



# FCC CFR47 Part 15 Subpart B Certification Test Report

For the

**Product** : 3D Printer  
**Model** : 1X  
**Multiple Model** : 1X DP302  
**FCC ID** : 2AB83-1X  
**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-W1807-009**

Signature

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

Choi, Young-min / Technical Manager

Date: 2018-07-12

**Test Laboratory: ENG Co., Ltd.**

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Report No.: TR-W1807-009

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** : EA1806C-133  
**Test Report Number** : TR-W1807-009  
**Type of Equipment** : 3D Printer  
**Model Name** : 1X  
**Multiple Model Name** : 1X DP302  
**FCC ID** : 2AB83-1X  
**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** : SINDOH (QINGDAO) CO., LTD.  
**Address** : 1008 Emeisan-road, Qingdao Economics & Technology  
Development Zone, 266555 Qingdao, Shandong,  
PEOPLE'S REPUBLIC OF CHINA  
**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** : 75 pages  
**Date of Receipt** : 2018-06-18  
**Date of Issue** : 2018-07-12  
**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

2018-07-12  
\_\_\_\_\_  
Date

Reviewed by Choi, Young-min / Technical Manager

  
\_\_\_\_\_  
Signature

2018-07-12  
\_\_\_\_\_  
Date

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### Release Control Record

| Issue Report No. | Issued Date | Details/Revisions |
|------------------|-------------|-------------------|
| TR-W1807-009     | 2018-07-12  | Initial Release   |
|                  |             |                   |

# 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<br>15.107 (b)  | AC Power Line Conducted Emission | PASS    |
|             | Part 15 Subpart B Section<br>15.109 (b)  | Radiated Emission                | PASS    |
| ISED Canada | ICES-003 Issue 6 Section 6.1,<br>Class A | AC Power Line Conducted Emission | PASS    |
|             | ICES-003 Issue 6 Section 6.2,<br>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, Gonjam-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 1X (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                              | Fused Filament Fabrication  |
| Max. Print Length(mm)                        | W(max):228, D(max):200, H(max):300  |
| Print Layer Thickness Setting                | 0.05~0.4 mm   |
| Basic Nozzle diameter                        | 0.4 mm  |
| Filament width                               | 1.75 mm   |
| Printable materials                          | PLA, ABS, FLEXIBLE  |
| Printable color                              | White, Black, Gray, Red, Yellow, Green, Blue, Pink(PLA), Purple(PLA)                                    |
| Bed leveling                                 | Auto measuring + Manual leveling  |
| Print Head                                   | One Nozzle  |
| Continuous Nozzle Usage/ Maximum Temperature | Recommended Temperature(Nozzle): PLA 200 °C, ABS 230 °C, Flexible 225 °C / Max 250 °C                   |
| Continuous Bed Usage/ Maximum Temperature    | Recommended Temperature(Bed): PLA 60 °C, ABS 90 °C, Flexible 60 °C / Max 100 °C                         |
| Recommended printing speed / maximum speed   | 40 mm/s Recommended / 200 mm/s max  |
| Electrical Rating                            | 100 - 240 V~, 50/60 Hz, 3.0 A   |
| Power  | 300 W   |
| Dimensions                                   | 454 (W) x 468 (D) x 571 (H)   |
| Weight                                       | 26 kg (excluding cartridge)   |
| Interface                                    | USB Device, USB Host, WiFi, Ethernet  |
| Cartridge                                    | Auto Load / Unload  |
| Contained Wi-Fi Module in the EUT            | Model: TWFM-M311D<br>Manufacturer: LG Innotek Co., Ltd.<br>FCC ID: 2AB83-TWFM-M311D/ IC: 2514A-TWFM311D |

## 2.2 Additional Model

| Model Name | Model Difference  |
|------------|---|
| 1X         | Basic Model   |
| 1X DP302   | Identical to the basic model except for the model designation only. |

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) *      | 1X          | <b>2AB83-1X</b> | 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  |
| 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         |
|              | USB Host   | -              | -                  | -          | USB Memory Stick |
|              | LAN        | N              | N                  | 3.0        | Notebook PC      |
|              | USB Device | Y              | N                  | 1.5        |                  |
| Mode #6 - #9 | AC IN      | N              | N                  | 1.8        | AC Mains         |
|              | USB Host   | -              | -                  | -          | USB Memory Stick |
|              | USB Device | Y              | N                  | 1.5        | Line terminated  |
|              | LAN        | N              | N                  | 3.0        |                  |



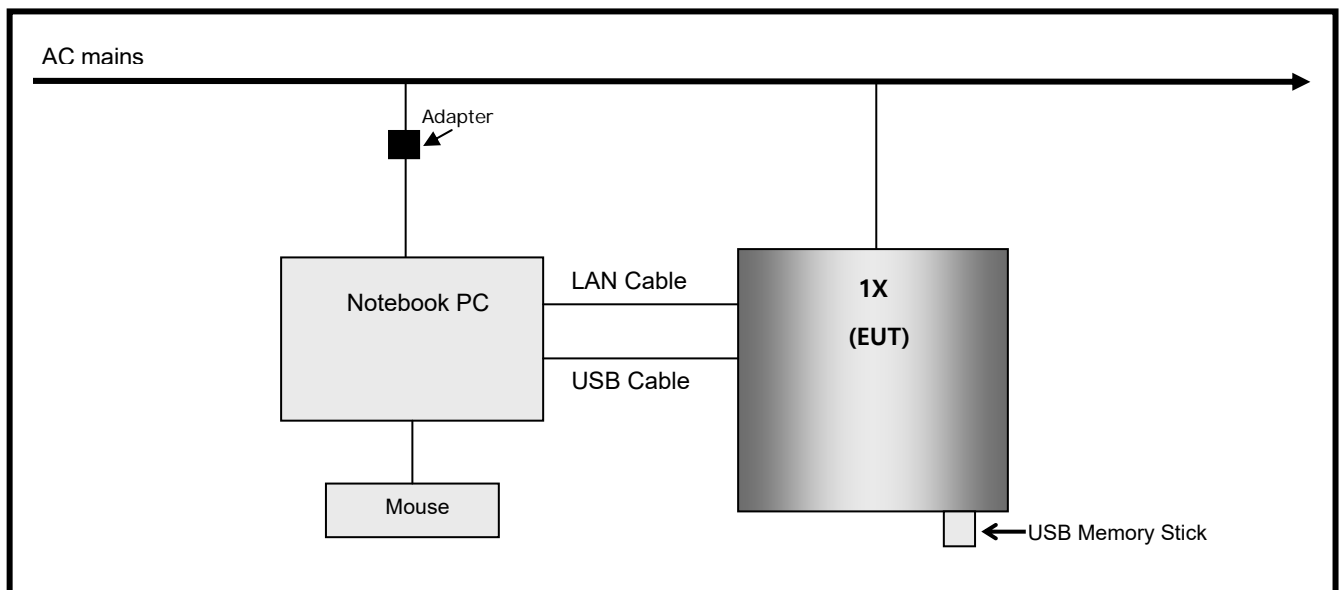
## 2.5 Mode of operation during the test

