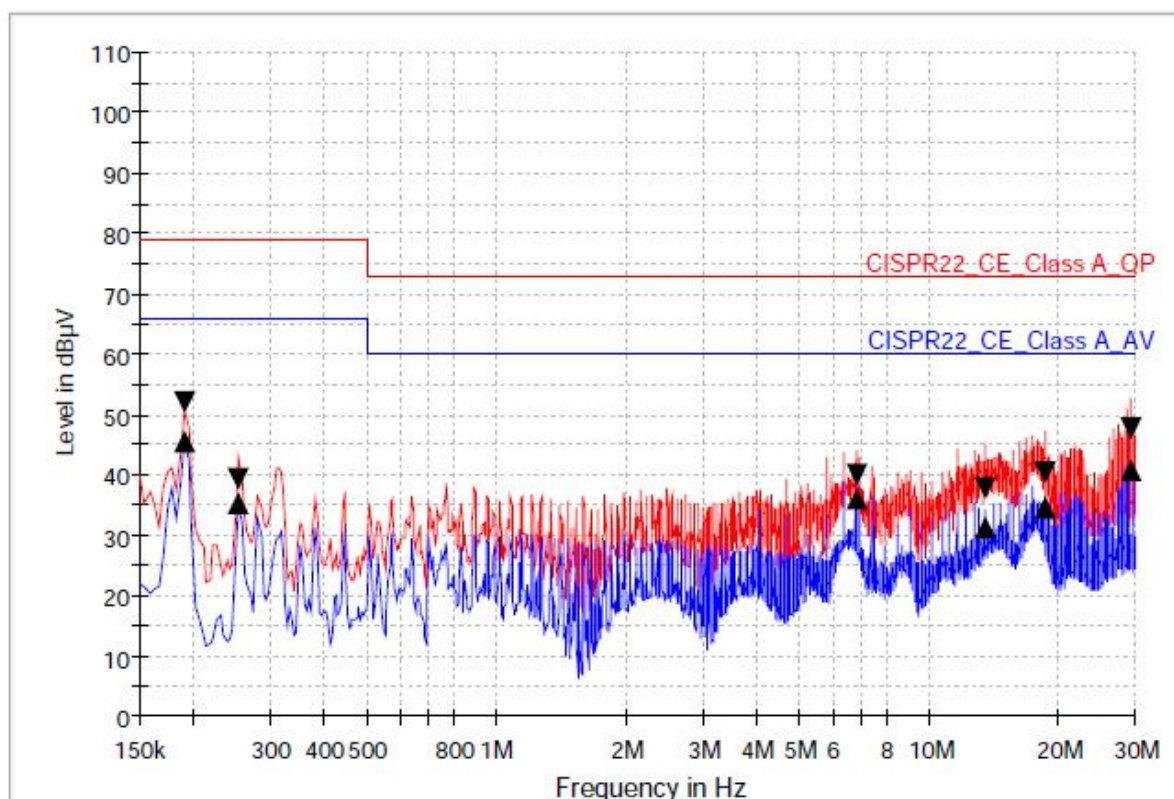


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)	Margin - CAV (dB)	Limit - CAV (dBμV)
0.186000	52.9	43.9	9.000	L1	9.7	26.1	79.0	22.1	66.0
0.894000	35.5	30.5	9.000	L1	9.7	37.5	73.0	29.5	60.0
6.646000	38.5	34.3	9.000	L1	9.9	34.5	73.0	25.7	60.0
18.226000	40.7	34.9	9.000	L1	10.2	32.3	73.0	25.1	60.0
21.790000	41.2	35.9	9.000	L1	10.2	31.8	73.0	24.1	60.0
29.026000	48.3	40.9	9.000	L1	10.3	24.7	73.0	19.1	60.0

Mode #2

NEUTRAL LINE

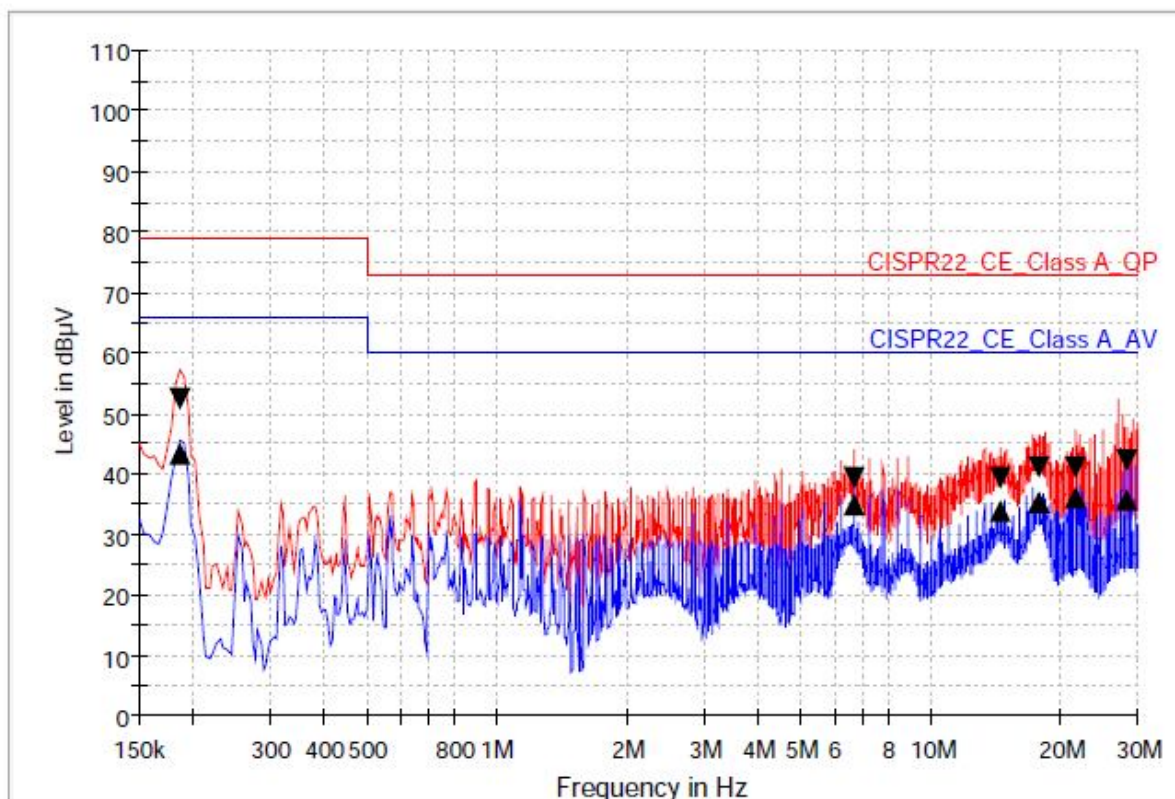


Limit and Margin1

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	52.0	45.6	9.000	N	9.7	27.0	79.0	20.4	66.0
0.254000	39.5	35.5	9.000	N	9.7	39.5	79.0	30.5	66.0
6.786000	40.1	36.1	9.000	N	9.9	32.9	73.0	23.9	60.0
13.566000	38.0	31.3	9.000	N	10.1	35.0	73.0	28.7	60.0
18.514000	40.4	34.7	9.000	N	10.2	32.6	73.0	25.3	60.0
29.314000	47.8	40.9	9.000	N	10.3	25.2	73.0	19.1	60.0

Mode #3

HOT LINE

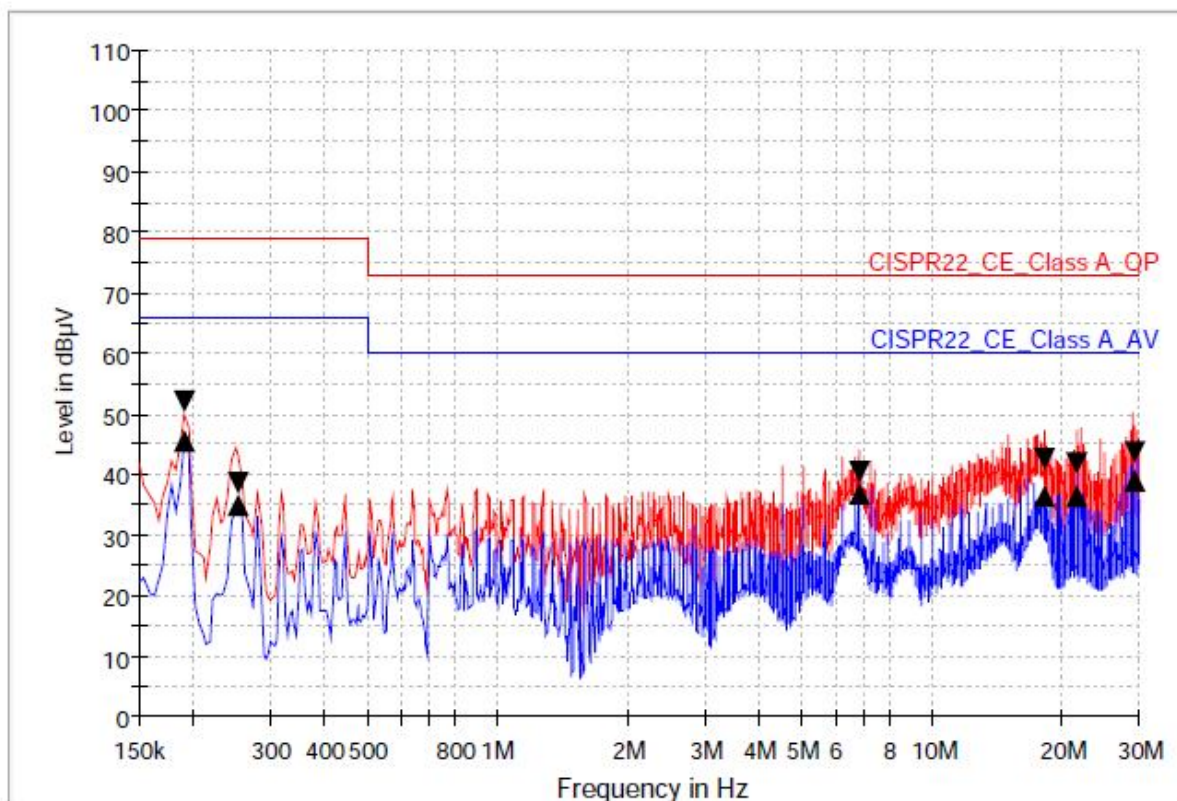


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)	Margin - CAV (dB)	Limit - CAV (dBμV)
0.186000	52.3	43.3	9.000	L1	9.7	26.7	79.0	22.7	66.0
6.646000	39.2	34.9	9.000	L1	9.9	33.8	73.0	25.1	60.0
14.418000	39.4	33.7	9.000	L1	10.1	33.6	73.0	26.3	60.0
17.722000	41.2	35.3	9.000	L1	10.2	31.8	73.0	24.7	60.0
21.482000	41.3	36.0	9.000	L1	10.2	31.7	73.0	24.0	60.0
28.414000	42.1	35.8	9.000	L1	10.3	30.9	73.0	24.2	60.0

Mode #3

NEUTRAL LINE

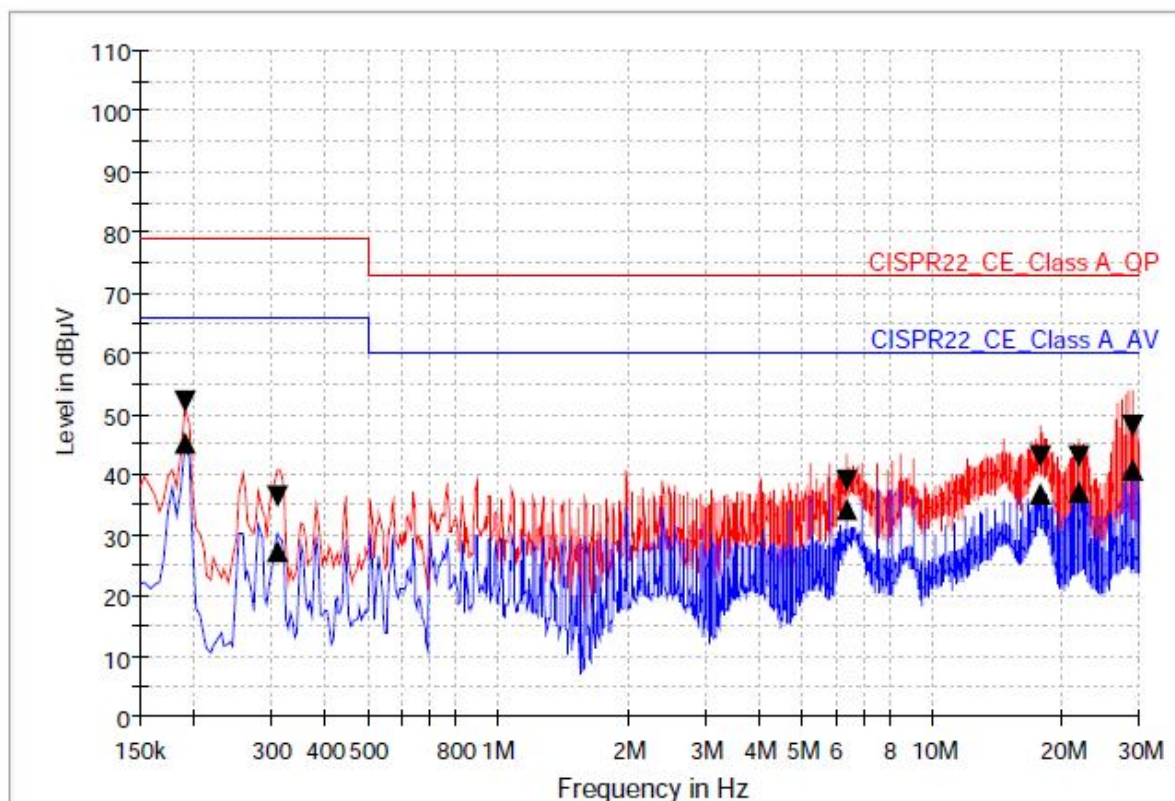


Limit and Margin1

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	52.2	45.5	9.000	N	9.7	26.8	79.0	20.5	66.0
0.254000	38.8	34.9	9.000	N	9.7	40.2	79.0	31.1	66.0
6.786000	40.6	36.8	9.000	N	9.9	32.4	73.0	23.2	60.0
18.234000	42.6	36.6	9.000	N	10.2	30.4	73.0	23.4	60.0
21.486000	42.0	36.5	9.000	N	10.2	31.0	73.0	23.5	60.0
29.258000	43.6	39.2	9.000	N	10.3	29.4	73.0	20.8	60.0

Mode #4

HOT LINE

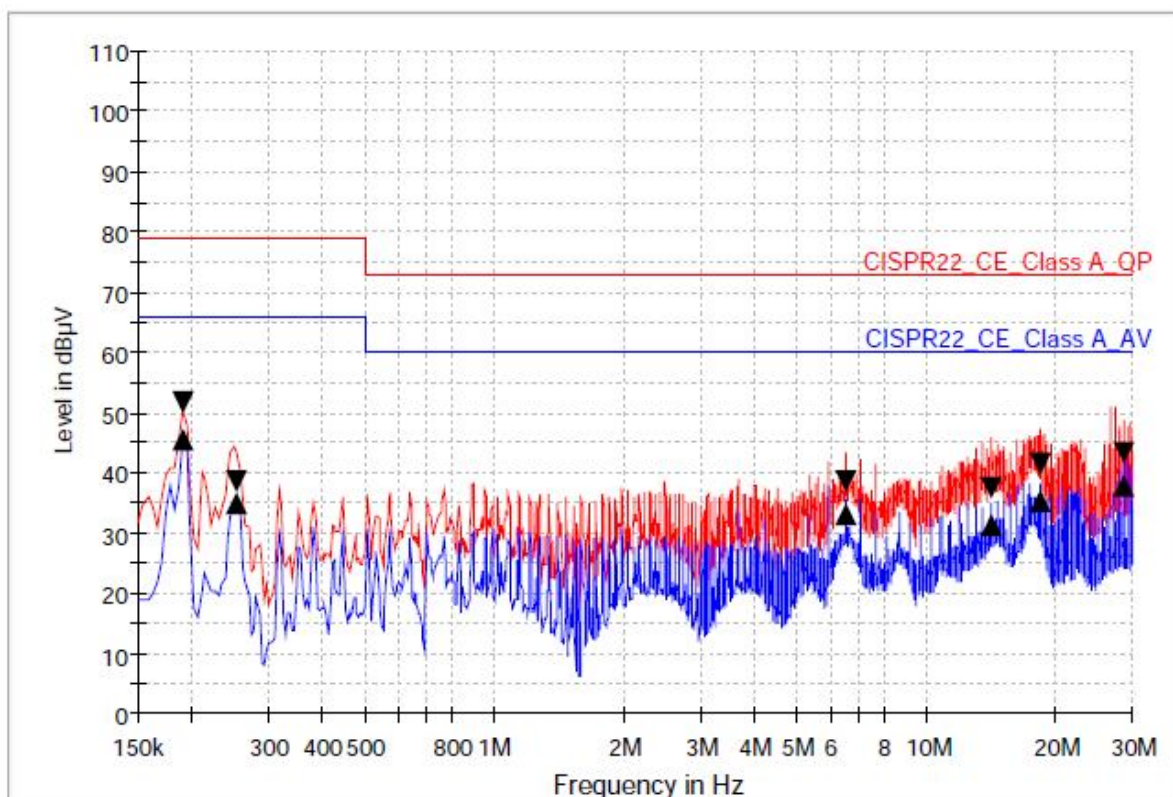


Limit and Margin1

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	52.2	45.3	9.000	L1	9.7	26.8	79.0	20.7	66.0
0.310000	36.4	27.2	9.000	L1	9.7	42.6	79.0	38.8	66.0
6.362000	39.0	34.3	9.000	L1	9.9	34.0	73.0	25.7	60.0
17.786000	43.0	36.7	9.000	L1	10.2	30.0	73.0	23.3	60.0
21.862000	43.1	37.3	9.000	L1	10.2	29.9	73.0	22.8	60.0
29.030000	48.0	40.7	9.000	L1	10.3	25.0	73.0	19.3	60.0

Mode #4

NEUTRAL LINE

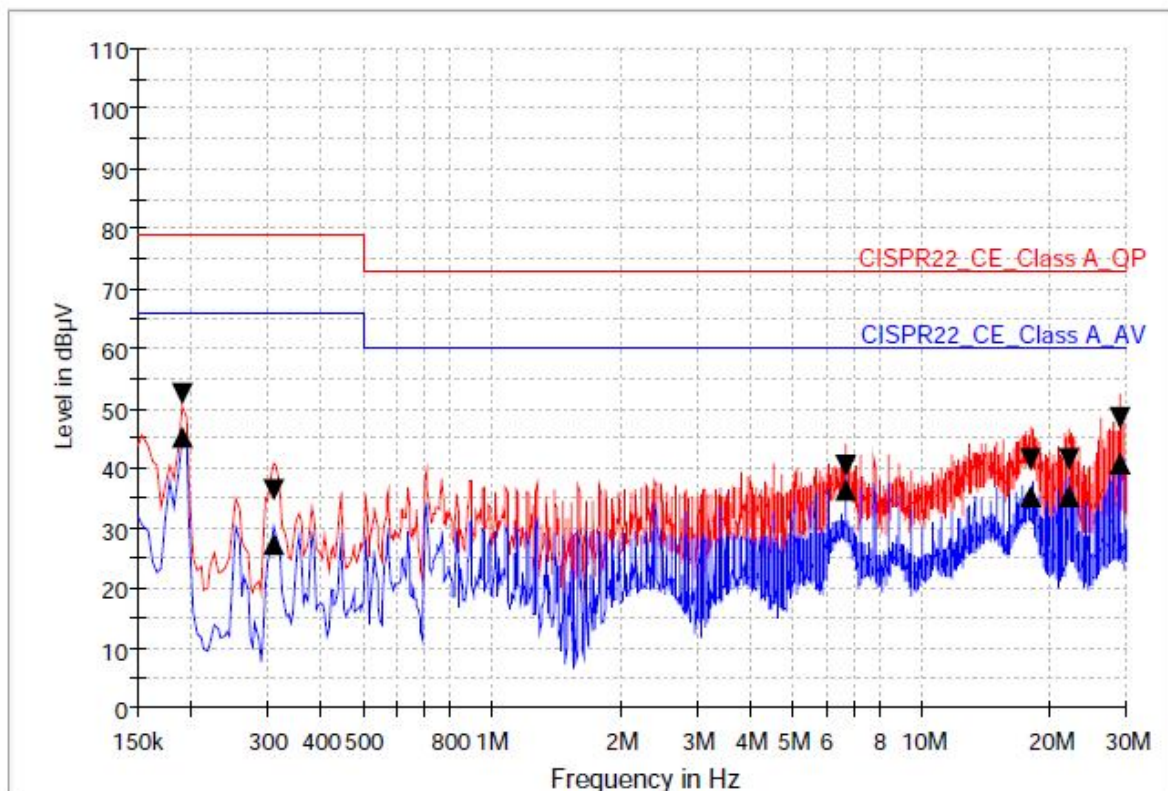


Limit and Margin1

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	51.9	45.5	9.000	N	9.7	27.1	79.0	20.5	66.0
0.254000	38.7	35.0	9.000	N	9.7	40.3	79.0	31.0	66.0
6.498000	38.5	33.0	9.000	N	9.9	34.5	73.0	27.0	60.0
14.138000	37.5	31.3	9.000	N	10.1	35.5	73.0	28.7	60.0
18.374000	41.4	35.4	9.000	N	10.2	31.6	73.0	24.6	60.0
28.694000	43.2	38.0	9.000	N	10.3	29.8	73.0	22.0	60.0

Mode #5

HOT LINE

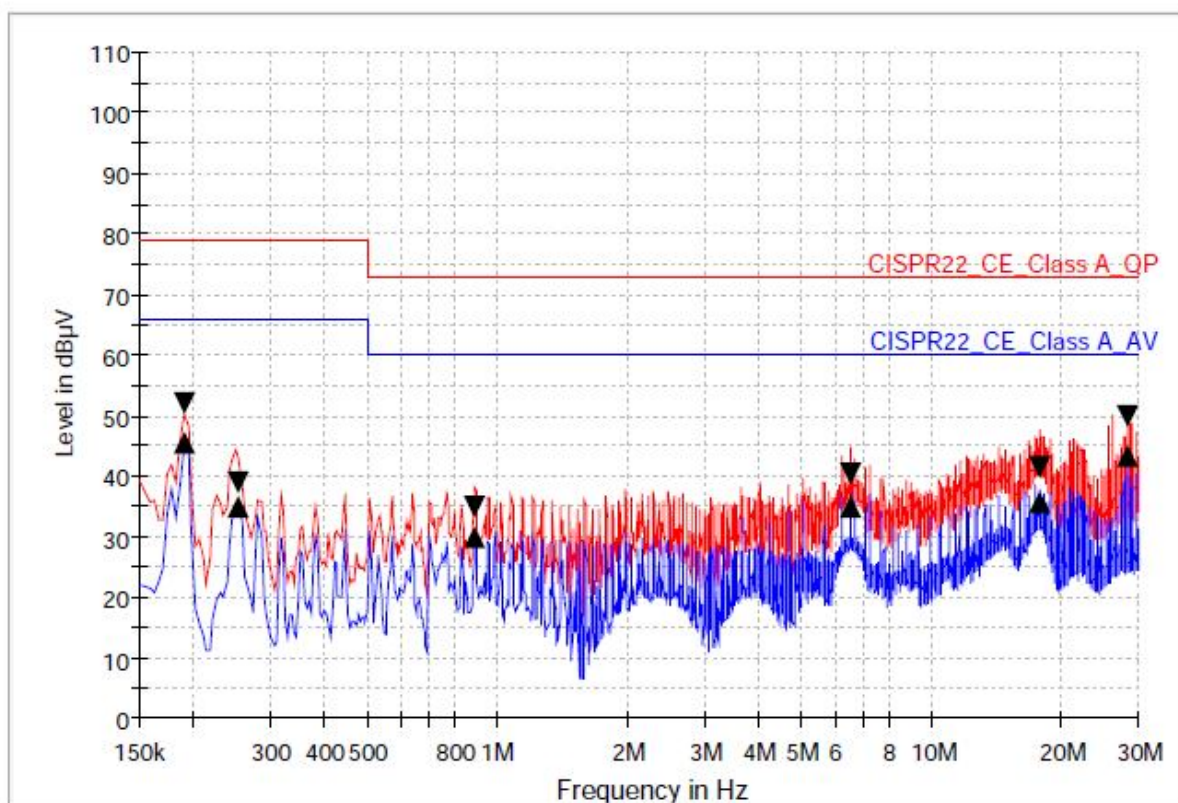


Limit and Margin1

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	52.4	45.3	9.000	L1	9.7	26.6	79.0	20.7	66.0
0.310000	36.3	27.2	9.000	L1	9.7	42.7	79.0	38.8	66.0
6.642000	40.3	36.5	9.000	L1	9.9	32.7	73.0	23.5	60.0
17.978000	41.5	35.3	9.000	L1	10.2	31.5	73.0	24.7	60.0
22.050000	41.6	35.2	9.000	L1	10.2	31.4	73.0	24.8	60.0
28.890000	48.3	40.9	9.000	L1	10.3	24.7	73.0	19.1	60.0

Mode #5

NEUTRAL LINE

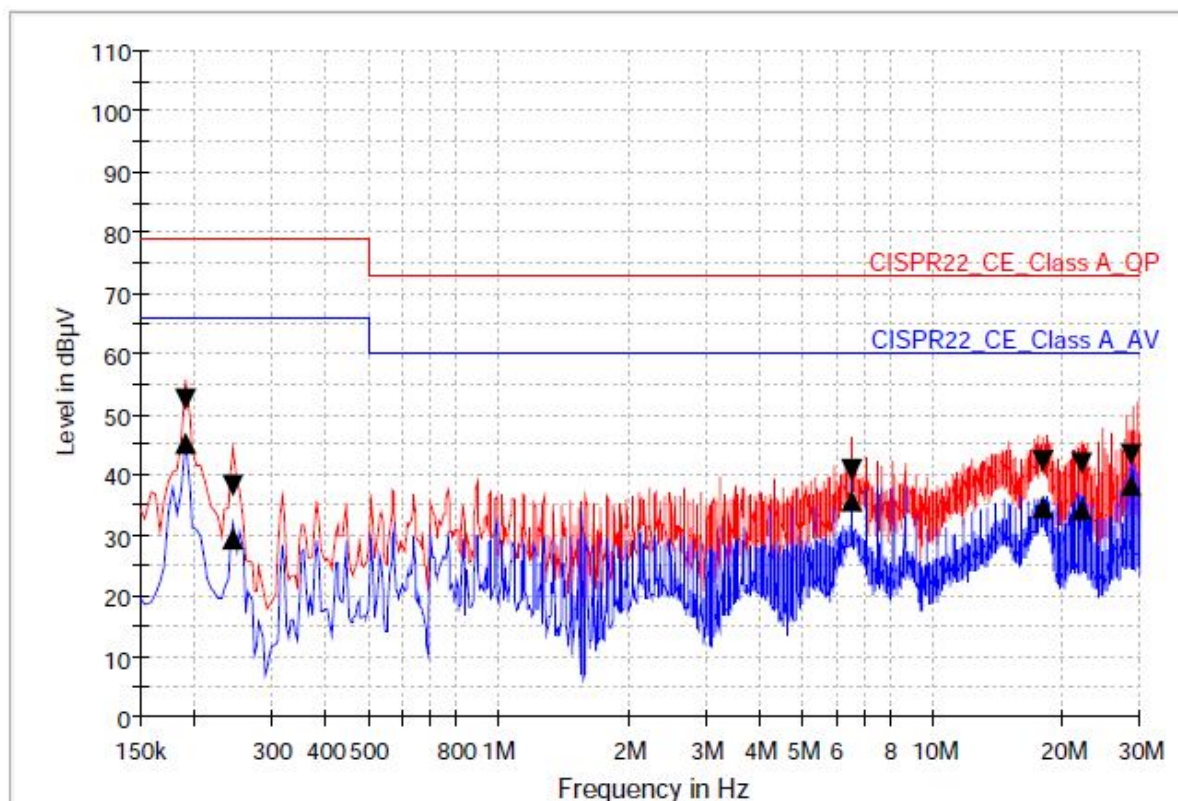


Limit and Margin1

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	52.2	45.5	9.000	N	9.7	26.8	79.0	20.5	66.0
0.254000	38.8	35.0	9.000	N	9.7	40.2	79.0	31.0	66.0
0.890000	34.8	29.8	9.000	N	9.7	38.2	73.0	30.2	60.0
6.502000	40.6	35.1	9.000	N	9.9	32.4	73.0	24.9	60.0
17.666000	41.5	35.5	9.000	N	10.2	31.5	73.0	24.5	60.0
28.414000	49.9	43.3	9.000	N	10.3	23.1	73.0	16.7	60.0

Mode #6

HOT LINE

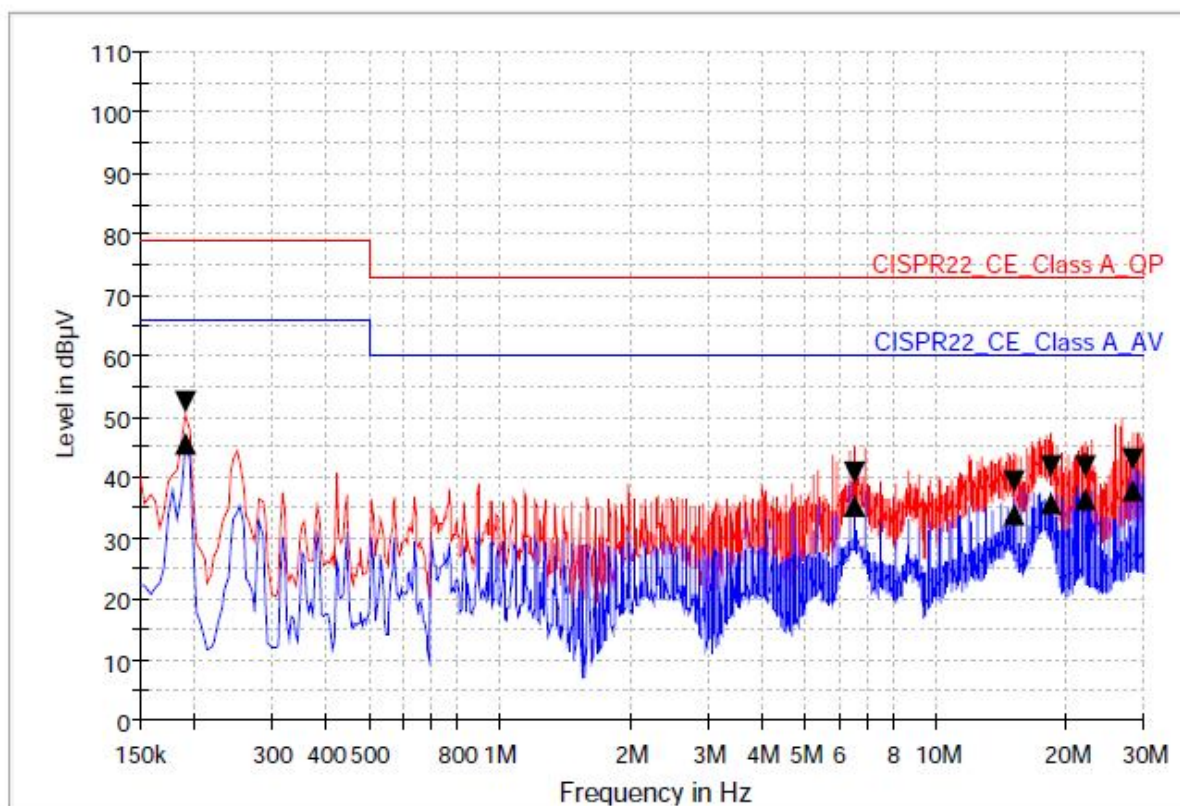


Limit and Margin1

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	52.3	45.3	9.000	L1	9.7	26.7	79.0	20.7	66.0
0.246000	38.4	29.4	9.000	L1	9.7	40.6	79.0	36.6	66.0
6.502000	40.6	35.7	9.000	L1	9.9	32.4	73.0	24.3	60.0
17.982000	42.4	34.7	9.000	L1	10.2	30.6	73.0	25.3	60.0
21.990000	41.8	34.4	9.000	L1	10.2	31.2	73.0	25.6	60.0
28.694000	43.3	38.2	9.000	L1	10.3	29.7	73.0	21.8	60.0