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

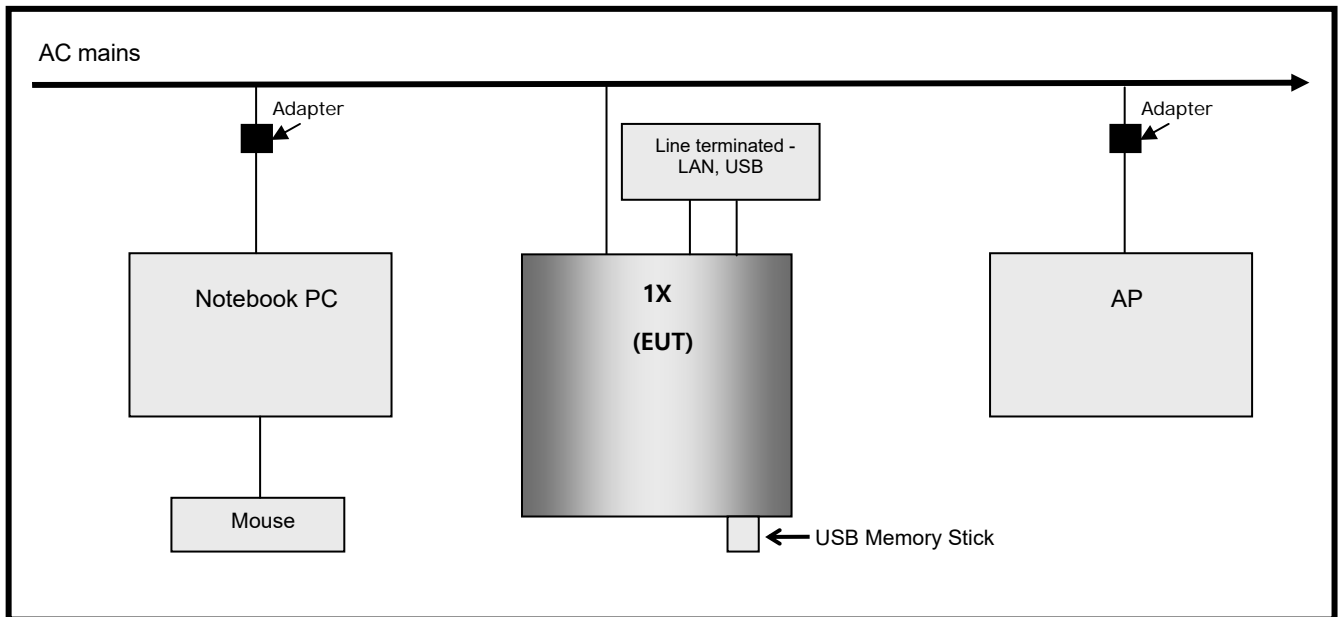
| Test Mode | Description   |
|-----------|---|
| # 1       | The EUT was operated in standby mode                            |
| # 2       | Printing mode using USB cable between the EUT and a Notebook PC |
| # 3       | Printing mode using USB memory stick                            |
| # 4       | Printing mode using Ethernet speed, 100 Mbps                    |
| # 5       | Printing mode using Ethernet speed, 1 000 Mbps                  |
| # 6       | Printing mode using Wi-Fi function, 802.11 b                    |
| # 7       | Printing mode using Wi-Fi function, 802.11 g                    |
| # 8       | Printing mode using Wi-Fi function, 802.11 n-20                 |
| # 9       | Printing mode using Wi-Fi function, 802.11 n-40                 |

## 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            | 2018-07-10 ~ 07-11 |                   |   |
| Temperature             | (23.2 ~ 25.7) °C   | Relative humidity | 52.4 ~ 53.0 % 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       |                   |   |
| <b>Test Result</b>      | <b>Pass</b>        | Tested By         | Kim, Kwang-hyun  |

##### 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

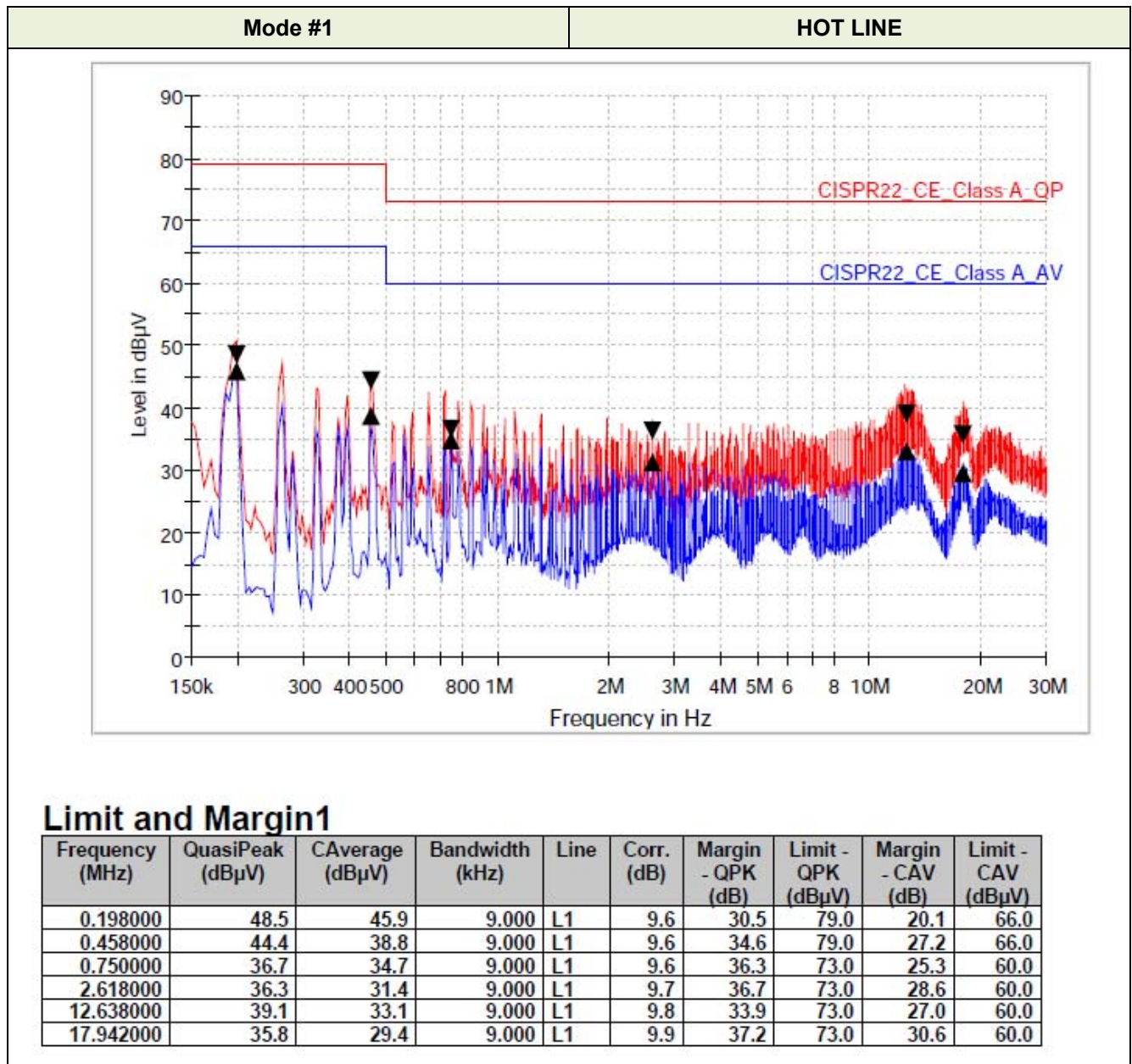
Q.P Reading from the Test receiver = 20.8 dBμV