Mode #6

NEUTRAL LINE

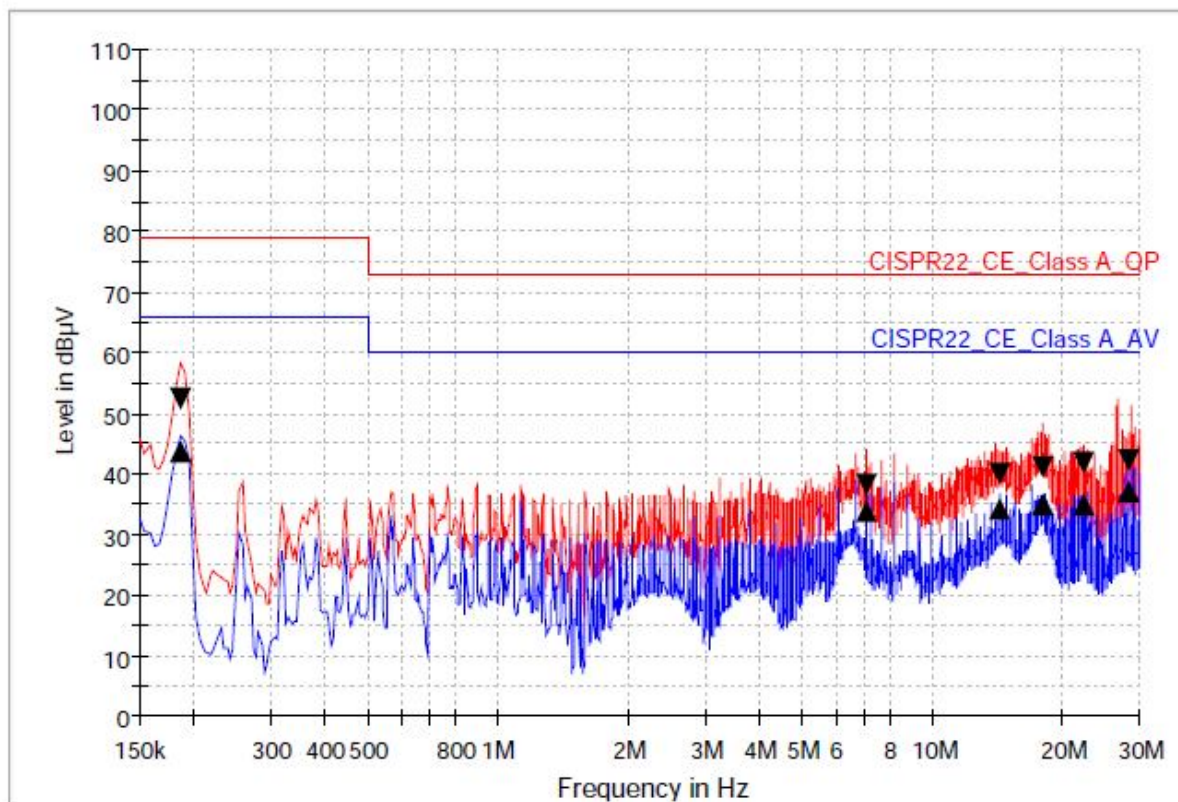


Limit and Margin1

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	52.3	45.4	9.000	N	9.7	26.7	79.0	20.6	66.0
6.502000	41.0	35.4	9.000	N	9.9	32.0	73.0	24.6	60.0
15.126000	39.3	33.8	9.000	N	10.1	33.7	73.0	26.2	60.0
18.378000	41.8	35.7	9.000	N	10.2	31.2	73.0	24.3	60.0
21.994000	41.9	36.6	9.000	N	10.2	31.1	73.0	23.4	60.0
28.270000	42.9	37.9	9.000	N	10.3	30.1	73.0	22.1	60.0

Mode #7

HOT LINE

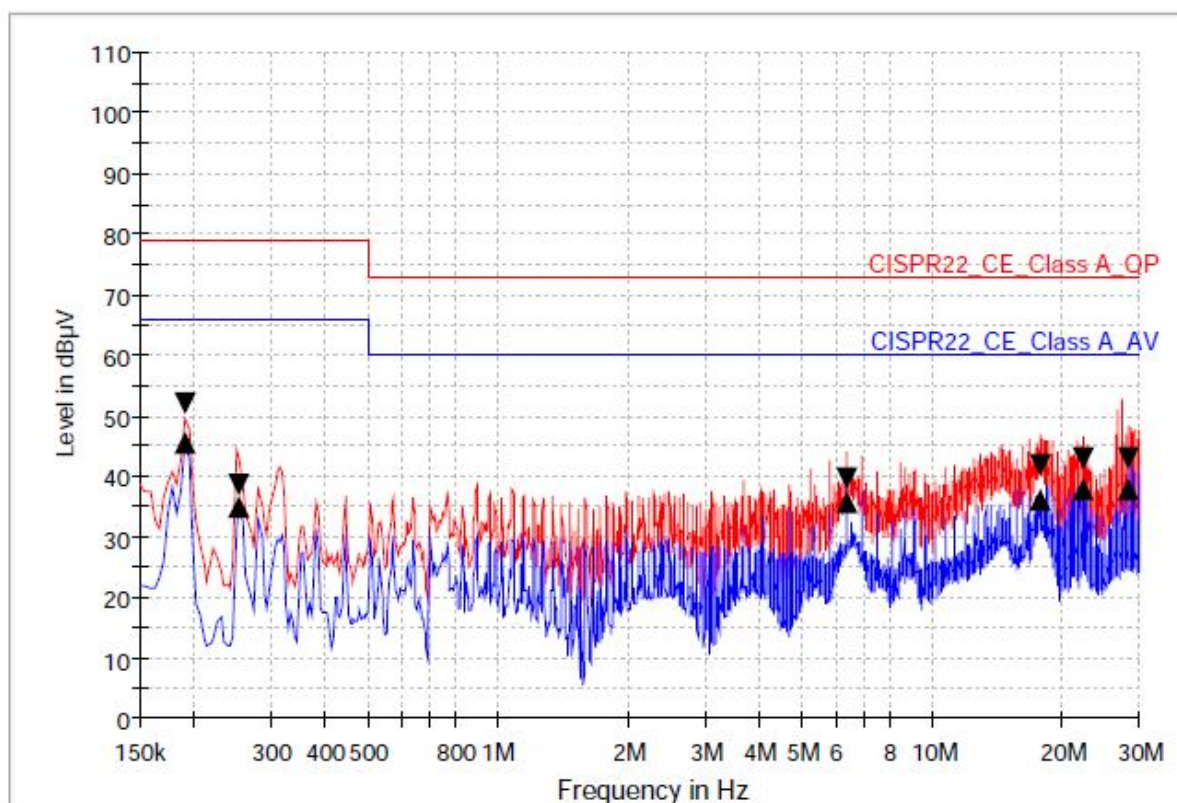


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)	Margin - CAV (dB)	Limit - CAV (dBμV)
0.186000	52.6	43.6	9.000	L1	9.7	26.4	79.0	22.4	66.0
7.070000	38.2	33.8	9.000	L1	9.9	34.8	73.0	26.2	60.0
14.278000	40.1	34.2	9.000	L1	10.1	32.9	73.0	25.8	60.0
17.982000	41.3	35.1	9.000	L1	10.2	31.7	73.0	24.9	60.0
22.318000	41.9	34.9	9.000	L1	10.2	31.1	73.0	25.1	60.0
28.270000	42.3	37.0	9.000	L1	10.3	30.7	73.0	23.0	60.0

Mode #7

NEUTRAL LINE

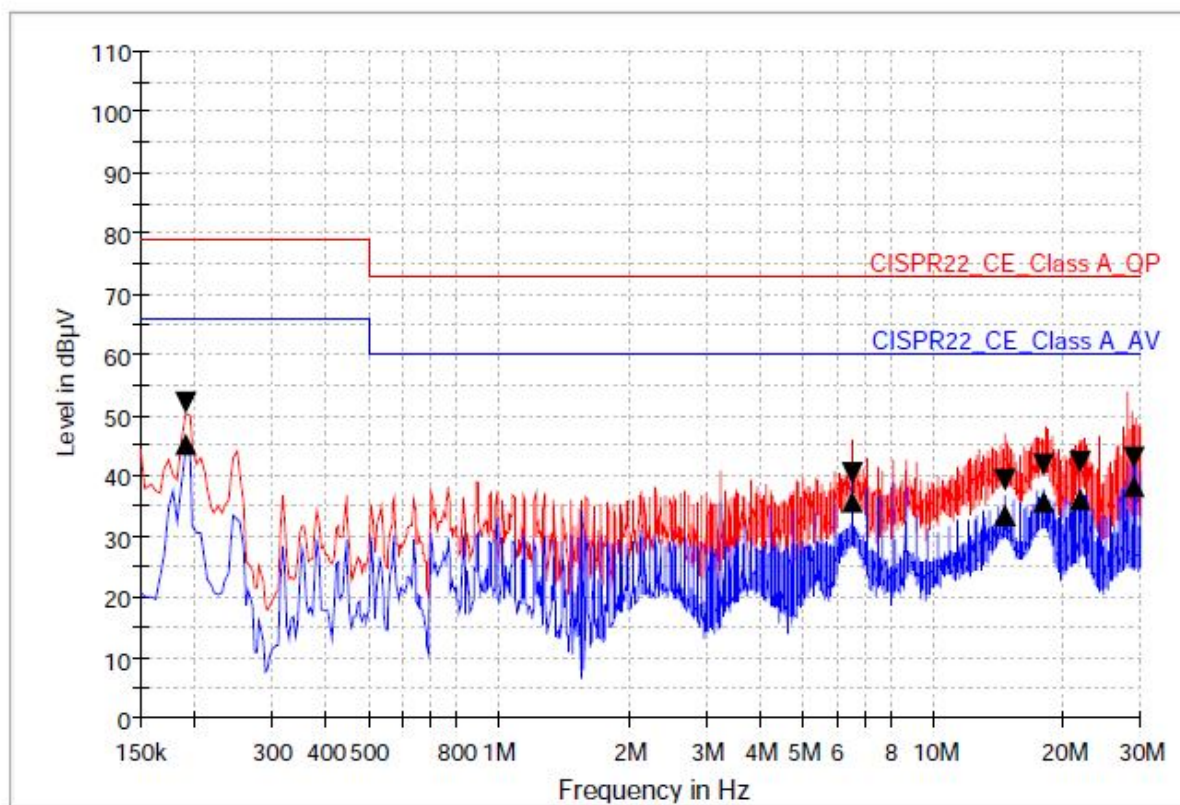


Limit and Margin1

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	52.3	45.5	9.000	N	9.7	26.7	79.0	20.5	66.0
0.254000	38.6	34.9	9.000	N	9.7	40.4	79.0	31.1	66.0
6.362000	39.7	35.9	9.000	N	9.9	33.3	73.0	24.1	60.0
17.810000	41.9	36.1	9.000	N	10.2	31.1	73.0	23.9	60.0
22.190000	43.1	37.8	9.000	N	10.2	29.9	73.0	22.2	60.0
28.270000	42.9	37.8	9.000	N	10.3	30.1	73.0	22.2	60.0

Mode #8

HOT LINE

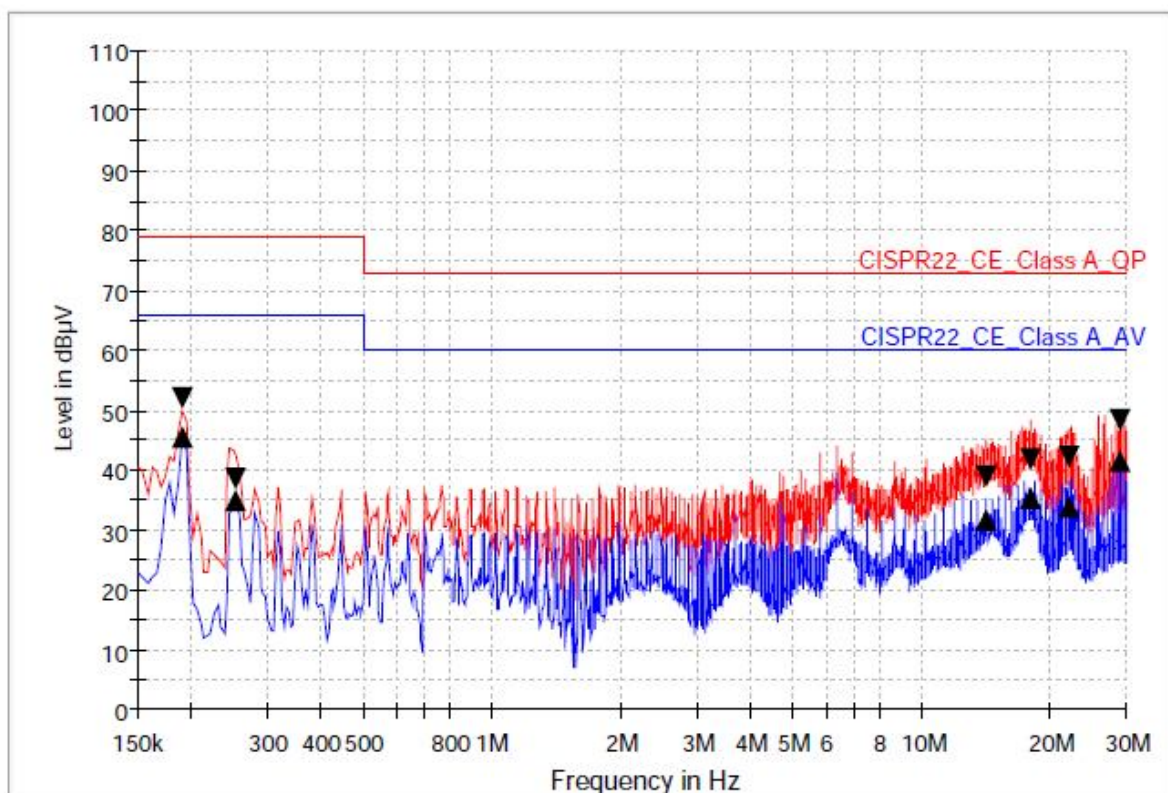


Limit and Margin1

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	52.2	45.2	9.000	L1	9.7	26.8	79.0	20.8	66.0
6.502000	40.6	35.6	9.000	L1	9.9	32.4	73.0	24.4	60.0
14.702000	39.3	33.6	9.000	L1	10.1	33.7	73.0	26.4	60.0
17.950000	41.8	35.9	9.000	L1	10.2	31.2	73.0	24.1	60.0
21.862000	42.4	35.9	9.000	L1	10.2	30.6	73.0	24.1	60.0
28.834000	43.0	38.2	9.000	L1	10.3	30.0	73.0	21.8	60.0

Mode #8

NEUTRAL LINE

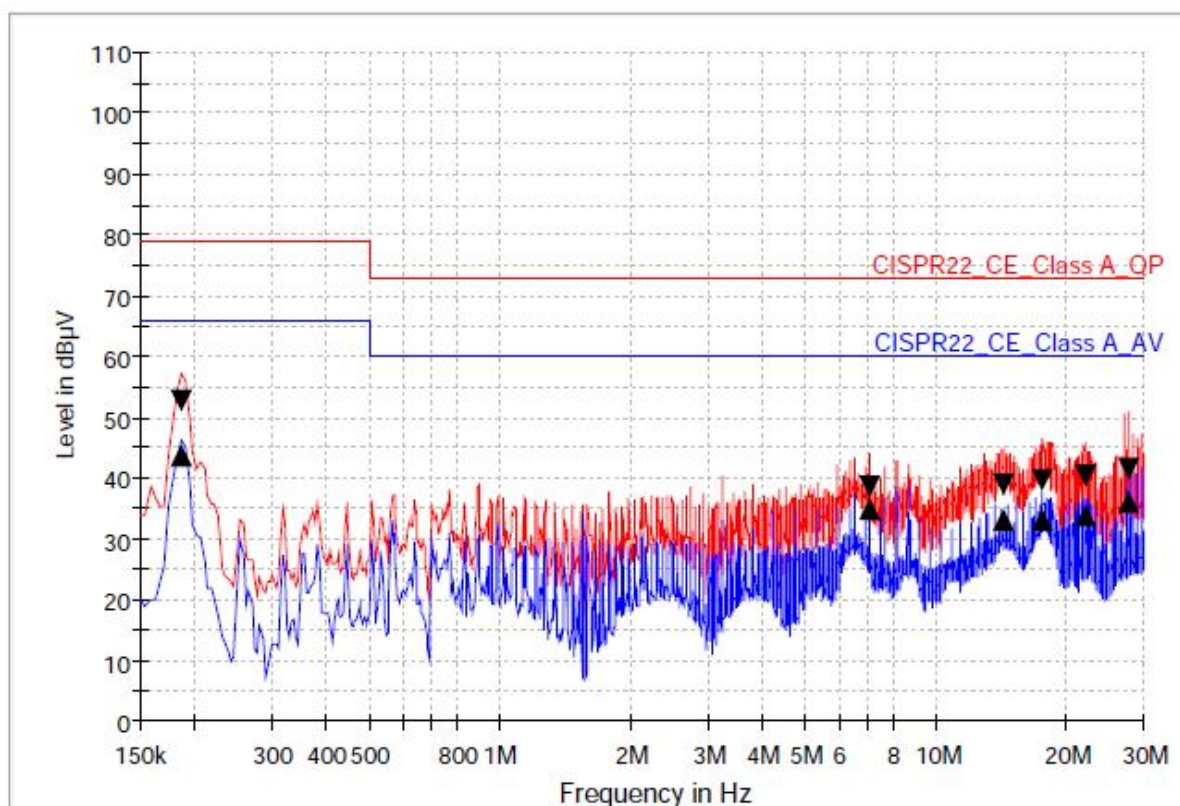


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)	Margin - CAV (dB)	Limit - CAV (dBμV)
0.190000	52.1	45.5	9.000	N	9.7	26.9	79.0	20.5	66.0
0.254000	38.7	34.9	9.000	N	9.7	40.3	79.0	31.1	66.0
14.150000	39.0	31.6	9.000	N	10.1	34.0	73.0	28.4	60.0
17.974000	41.9	35.3	9.000	N	10.2	31.1	73.0	24.7	60.0
21.934000	42.4	33.8	9.000	N	10.2	30.6	73.0	26.2	60.0
28.878000	48.6	41.5	9.000	N	10.3	24.4	73.0	18.5	60.0

Mode #9

HOT LINE

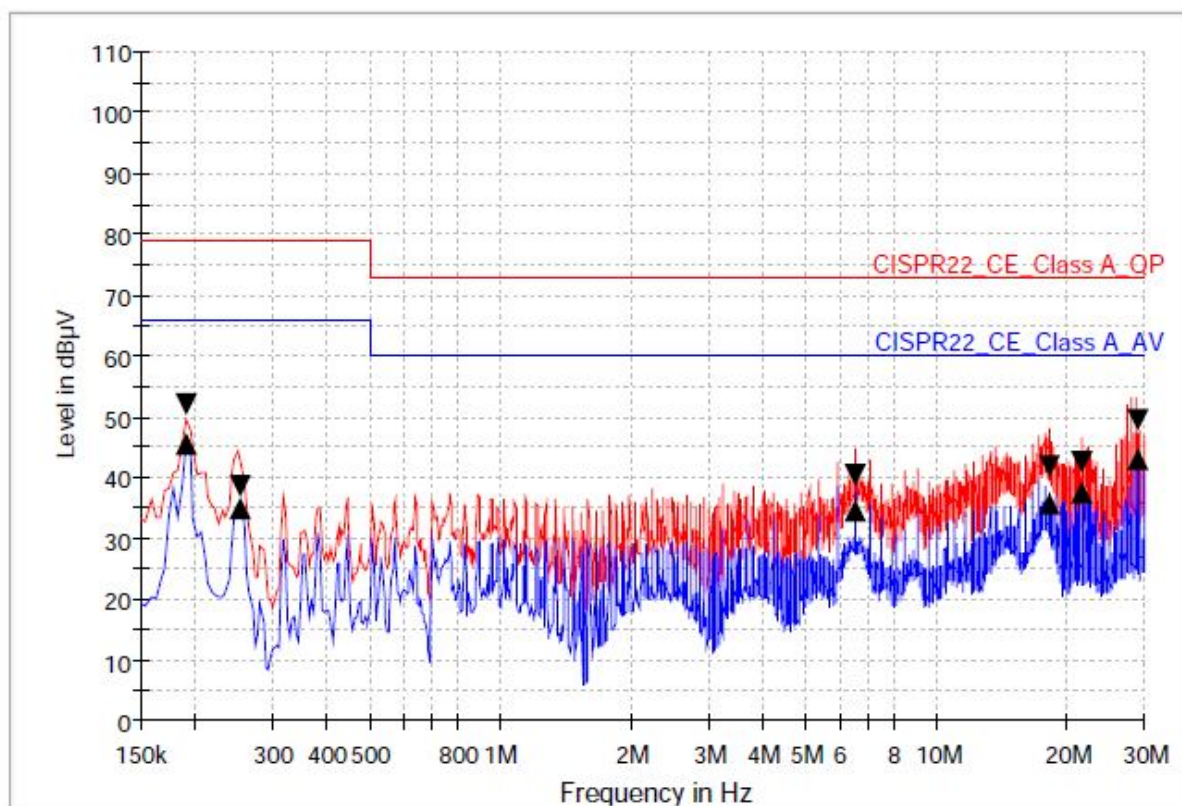


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)	Margin - CAV (dB)	Limit - CAV (dBμV)
0.186000	52.7	43.6	9.000	L1	9.7	26.3	79.0	22.4	66.0
7.066000	38.7	35.0	9.000	L1	9.9	34.3	73.0	25.0	60.0
14.278000	39.0	33.3	9.000	L1	10.1	34.0	73.0	26.7	60.0
17.658000	39.6	33.1	9.000	L1	10.2	33.4	73.0	26.9	60.0
22.122000	40.6	33.7	9.000	L1	10.2	32.4	73.0	26.3	60.0
27.846000	41.4	36.0	9.000	L1	10.3	31.6	73.0	24.0	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	52.2	45.4	9.000	N	9.7	26.8	79.0	20.6	66.0
0.254000	38.7	34.9	9.000	N	9.7	40.3	79.0	31.1	66.0
6.502000	40.5	34.6	9.000	N	9.9	32.5	73.0	25.4	60.0
18.234000	41.9	35.6	9.000	N	10.2	31.1	73.0	24.4	60.0
21.486000	42.7	37.6	9.000	N	10.2	30.3	73.0	22.4	60.0
28.834000	49.6	42.9	9.000	N	10.3	23.4	73.0	17.1	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	4.40 dB
Above 1 000 MHz	4.09 dB

The measurement uncertainties are given with 95 % confidence.

3.2.4 Test result

Date of Test	2020-03-26			
Temperature	(20.4 ± 0.1) °C		Relative humidity	(38.6 ± 0.1) % 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	2020-03-27			
Temperature	(20.35 ± 0.15) °C		Relative humidity	(38.55 ± 0.25) % 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	Chu, Woo-Sik 	