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

Therefore Q.P Margin = 60 - 20.8 = 39.2

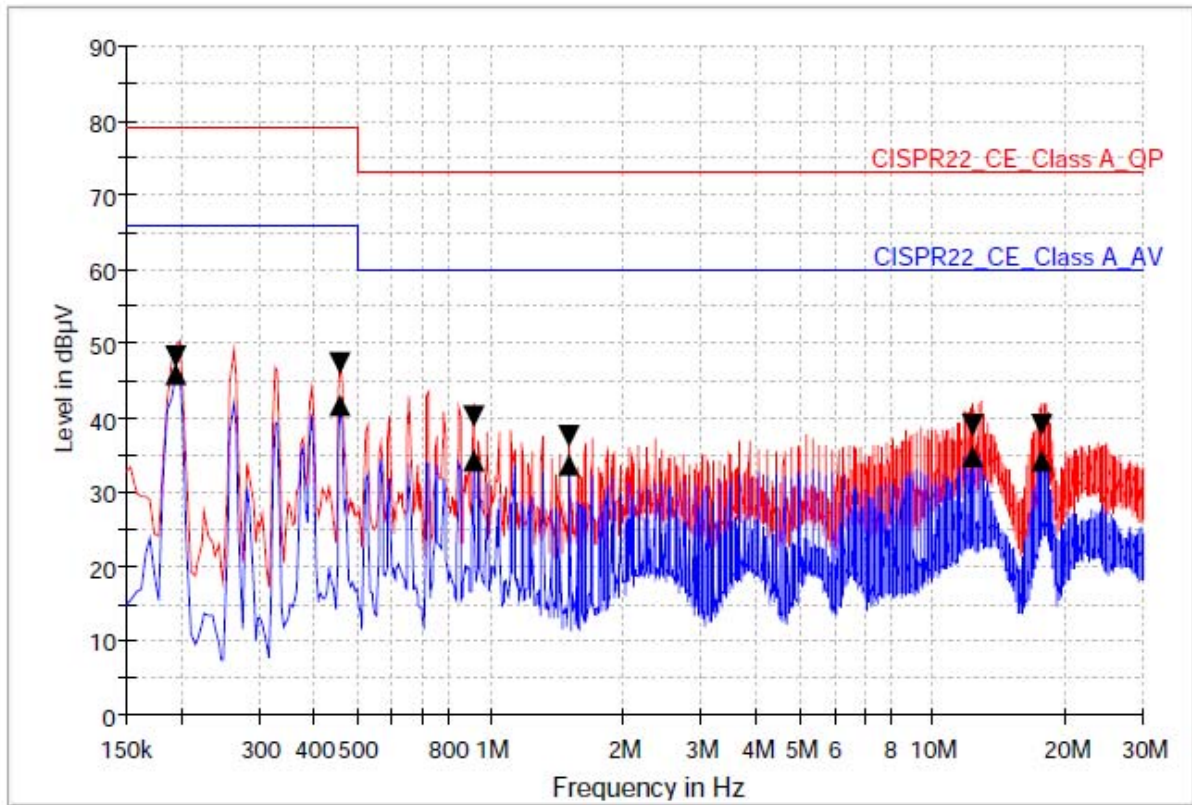
so the EUT has 39.2 dB margin at 5.31 MHz

### 3.1.5 Test Data



Mode #1

NEUTRAL LINE

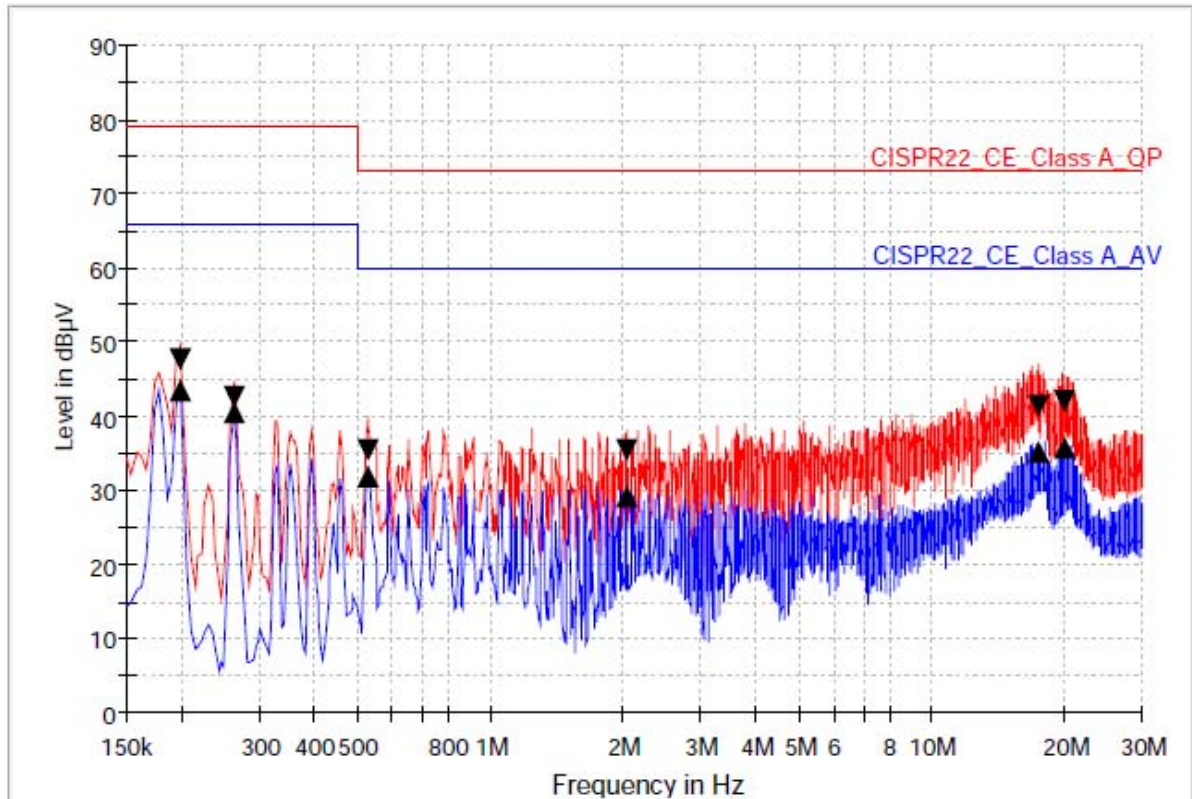


### Limit and Margin1

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) | Margin - CAV (dB) | Limit - CAV (dBµV) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.194000        | 48.2             | 46.0            | 9.000           | N    | 9.6        | 30.8              | 79.0               | 20.0              | 66.0               |
| 0.458000        | 47.3             | 41.7            | 9.000           | N    | 9.6        | 31.7              | 79.0               | 24.3              | 66.0               |
| 0.918000        | 40.2             | 34.3            | 9.000           | N    | 9.6        | 32.8              | 73.0               | 25.7              | 60.0               |
| 1.506000        | 37.6             | 33.7            | 9.000           | N    | 9.6        | 35.4              | 73.0               | 26.3              | 60.0               |
| 12.334000       | 39.0             | 34.7            | 9.000           | N    | 9.8        | 34.0              | 73.0               | 25.3              | 60.0               |
| 17.694000       | 39.1             | 34.2            | 9.000           | N    | 9.9        | 33.9              | 73.0               | 25.8              | 60.0               |