3.2.5 Sample Calculated Example

At 80 MHz

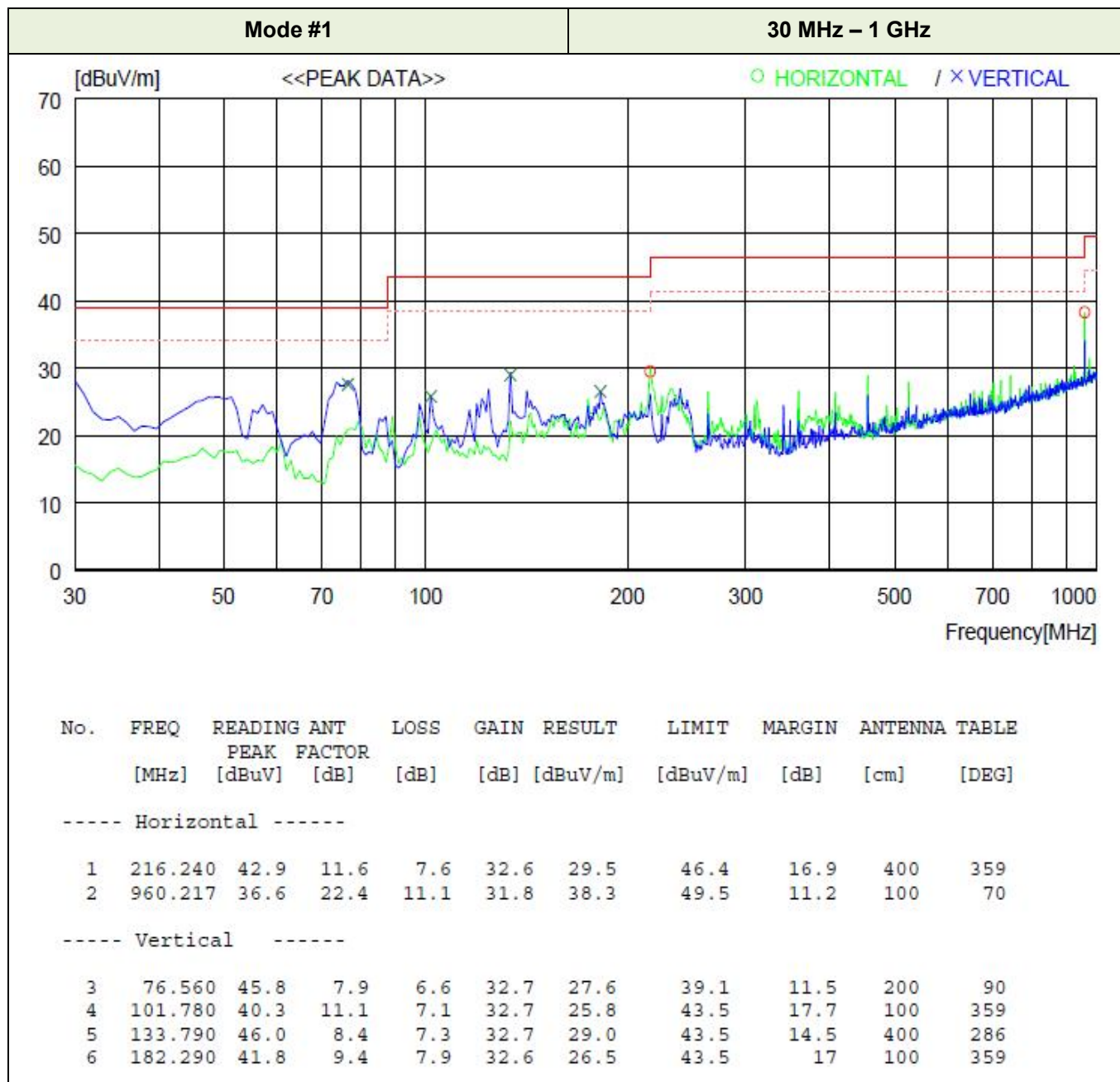
Limit = 40.0 dBμV/m

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

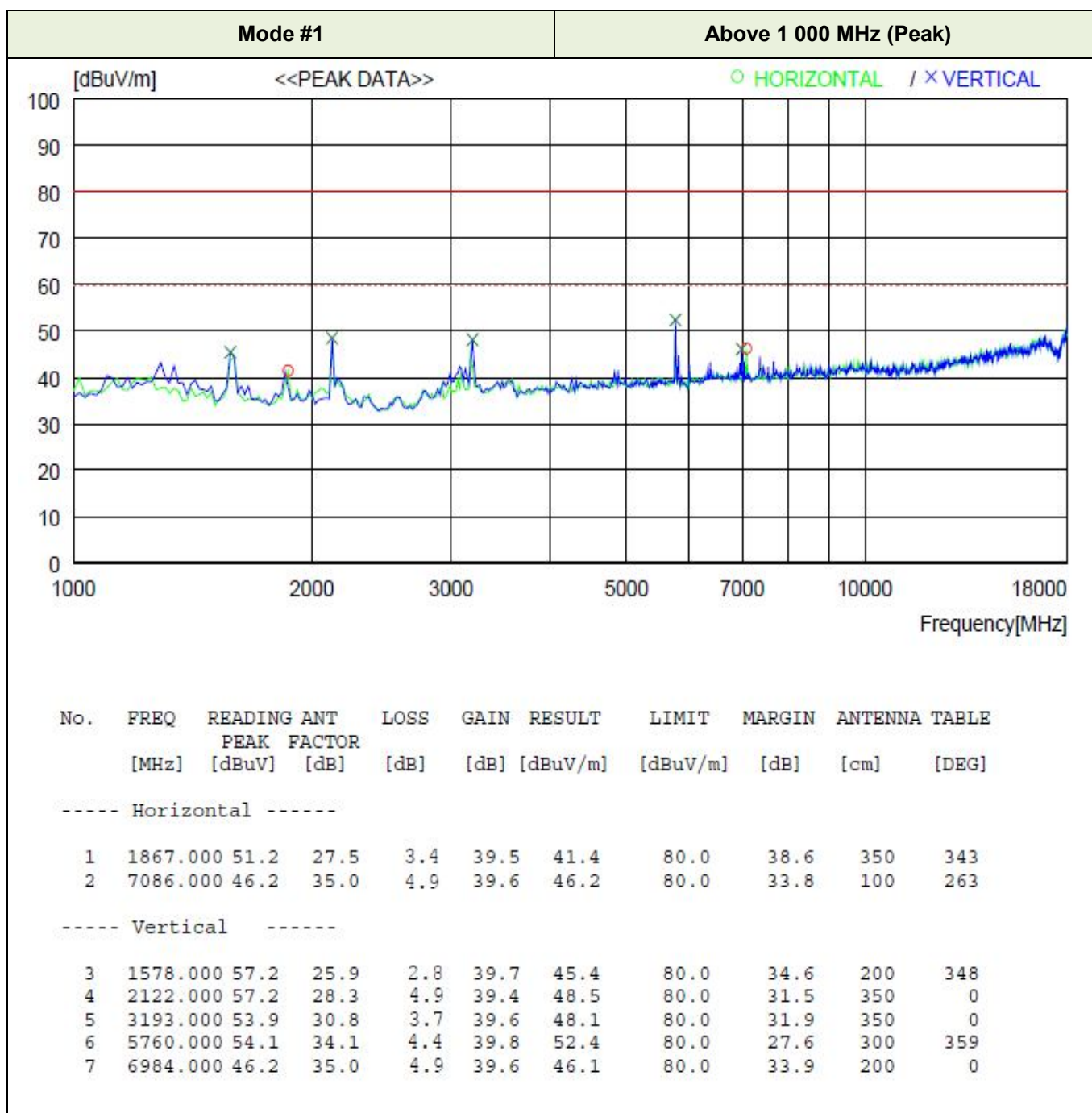
Margin = Limit - Result = 40 - 30 = 10

so the EUT has 10.0 dB margin at 80 MHz

3.2.6 Test Data



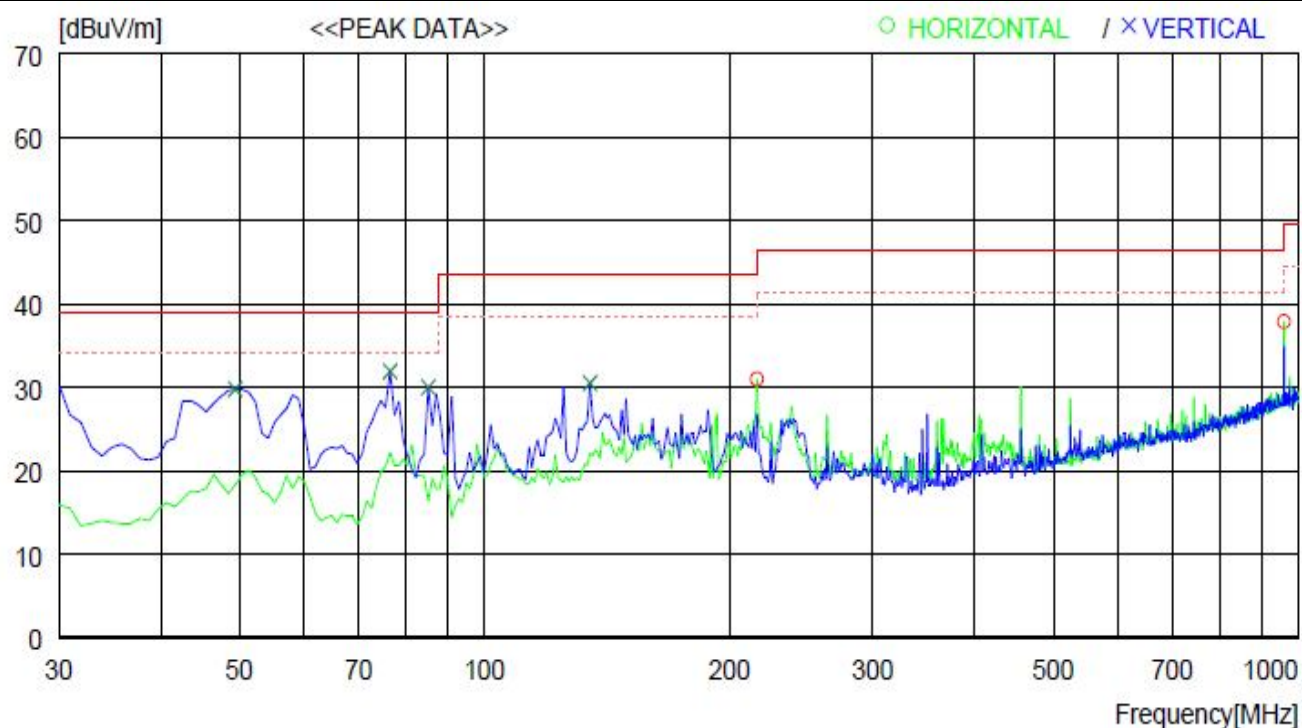
NOTE: Quasi-Peak was not measured, because Peak values met Quasi-Peak limit.



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

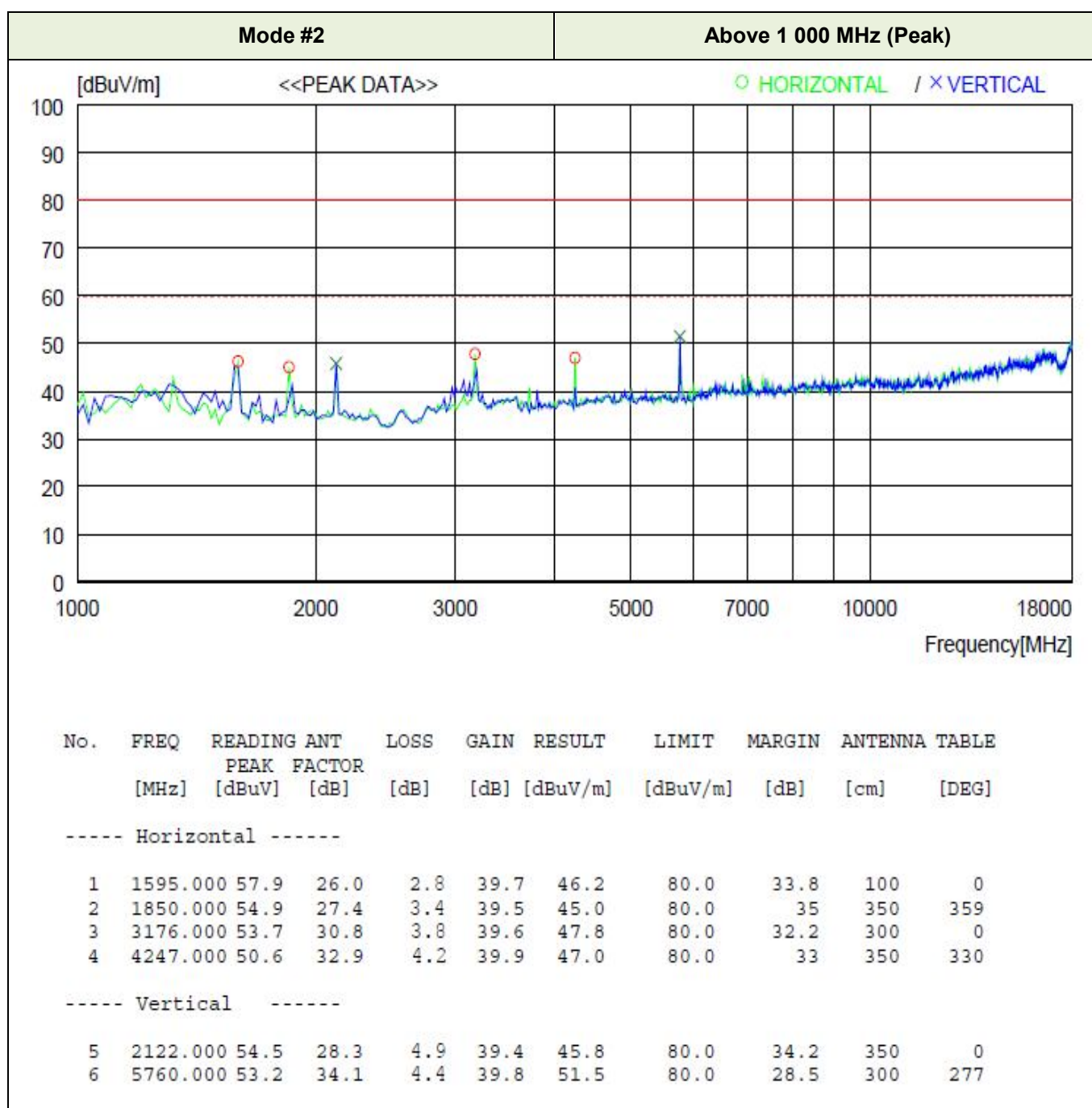
Mode #2

30 MHz – 1 GHz

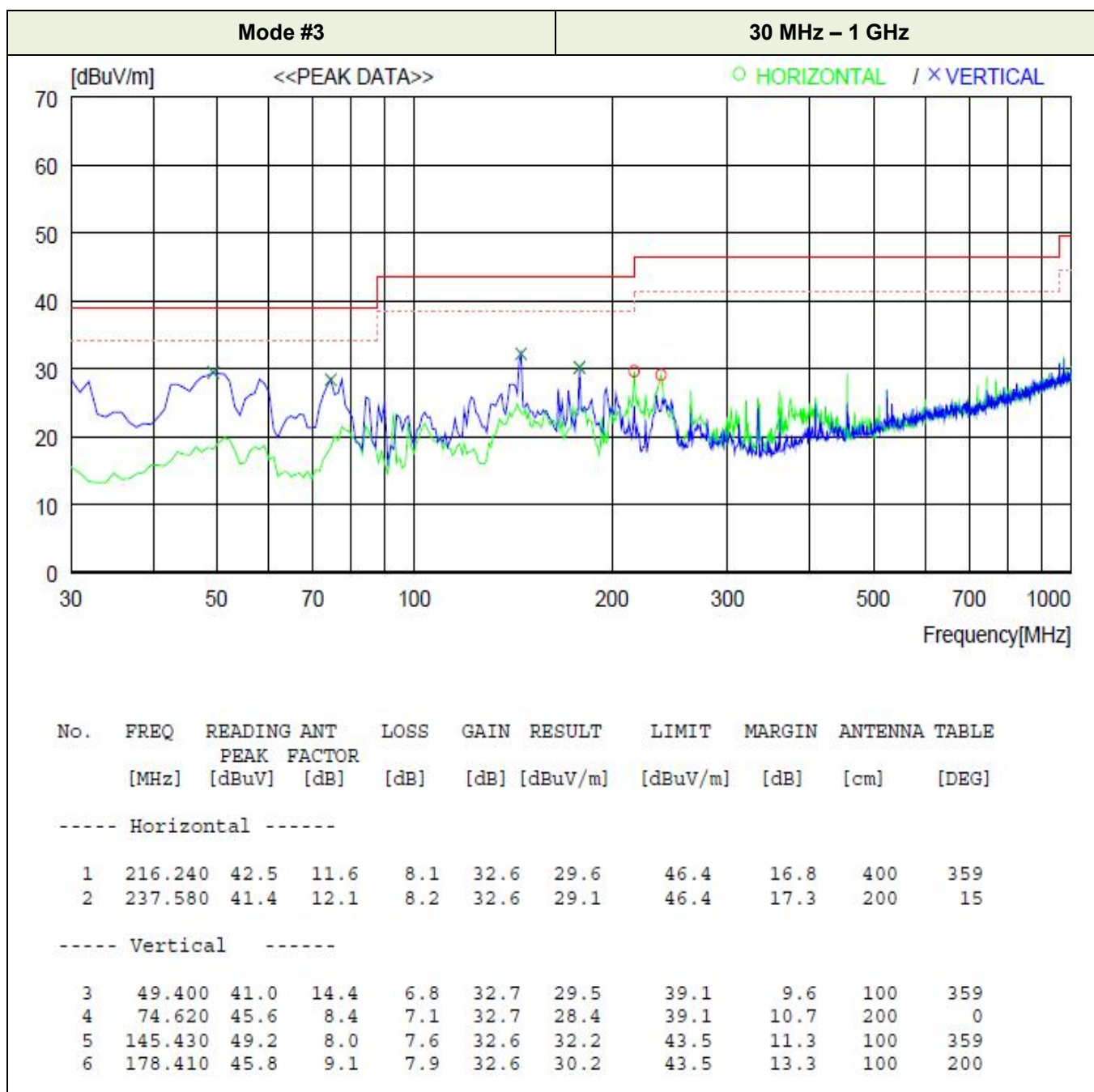


No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	216.240	43.9	11.6	8.1	32.6	31.0	46.4	15.4	400	175
2	960.217	36.2	22.4	11.1	31.8	37.9	49.5	11.6	100	0
----- Vertical -----										
3	49.400	41.3	14.4	6.8	32.7	29.8	39.1	9.3	100	359
4	76.560	49.6	7.9	7.1	32.7	31.9	39.1	7.2	200	0
5	85.290	47.0	8.5	7.2	32.7	30.0	39.1	9.1	300	322
6	134.760	47.2	8.3	7.6	32.6	30.5	43.5	13	100	333

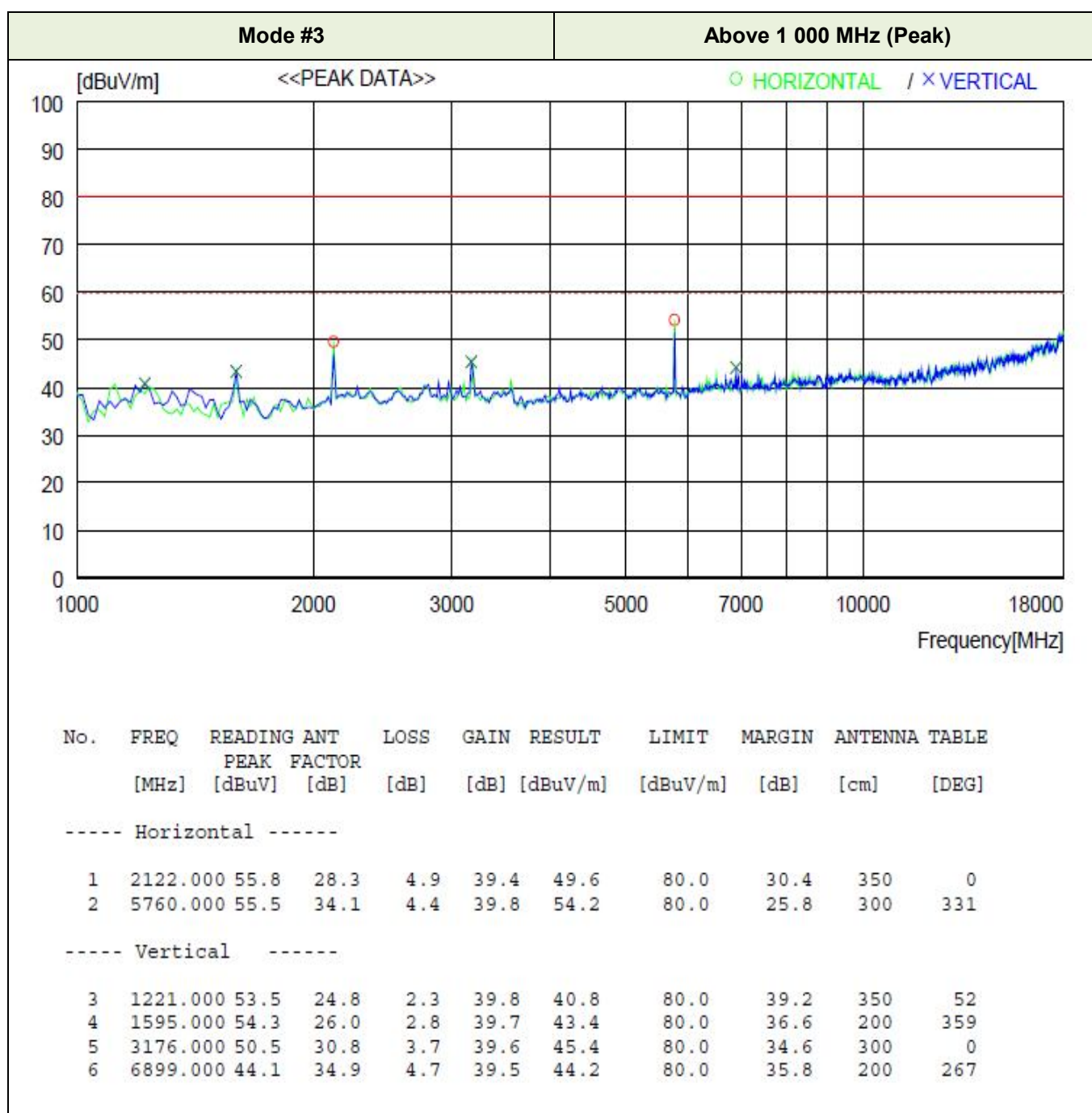
NOTE: Quasi-Peak was not measured, because Peak values met Quasi-Peak limit.