Mode #2

HOT LINE

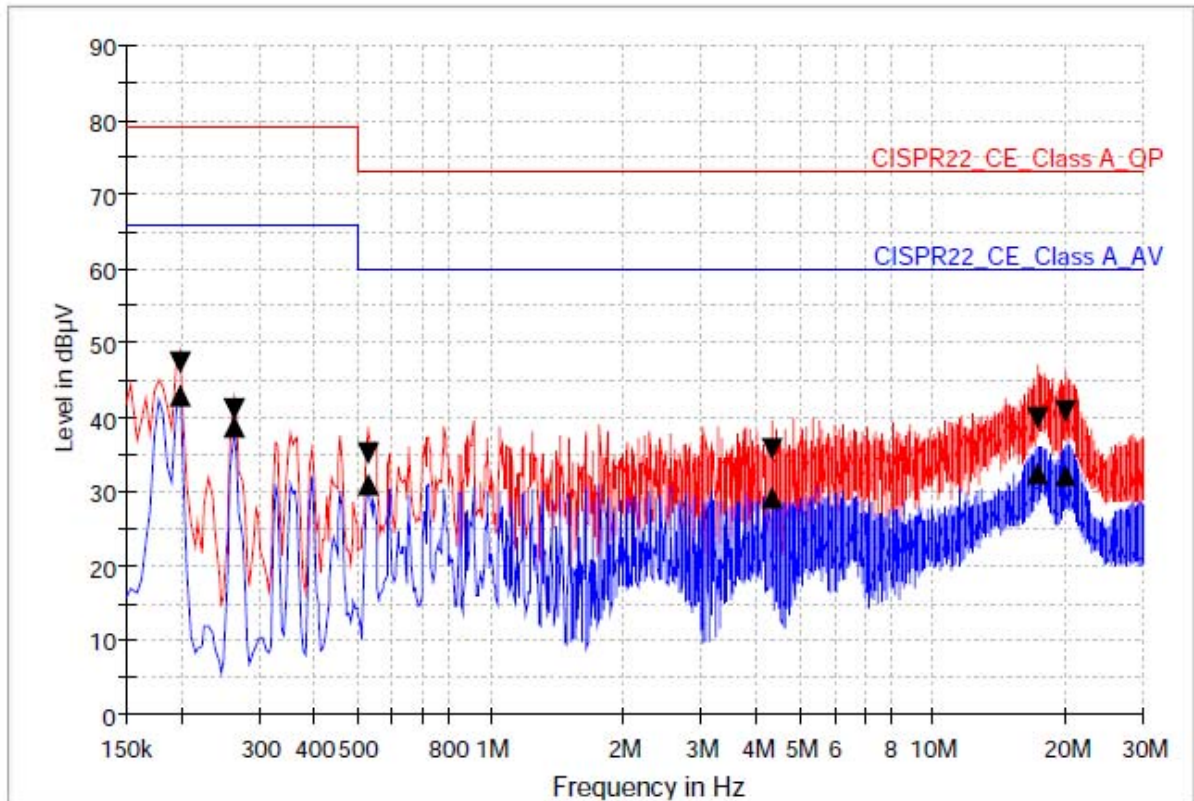


### Limit and Margin1

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) | Margin - CAV (dB) | Limit - CAV (dBµV) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.198000        | 47.8             | 43.5            | 9.000           | L1   | 9.6        | 31.2              | 79.0               | 22.5              | 66.0               |
| 0.262000        | 42.7             | 40.4            | 9.000           | L1   | 9.6        | 36.3              | 79.0               | 25.6              | 66.0               |
| 0.526000        | 35.5             | 31.8            | 9.000           | L1   | 9.6        | 37.6              | 73.0               | 28.2              | 60.0               |
| 2.030000        | 35.3             | 29.3            | 9.000           | L1   | 9.6        | 37.7              | 73.0               | 30.7              | 60.0               |
| 17.486000       | 41.5             | 35.2            | 9.000           | L1   | 9.9        | 31.5              | 73.0               | 24.8              | 60.0               |
| 20.042000       | 42.0             | 35.9            | 9.000           | L1   | 9.9        | 31.0              | 73.0               | 24.1              | 60.0               |

Mode #2

NEUTRAL LINE

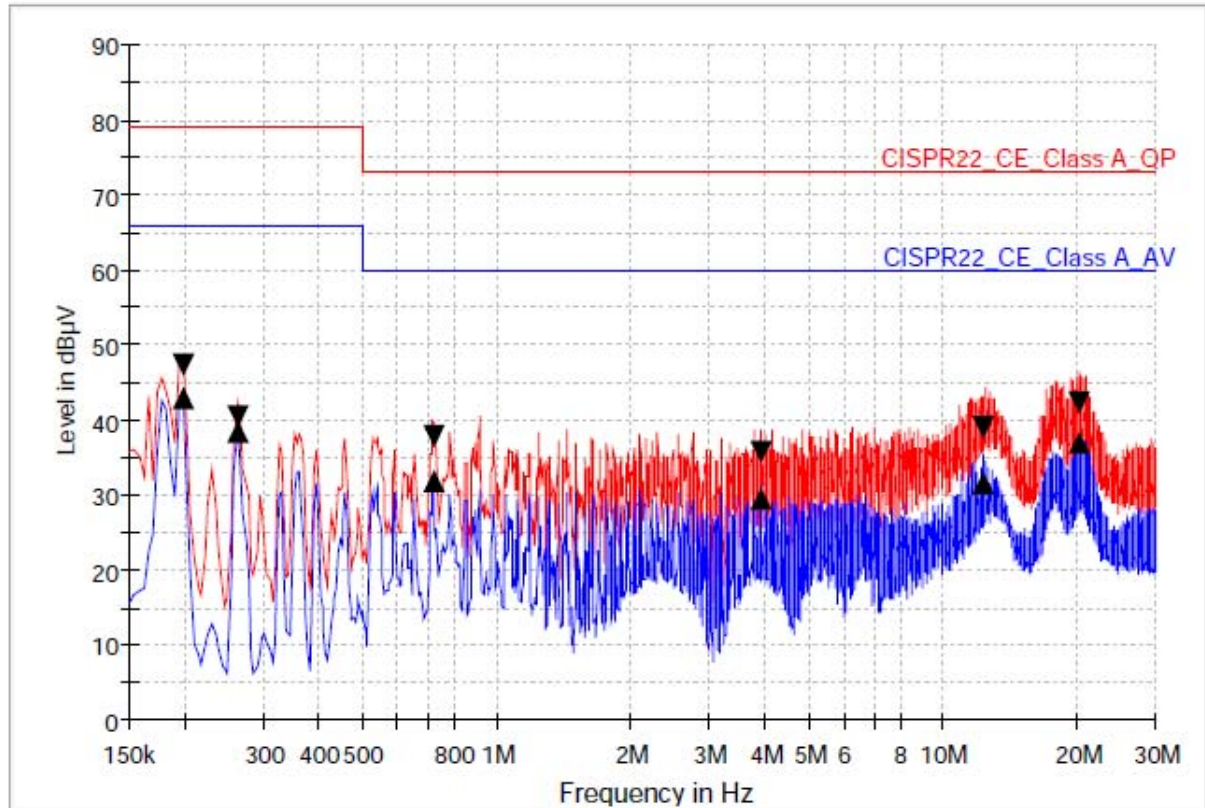


### Limit and Margin1

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) | Margin - CAV (dB) | Limit - CAV (dBµV) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.198000        | 47.4             | 42.8            | 9.000           | N    | 9.6        | 31.6              | 79.0               | 23.2              | 66.0               |
| 0.262000        | 41.3             | 38.6            | 9.000           | N    | 9.6        | 37.7              | 79.0               | 27.4              | 66.0               |
| 0.526000        | 35.2             | 30.9            | 9.000           | N    | 9.6        | 37.8              | 73.0               | 29.1              | 60.0               |
| 4.322000        | 35.6             | 29.3            | 9.000           | N    | 9.7        | 37.4              | 73.0               | 30.7              | 60.0               |
| 17.362000       | 39.8             | 32.5            | 9.000           | N    | 9.9        | 33.2              | 73.0               | 27.5              | 60.0               |
| 20.046000       | 40.7             | 32.2            | 9.000           | N    | 9.9        | 32.3              | 73.0               | 27.8              | 60.0               |

Mode #3

HOT LINE



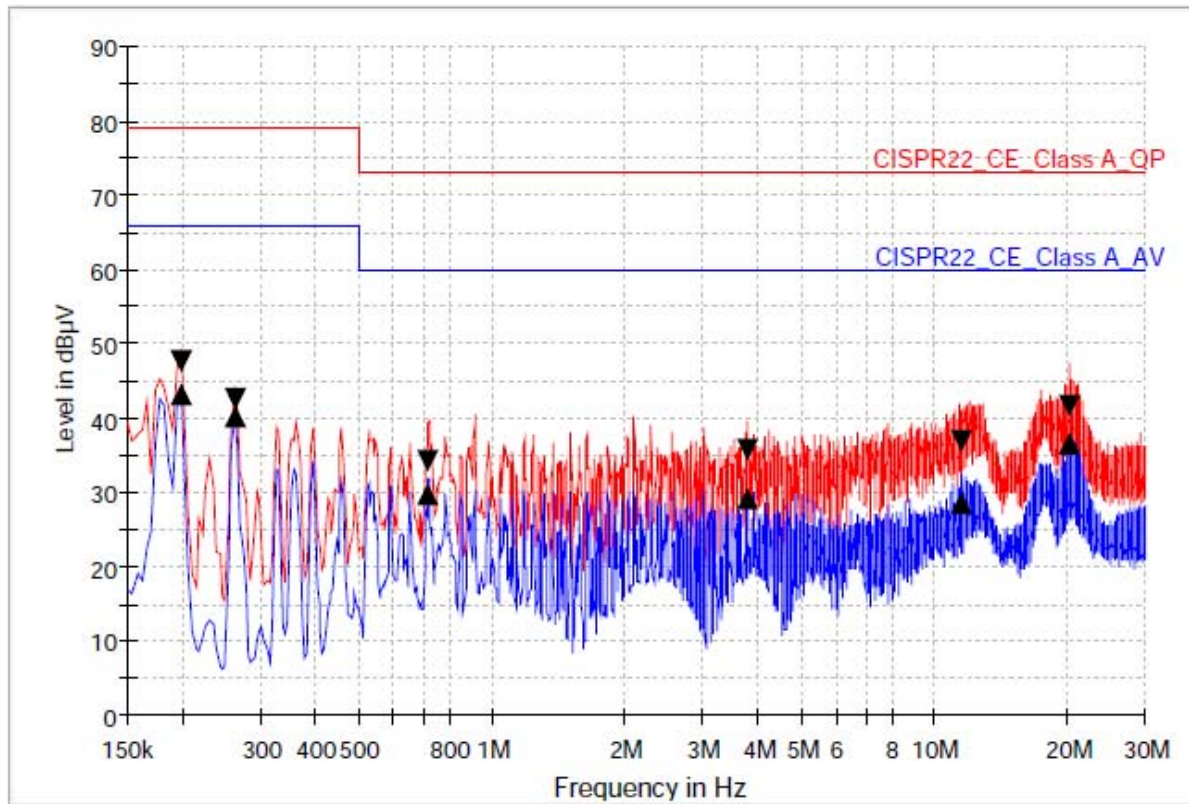
### Limit and Margin1

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) | Margin - CAV (dB) | Limit - CAV (dBµV) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.198000        | 47.3             | 42.8            | 9.000           | L1   | 9.6        | 31.7              | 79.0               | 23.2              | 66.0               |
| 0.262000        | 40.7             | 38.5            | 9.000           | L1   | 9.6        | 38.3              | 79.0               | 27.5              | 66.0               |
| 0.722000        | 37.8             | 31.8            | 9.000           | L1   | 9.6        | 35.2              | 73.0               | 28.2              | 60.0               |
| 3.930000        | 35.8             | 29.6            | 9.000           | L1   | 9.7        | 37.2              | 73.0               | 30.4              | 60.0               |
| 12.318000       | 39.2             | 31.7            | 9.000           | L1   | 9.8        | 33.8              | 73.0               | 28.3              | 60.0               |
| 20.234000       | 42.3             | 36.8            | 9.000           | L1   | 9.9        | 30.7              | 73.0               | 23.2              | 60.0               |



Mode #3

NEUTRAL LINE

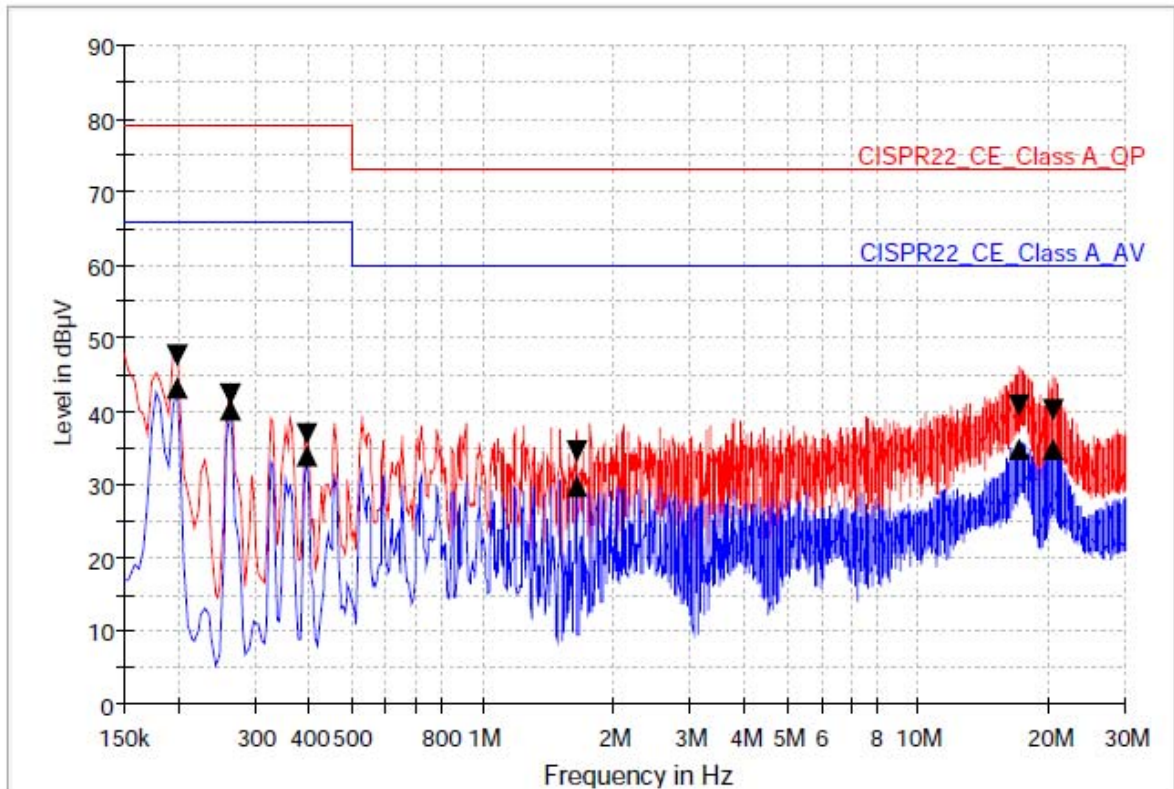


### Limit and Margin1

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) | Margin - CAV (dB) | Limit - CAV (dBµV) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.198000        | 47.6             | 43.2            | 9.000           | N    | 9.6        | 31.4              | 79.0               | 22.8              | 66.0               |
| 0.262000        | 42.6             | 40.3            | 9.000           | N    | 9.6        | 36.4              | 79.0               | 25.7              | 66.0               |
| 0.718000        | 34.2             | 29.9            | 9.000           | N    | 9.6        | 38.8              | 73.0               | 30.1              | 60.0               |
| 3.798000        | 35.7             | 29.1            | 9.000           | N    | 9.7        | 37.3              | 73.0               | 30.9              | 60.0               |
| 11.594000       | 36.9             | 28.7            | 9.000           | N    | 9.8        | 36.1              | 73.0               | 31.3              | 60.0               |
| 20.298000       | 41.9             | 36.8            | 9.000           | N    | 9.9        | 31.1              | 73.0               | 23.2              | 60.0               |