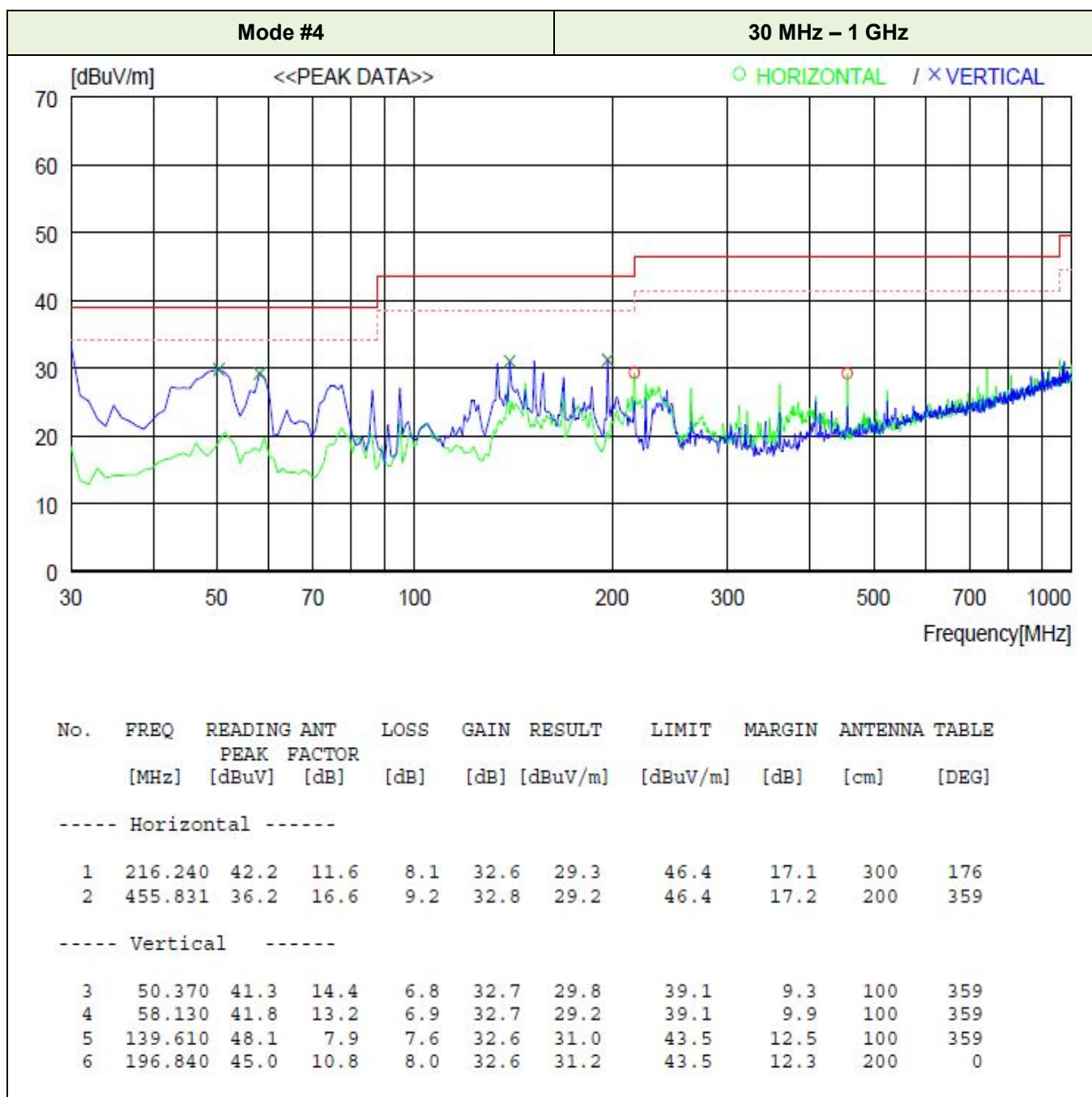
NOTE: Average mode was not measured, because Peak values were under the Average limit.



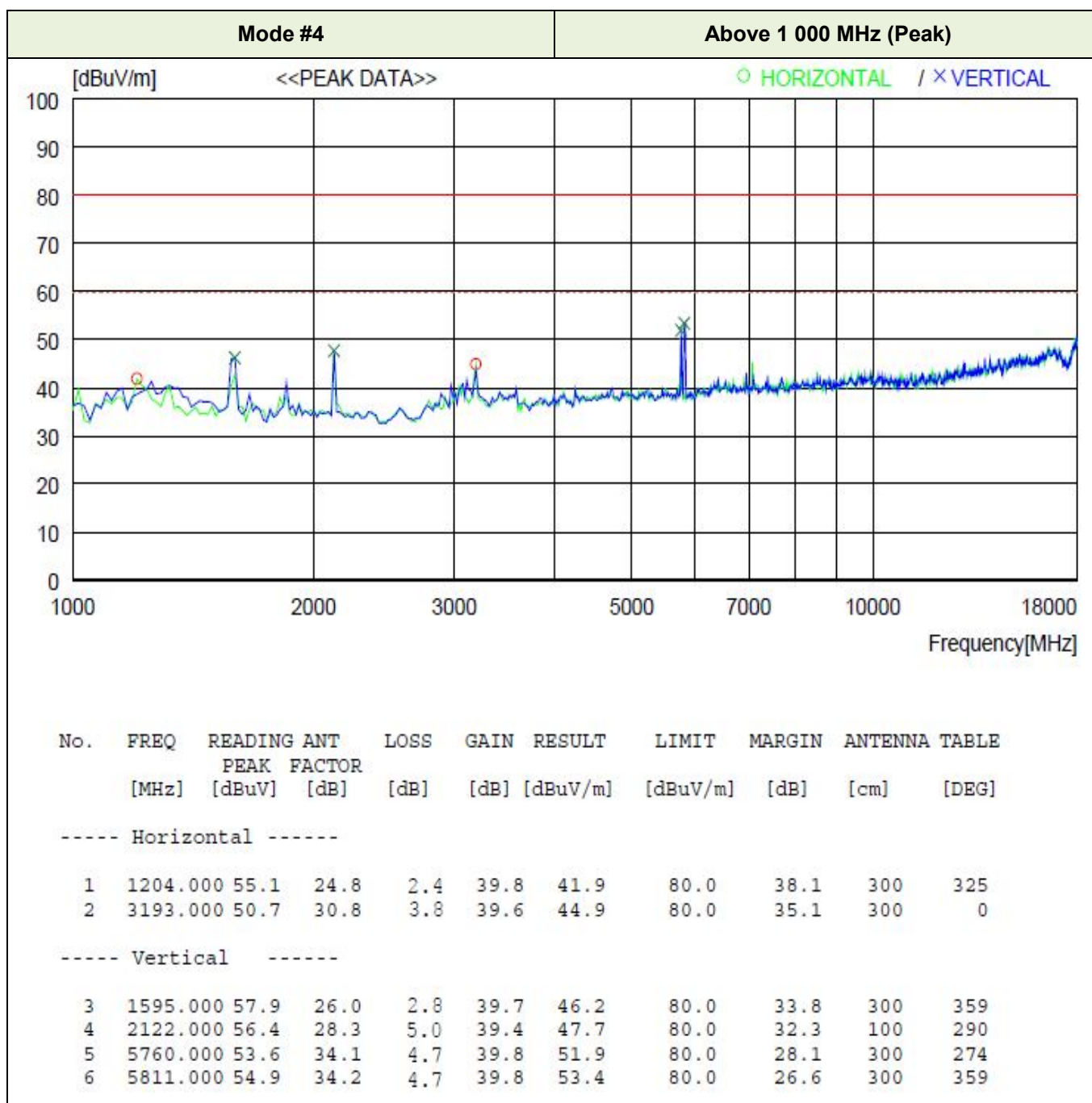
NOTE: Quasi-Peak was not measured, because Peak values met Quasi-Peak limit.



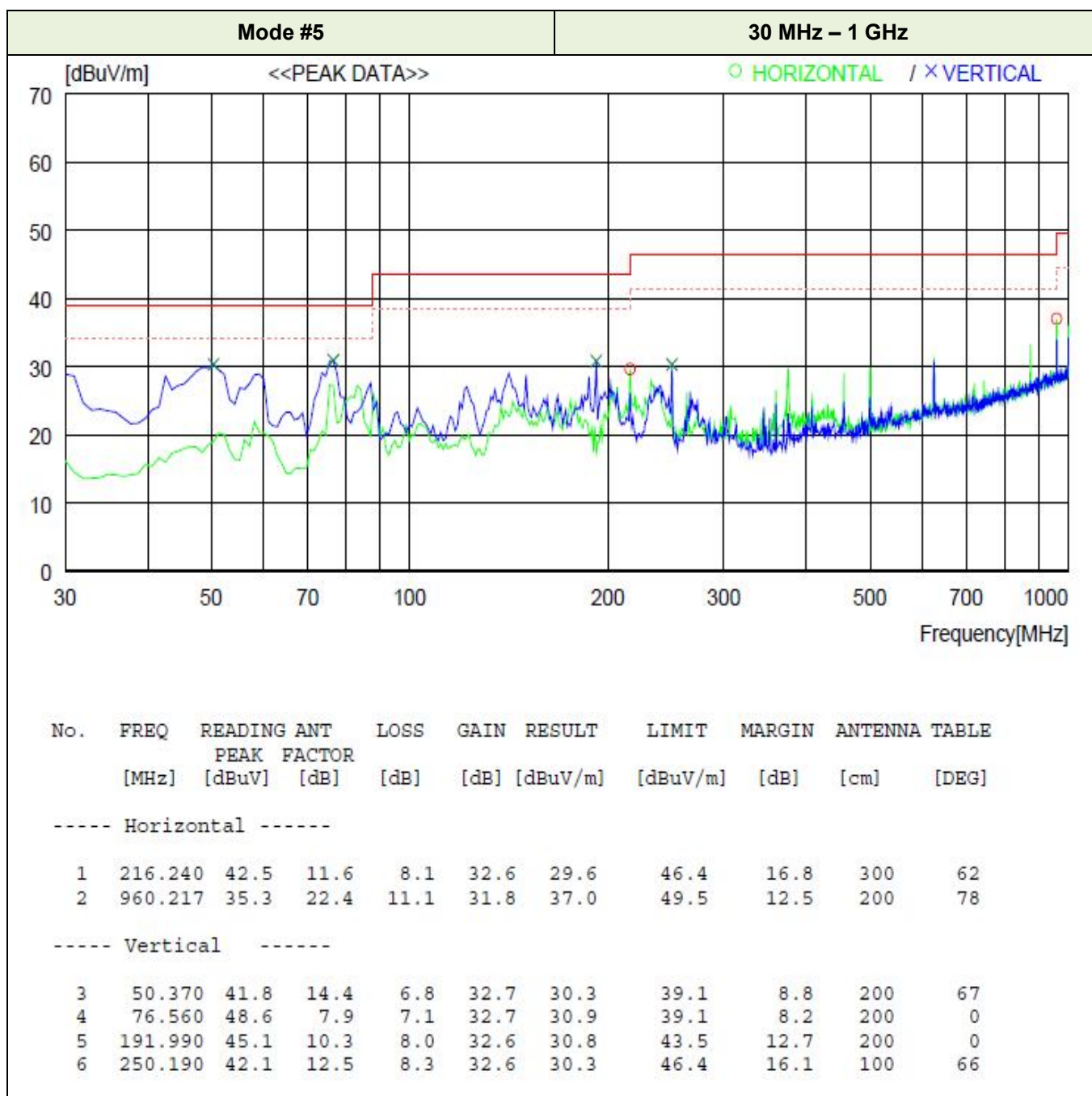
NOTE: Average mode was not measured, because Peak values were under the Average limit.



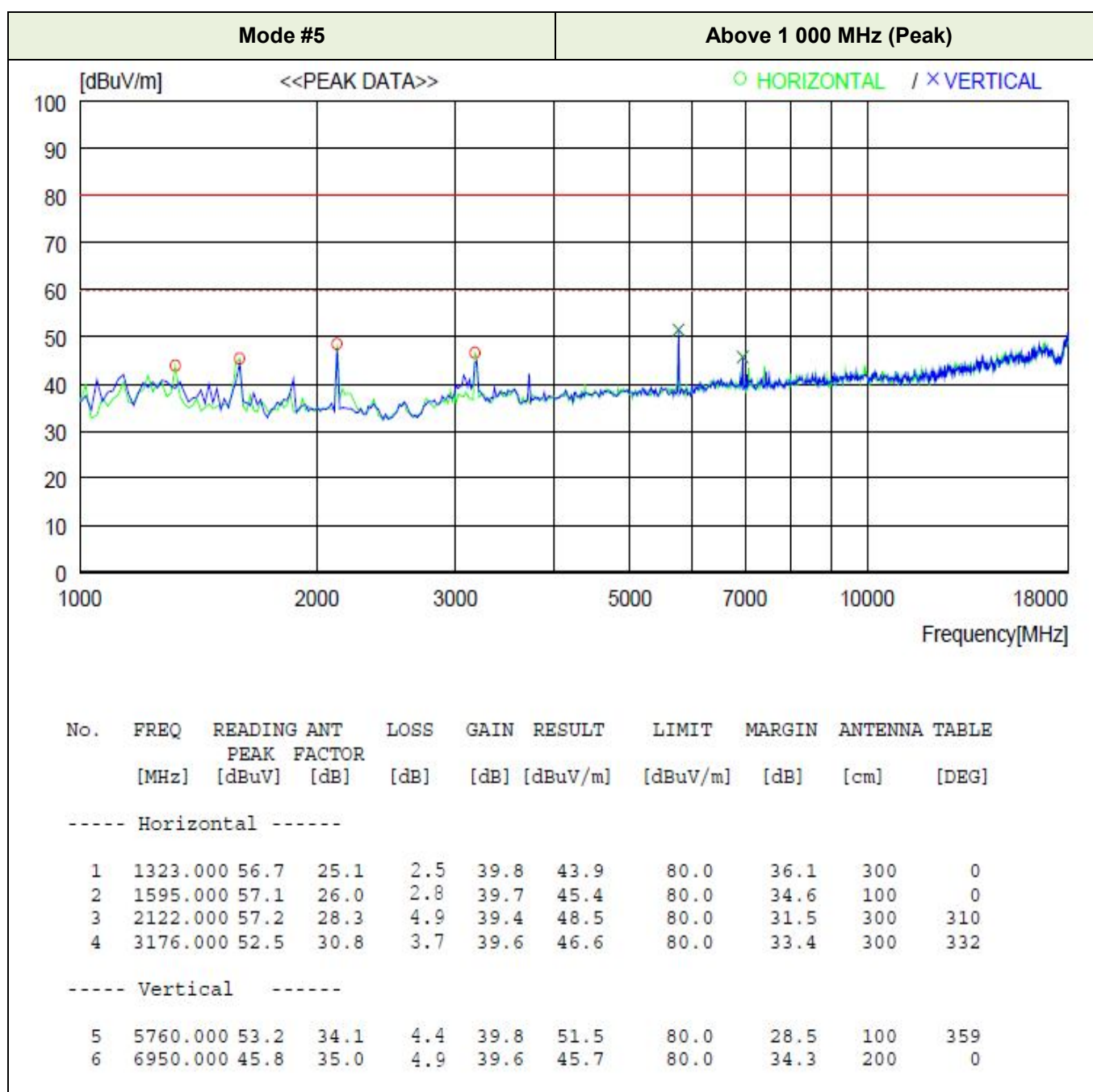
NOTE: Quasi-Peak was not measured, because Peak values met Quasi-Peak limit.



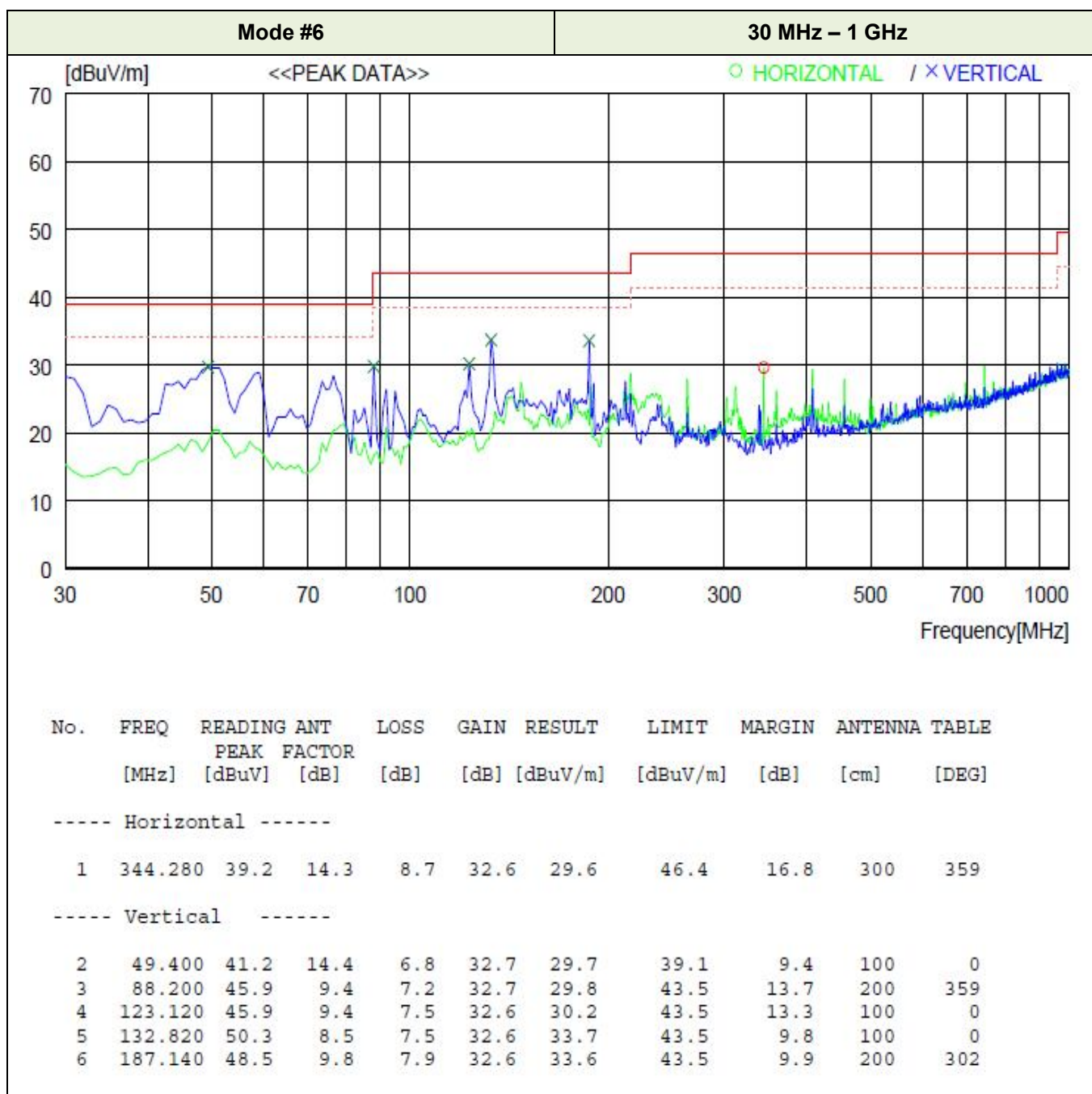
NOTE: Average mode was not measured, because Peak values were under the Average limit.



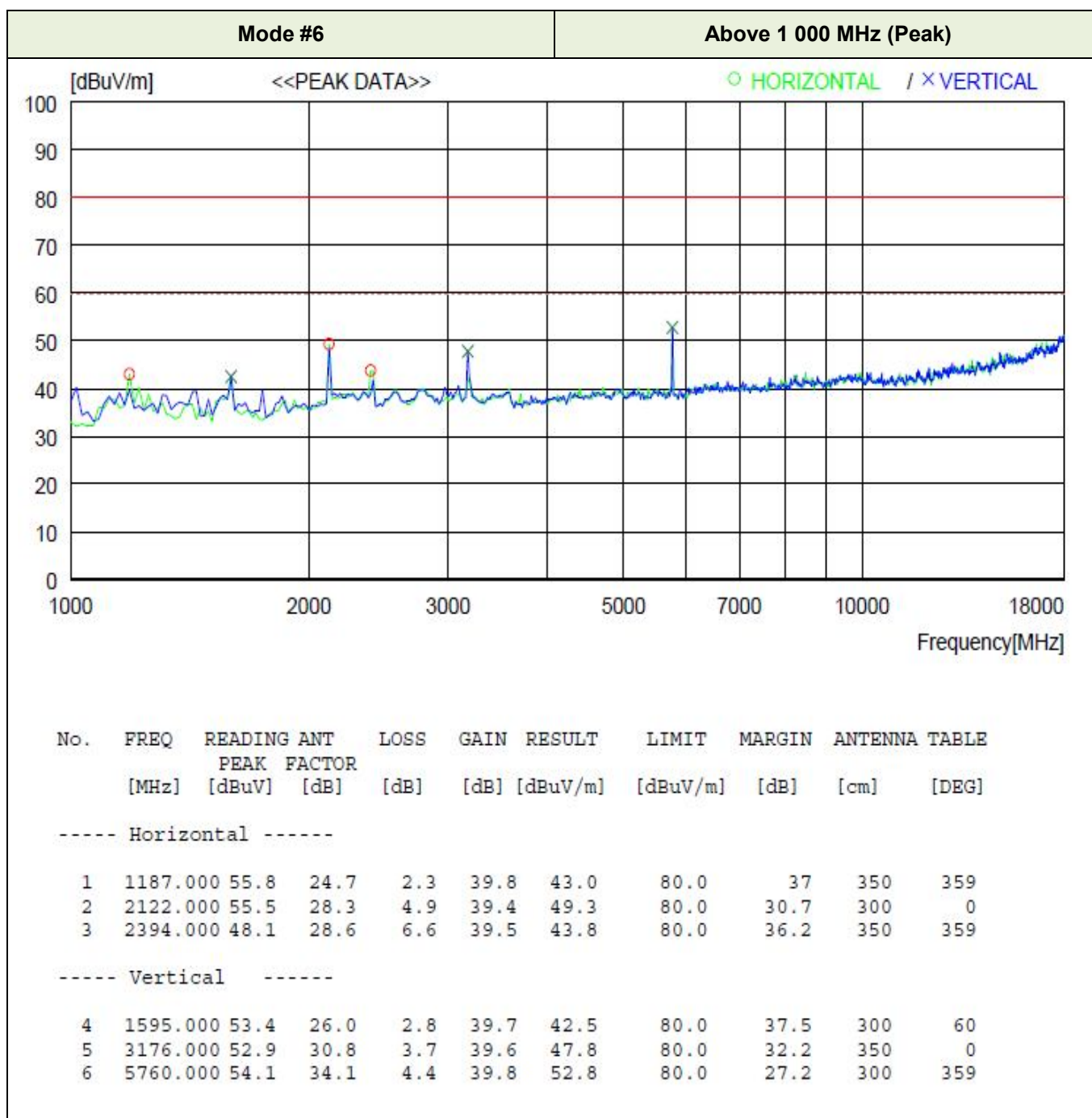
NOTE: Quasi-Peak was not measured, because Peak values met Quasi-Peak limit.



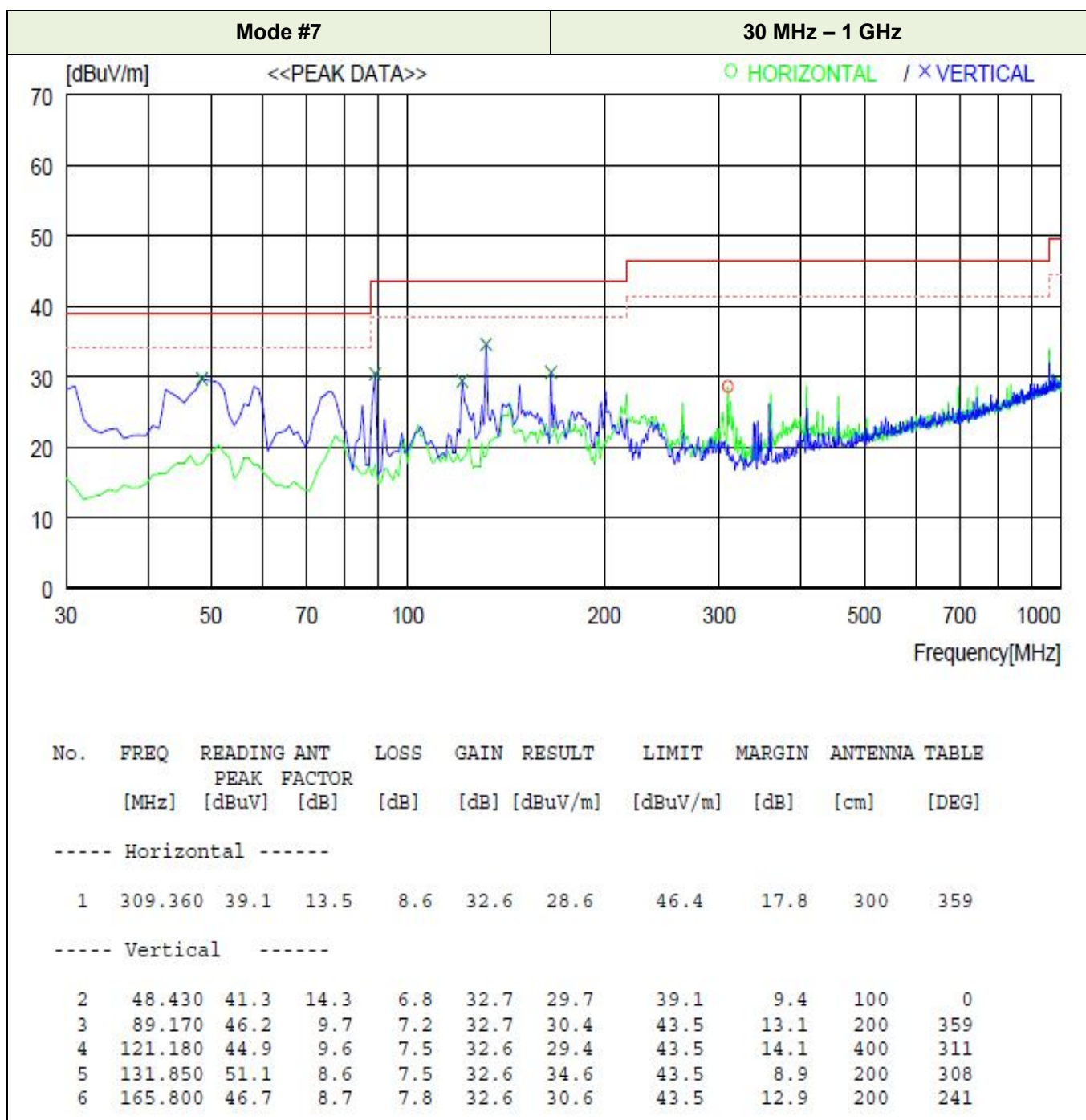
NOTE: Average mode was not measured, because Peak values were under the Average limit.



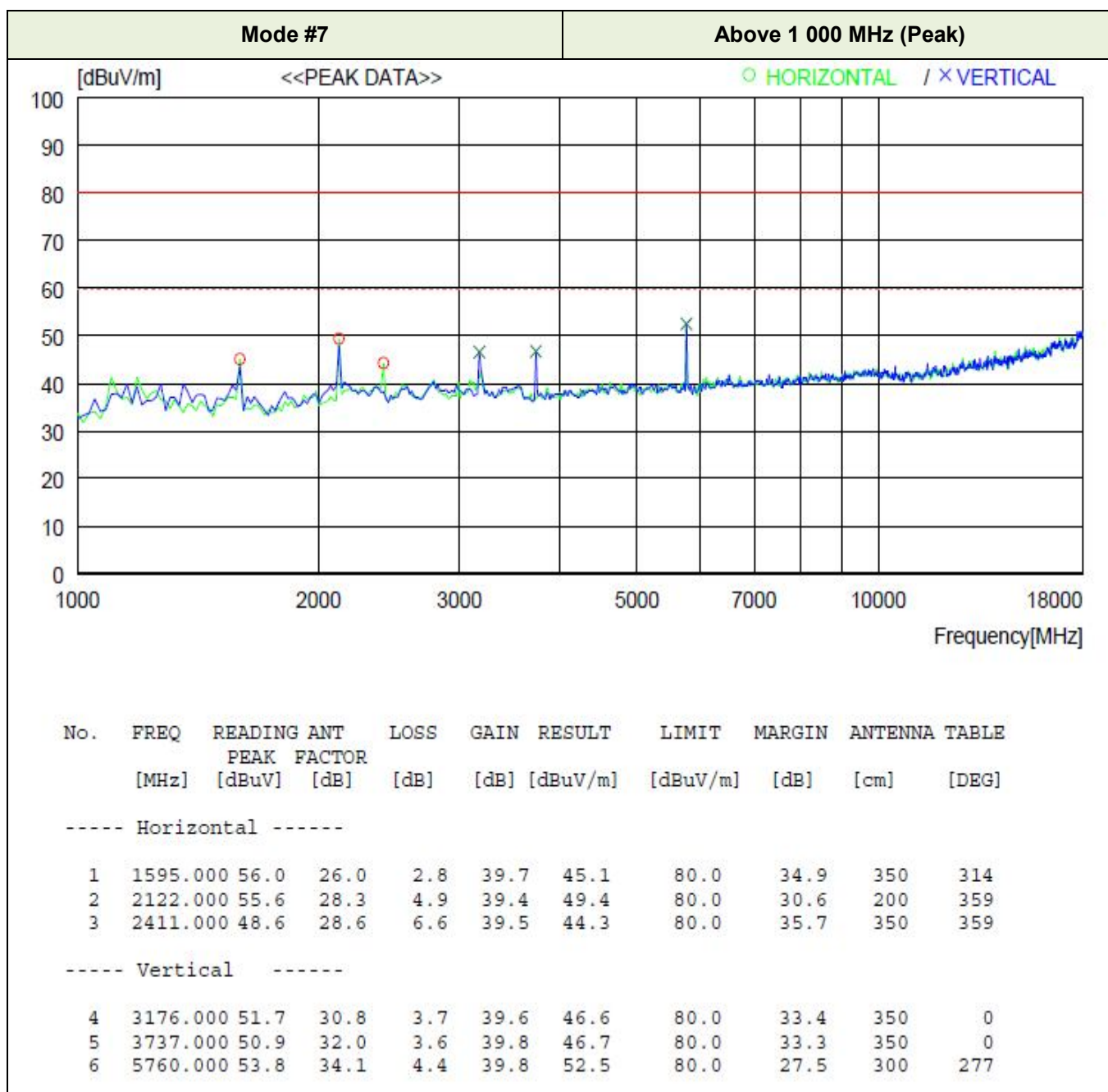
NOTE: Quasi-Peak was not measured, because Peak values met Quasi-Peak limit.



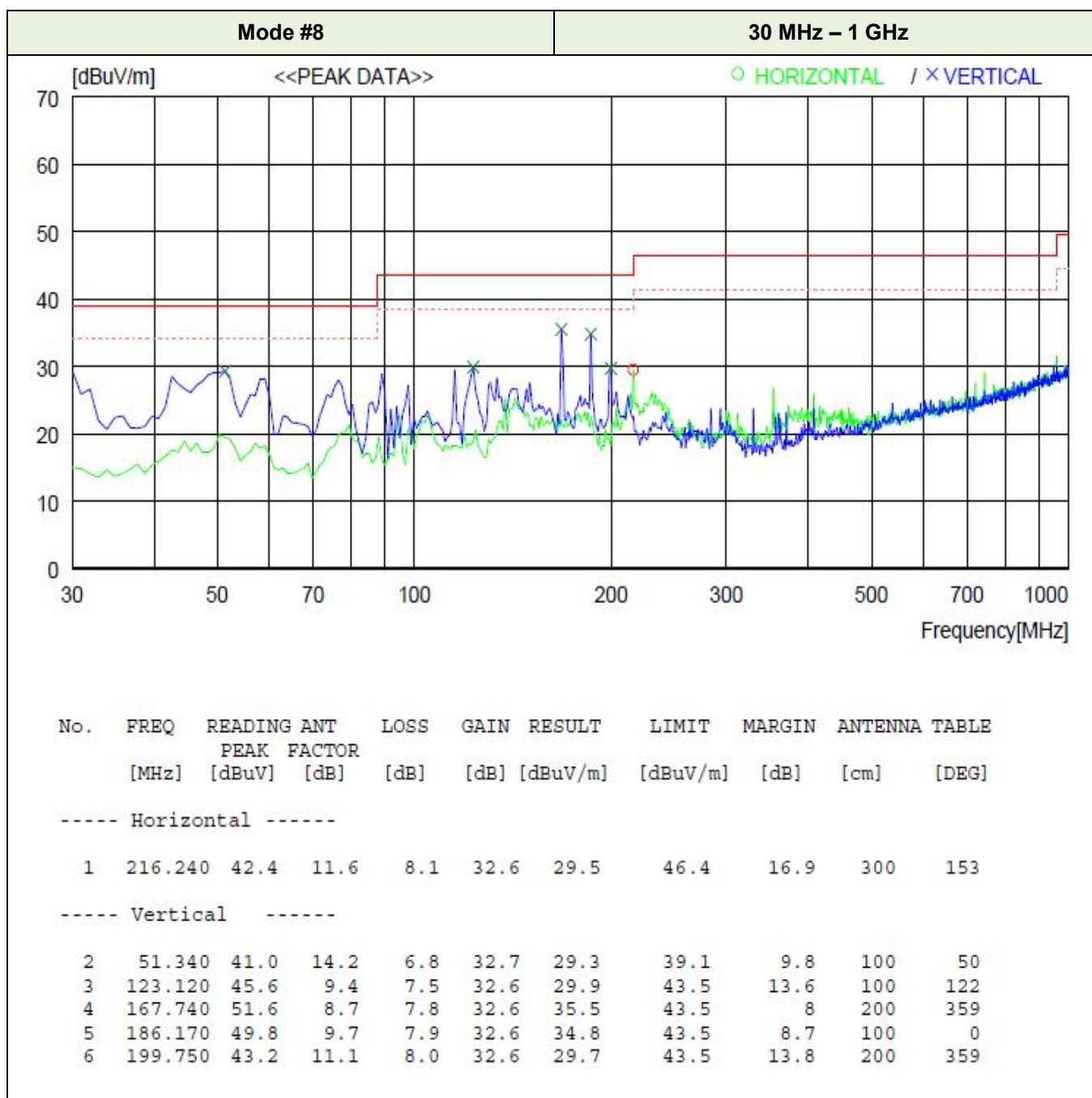
NOTE: Average mode was not measured, because Peak values were under the Average limit.