Mode #4

HOT LINE

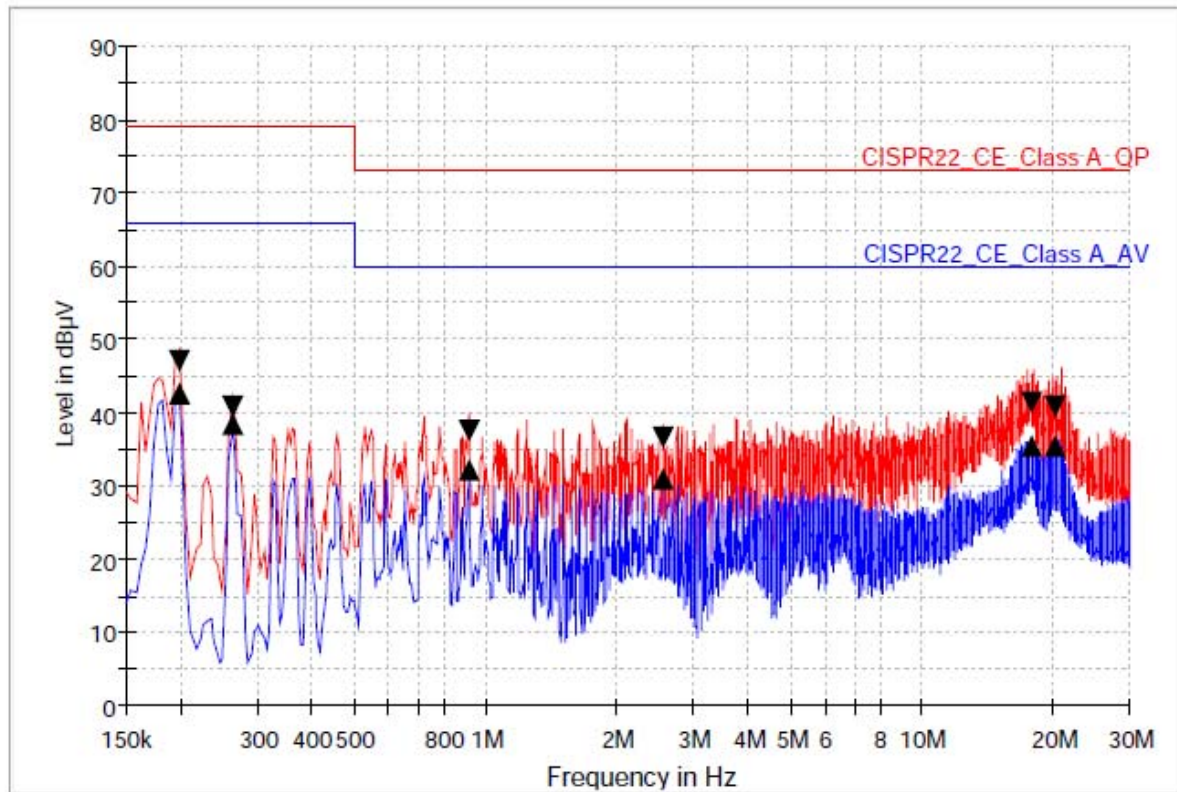


### Limit and Margin1

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) | Margin - CAV (dB) | Limit - CAV (dBµV) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.198000        | 47.5             | 43.1            | 9.000           | L1   | 9.6        | 31.5              | 79.0               | 22.9              | 66.0               |
| 0.262000        | 42.2             | 40.1            | 9.000           | L1   | 9.6        | 36.8              | 79.0               | 25.9              | 66.0               |
| 0.394000        | 36.8             | 34.0            | 9.000           | L1   | 9.6        | 42.2              | 79.0               | 32.0              | 66.0               |
| 1.638000        | 34.5             | 29.9            | 9.000           | L1   | 9.6        | 38.5              | 73.0               | 30.1              | 60.0               |
| 17.158000       | 40.9             | 35.0            | 9.000           | L1   | 9.9        | 32.1              | 73.0               | 25.0              | 60.0               |
| 20.430000       | 40.2             | 34.8            | 9.000           | L1   | 9.9        | 32.8              | 73.0               | 25.2              | 60.0               |

Mode #4

NEUTRAL LINE

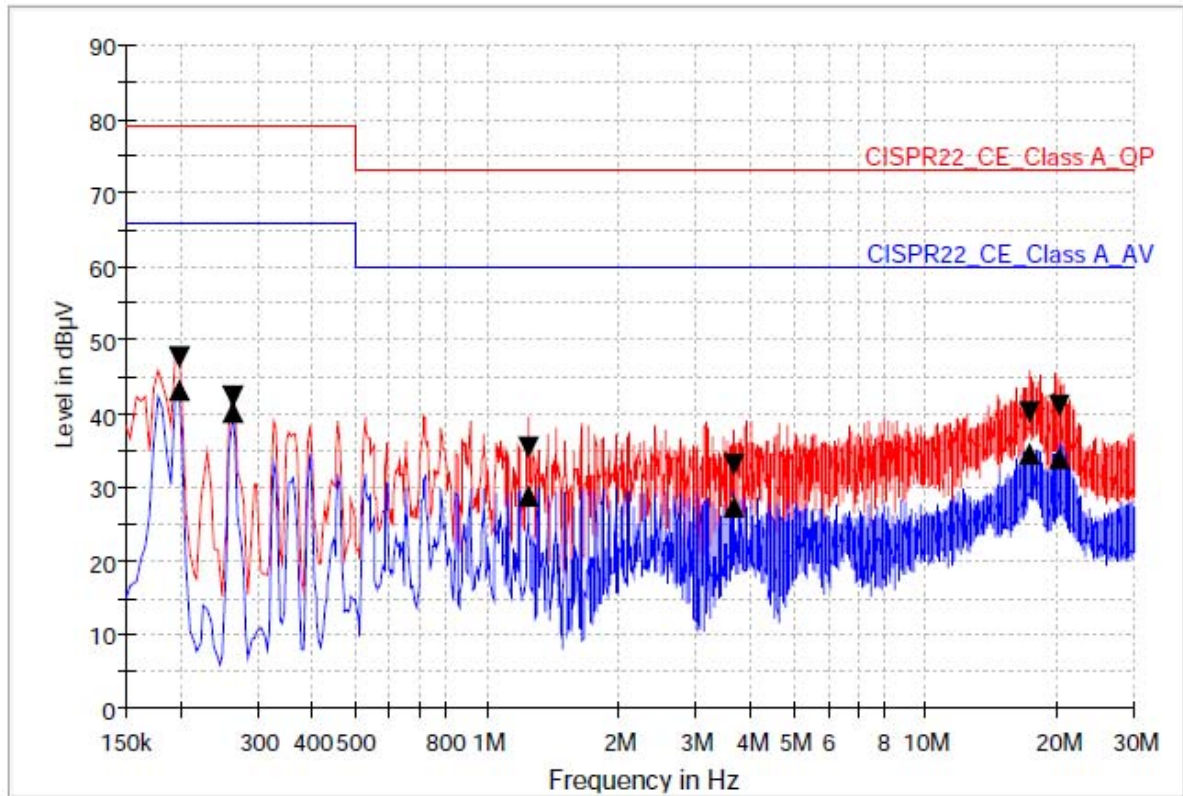


### Limit and Margin1

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) | Margin - CAV (dB) | Limit - CAV (dBµV) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.198000        | 47.2             | 42.6            | 9.000           | N    | 9.6        | 31.8              | 79.0               | 23.4              | 66.0               |
| 0.262000        | 40.9             | 38.4            | 9.000           | N    | 9.6        | 38.1              | 79.0               | 27.6              | 66.0               |
| 0.914000        | 37.5             | 32.2            | 9.000           | N    | 9.6        | 35.5              | 73.0               | 27.8              | 60.0               |
| 2.554000        | 36.7             | 30.9            | 9.000           | N    | 9.7        | 36.3              | 73.0               | 29.1              | 60.0               |
| 17.878000       | 41.4             | 35.3            | 9.000           | N    | 9.9        | 31.6              | 73.0               | 24.7              | 60.0               |
| 20.298000       | 40.9             | 35.6            | 9.000           | N    | 9.9        | 32.1              | 73.0               | 24.4              | 60.0               |