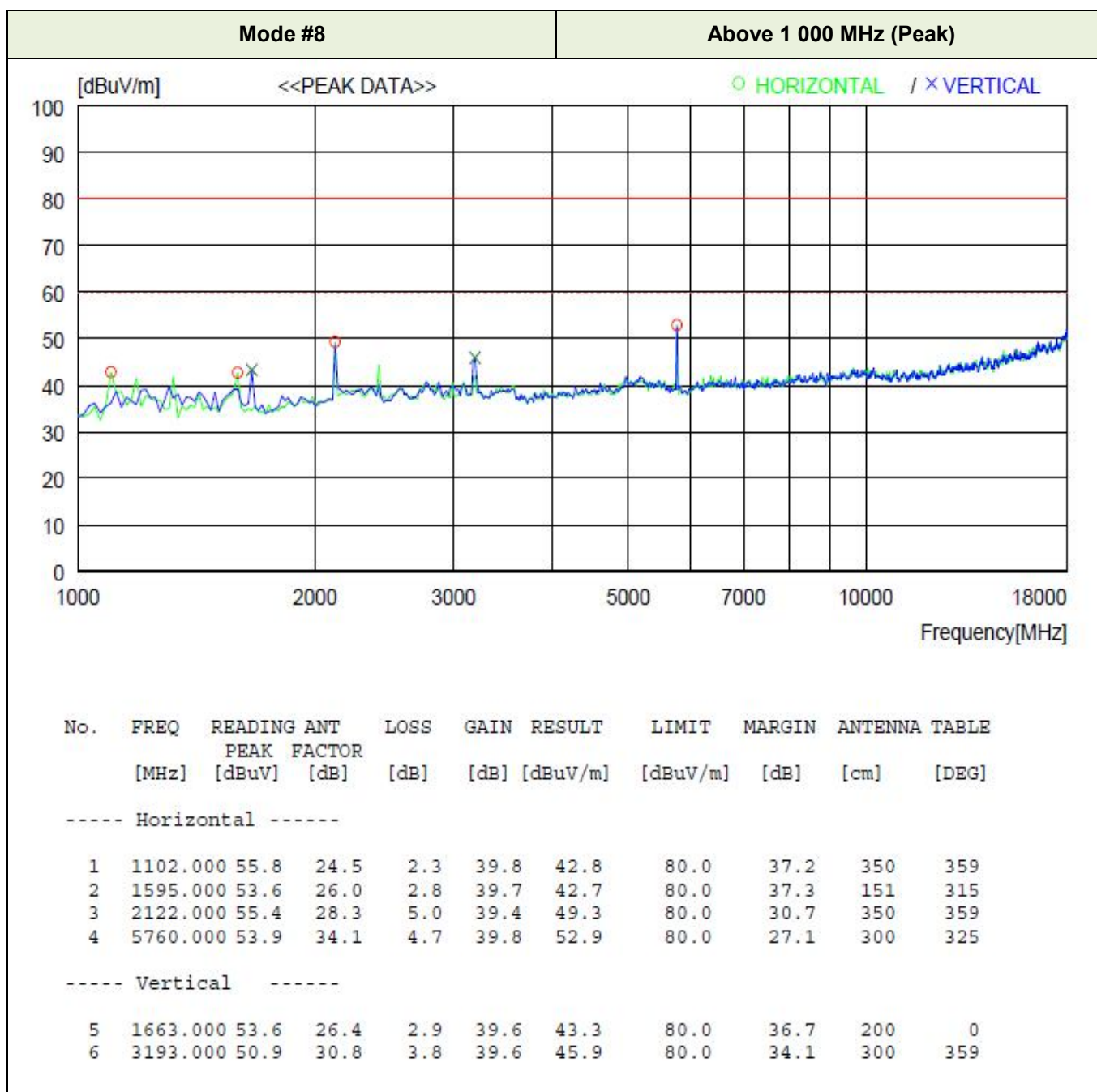
NOTE: Quasi-Peak was not measured, because Peak values met Quasi-Peak limit.



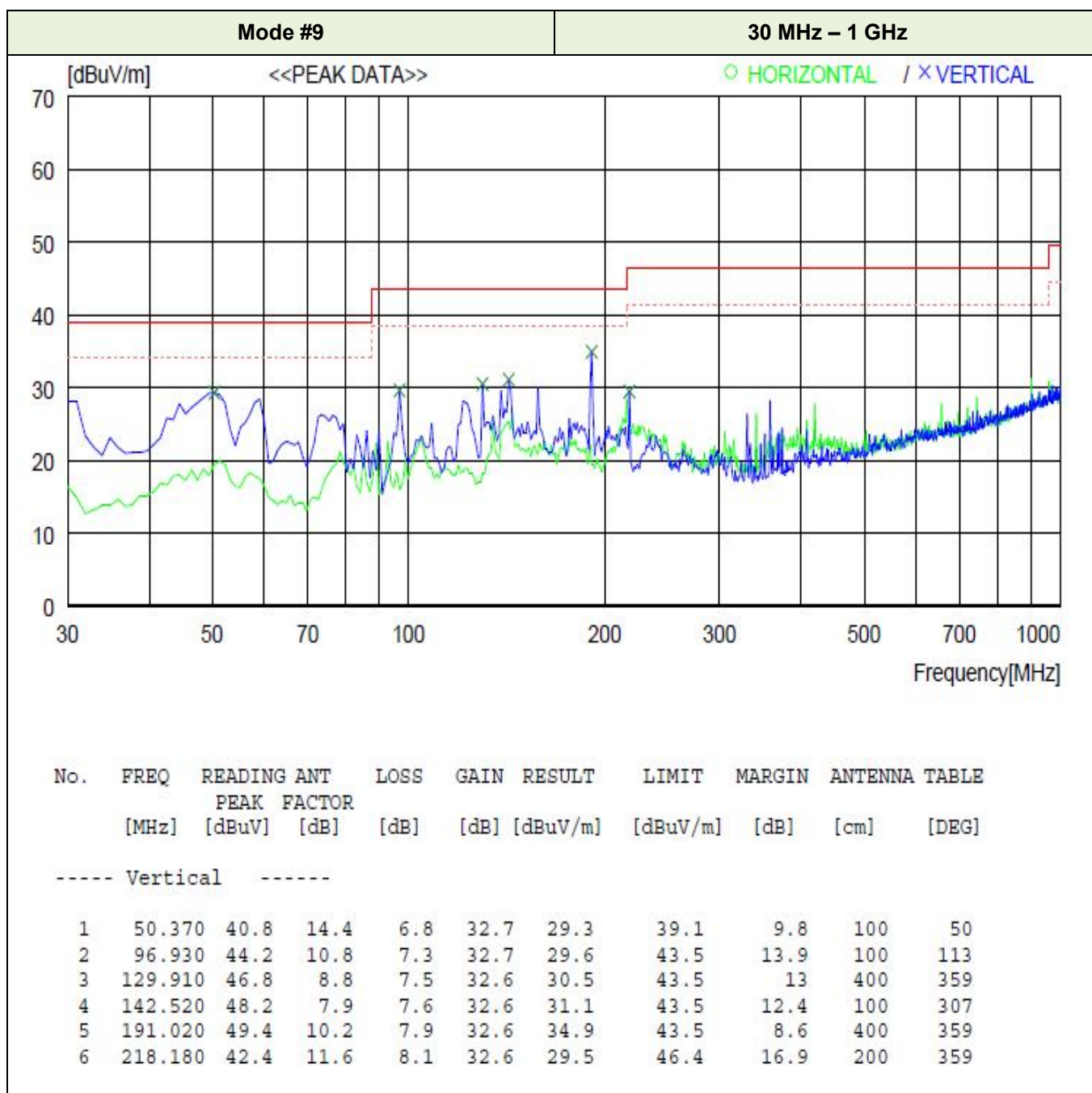
NOTE: Average mode was not measured, because Peak values were under the Average limit.



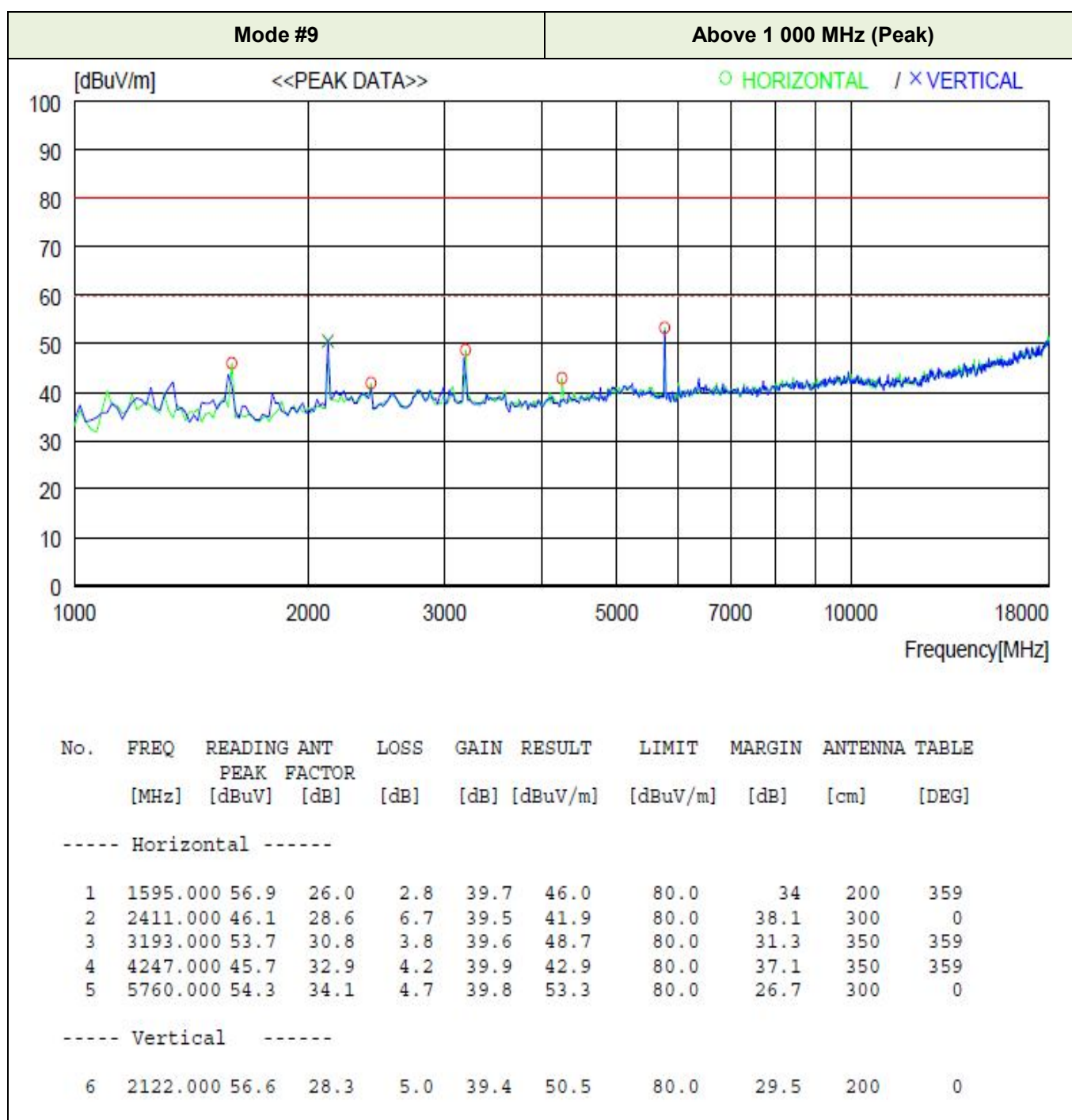
NOTE: Quasi-Peak was not measured, because Peak values met Quasi-Peak limit.



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



NOTE: 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.

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	2020-01-16 (1Y)	■
LISN	ENV4200	Rohde & Schwarz	100203	2020-01-16 (1Y)	□
LISN	ENV216	Rohde & Schwarz	100110	2020-01-22 (1Y)	■
LISN	LS16C	AFJ	16011403310	2019-08-08 (1Y)	■
LISN	NNLK8121	SchwarzBeck	8121-163	2019-07-26 (1Y)	□
Voltage Probe	TK9420	Schwarzbeck	9420-165	2020-01-16 (1Y)	□
Loop Antenna	HFH2-Z2	Rohde & Schwarz	100341	2019-06-21 (2Y)	□
8-Wire ISN CAT 3	CAT3 8158	Schwarzbeck	CAT3 8158 #70	2020-01-21 (1Y)	□
8-Wire ISN CAT 5	CAT5 8158	Schwarzbeck	CAT5 8158 #126	2020-01-21 (1Y)	□
8-Wire ISN CAT 6	NTFM 8158	Schwarzbeck	NTFM 8158 #95	2020-01-21 (1Y)	□
Test Receiver	ESU	Rohde & Schwarz	100303	2020-01-21 (1Y)	■
TRILog Broadband Antenna	VULB9163	Schwarzbeck	9163-799	2019-11-12 (2Y)	■
DOPPEL STEG HORN Antenna	HF 907	Rohde & Schwarz	102426	2019-01-11 (2Y)	■
Preamp (1-18) GHz	SCU 18D	Rohde & Schwarz	19006450	2019-04-19 (1Y)	■
Preamp 9 kHz-1 GHz	310N	Sonoma Instrument	344015	2020-01-16 (1Y)	■
Attenuators	6 dB	Rohde & Schwarz	272.4110.50	2020-01-16 (1Y)	■
Antenna Master	MA4000-EP	INNCO SYSTEM	4600814	N/A	■
Antenna Master	MA4000-XP-ET	INNCO SYSTEM	N/A	N/A	■
Turn Table	DT3000-3t	INNCO SYSTEM	1310814	N/A	■
CO3000 Controller	CO3000-4PORT	INNCO SYSTEM	CO3000/806/34130 814/L	N/A	■
CO3000 Controller	CO3000-4PORT	INNCO SYSTEM	CO3000/807/34130 814/L	N/A	■
Notch Filter	BRM50702	MICRO-TRONICS	G318	2019-11-11(1Y)	■
Digital Power Analyzer For Harmonic & Flicker	DPA 500	EM Test	V0713102356	2020-01-22 (1Y)	□
AC Power Source	ACS 500	EM Test	V0713102357	2019-07-26 (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.