Mode #5

HOT LINE

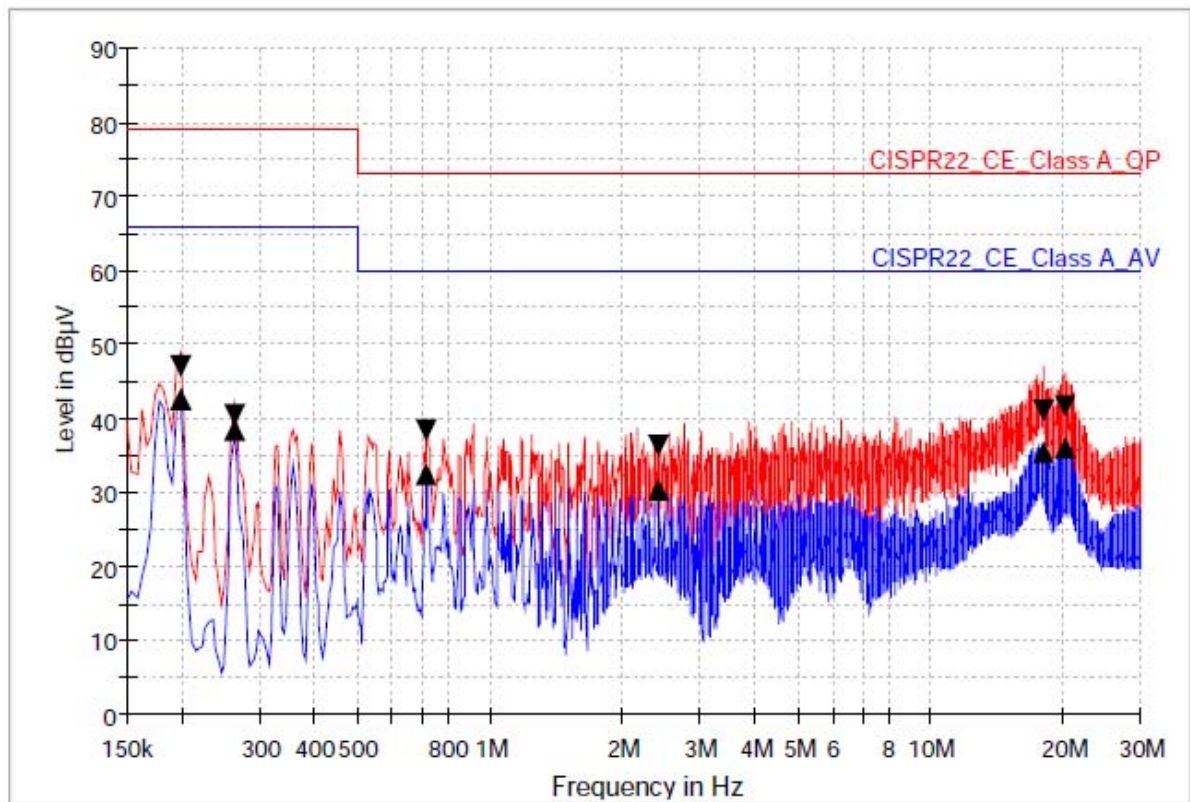


### Limit and Margin1

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) | Margin - CAV (dB) | Limit - CAV (dBµV) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.198000        | 47.6             | 43.2            | 9.000           | L1   | 9.6        | 31.4              | 79.0               | 22.8              | 66.0               |
| 0.262000        | 42.4             | 40.2            | 9.000           | L1   | 9.6        | 36.6              | 79.0               | 25.8              | 66.0               |
| 1.246000        | 35.4             | 28.8            | 9.000           | L1   | 9.6        | 37.6              | 73.0               | 31.2              | 60.0               |
| 3.670000        | 33.1             | 27.4            | 9.000           | L1   | 9.7        | 39.9              | 73.0               | 32.6              | 60.0               |
| 17.354000       | 40.2             | 34.4            | 9.000           | L1   | 9.9        | 32.8              | 73.0               | 25.6              | 60.0               |
| 20.174000       | 41.0             | 34.1            | 9.000           | L1   | 9.9        | 32.0              | 73.0               | 25.9              | 60.0               |

Mode #5

NEUTRAL LINE

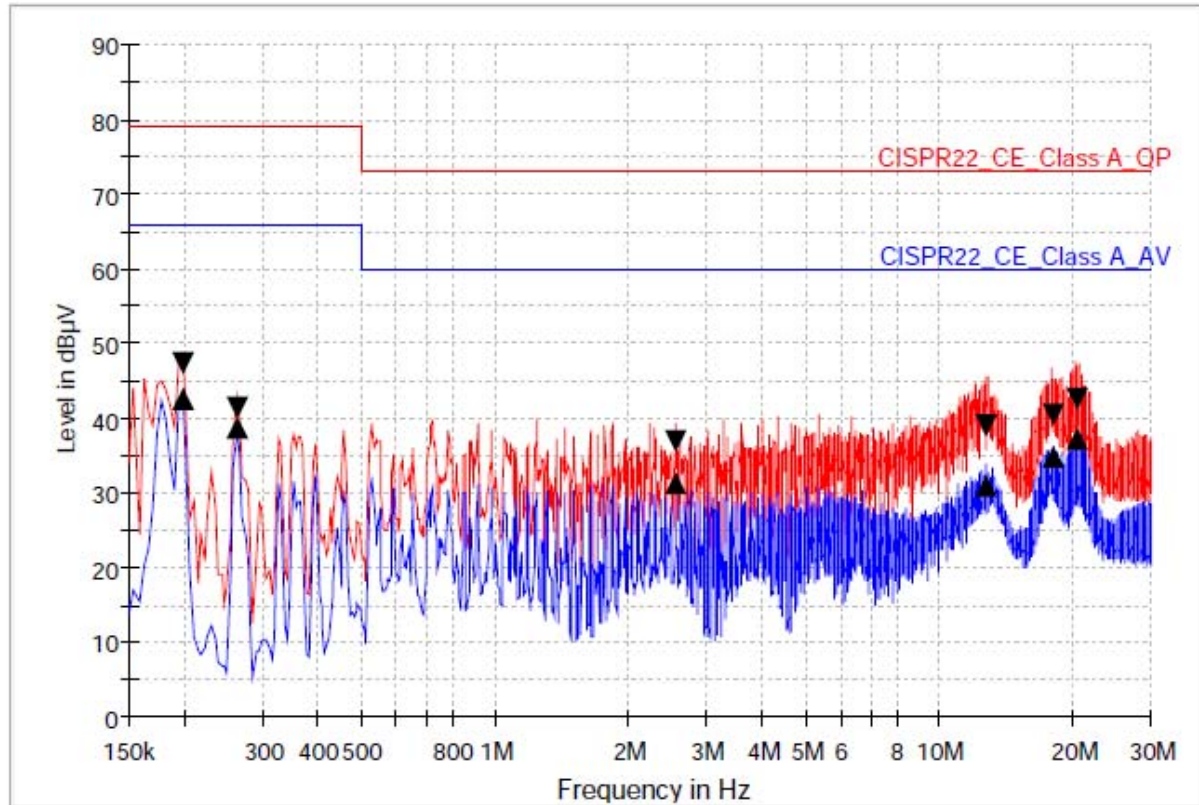


### Limit and Margin1

| 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        | 47.2             | 42.7            | 9.000           | N    | 9.6        | 31.8              | 79.0               | 23.3              | 66.0               |
| 0.262000        | 40.7             | 38.4            | 9.000           | N    | 9.6        | 38.3              | 79.0               | 27.6              | 66.0               |
| 0.718000        | 38.5             | 32.4            | 9.000           | N    | 9.6        | 34.5              | 73.0               | 27.6              | 60.0               |
| 2.422000        | 36.5             | 30.4            | 9.000           | N    | 9.7        | 36.5              | 73.0               | 29.6              | 60.0               |
| 18.006000       | 41.0             | 35.3            | 9.000           | N    | 9.9        | 32.0              | 73.0               | 24.7              | 60.0               |
| 20.302000       | 41.6             | 36.0            | 9.000           | N    | 9.9        | 31.4              | 73.0               | 24.0              | 60.0               |

Mode #6

HOT LINE

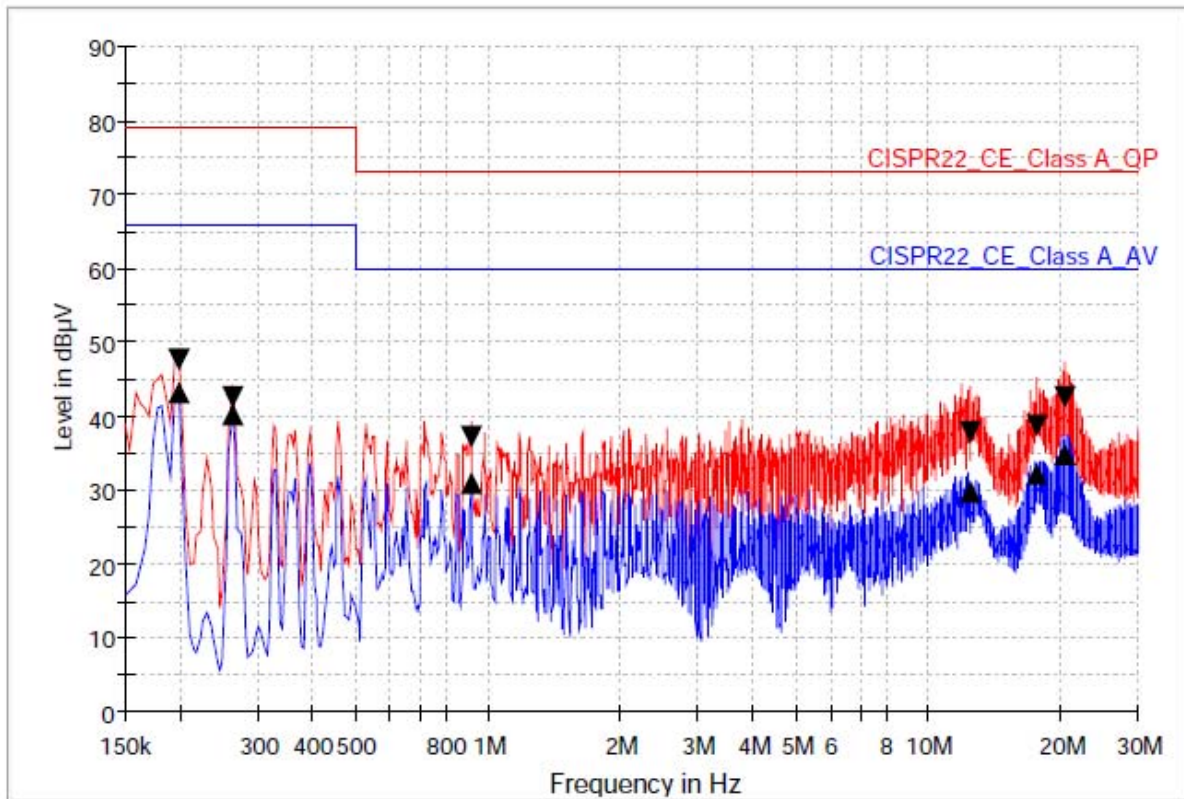


### Limit and Margin1

| 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        | 47.3             | 42.8            | 9.000           | L1   | 9.6        | 31.7              | 79.0               | 23.2              | 66.0               |
| 0.262000        | 41.4             | 38.6            | 9.000           | L1   | 9.6        | 37.6              | 79.0               | 27.4              | 66.0               |
| 2.554000        | 36.9             | 31.2            | 9.000           | L1   | 9.7        | 36.1              | 73.0               | 28.8              | 60.0               |
| 12.702000       | 39.0             | 31.1            | 9.000           | L1   | 9.8        | 34.0              | 73.0               | 28.9              | 60.0               |
| 18.006000       | 40.6             | 34.8            | 9.000           | L1   | 9.9        | 32.4              | 73.0               | 25.2              | 60.0               |
| 20.494000       | 42.6             | 37.2            | 9.000           | L1   | 10.0       | 30.4              | 73.0               | 22.8              | 60.0               |

Mode #6

NEUTRAL LINE

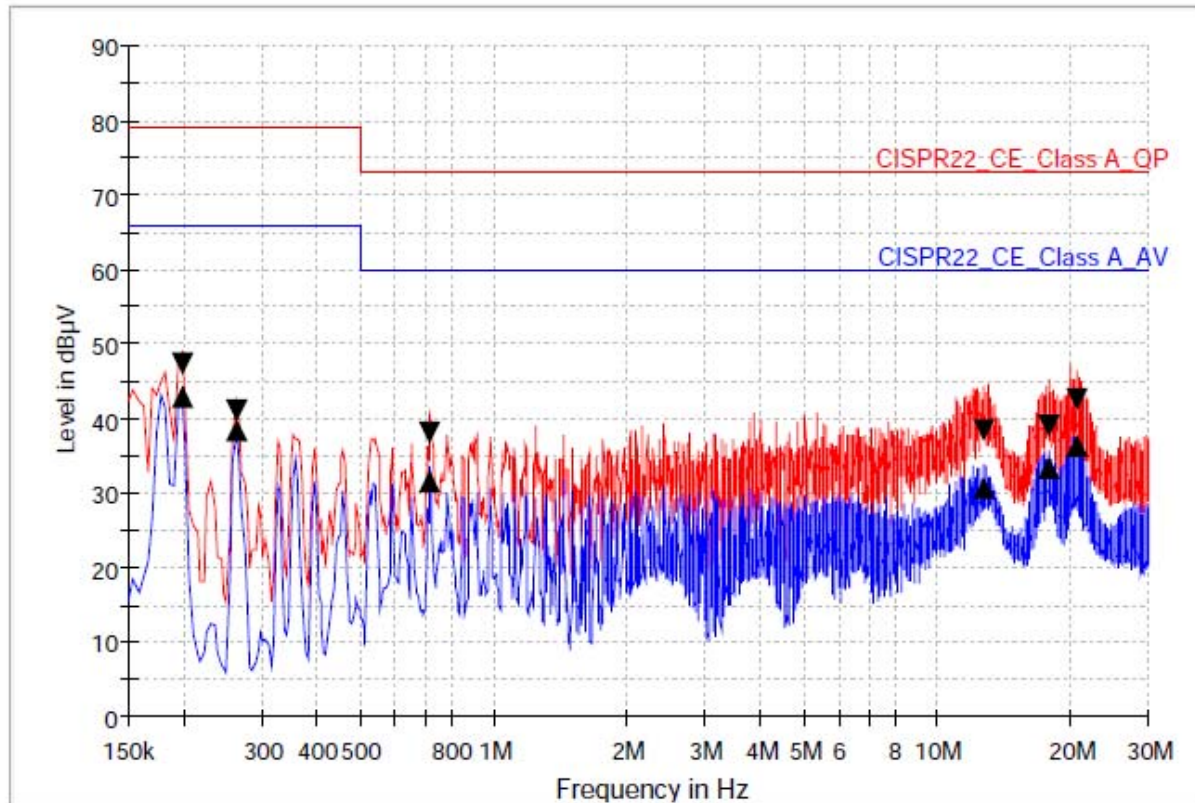


### Limit and Margin1

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) | Margin - CAV (dB) | Limit - CAV (dBµV) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.198000        | 47.6             | 43.2            | 9.000           | N    | 9.6        | 31.4              | 79.0               | 22.8              | 66.0               |
| 0.262000        | 42.5             | 40.2            | 9.000           | N    | 9.6        | 36.5              | 79.0               | 25.8              | 66.0               |
| 0.918000        | 37.3             | 31.0            | 9.000           | N    | 9.6        | 35.7              | 73.0               | 29.0              | 60.0               |
| 12.510000       | 37.9             | 29.7            | 9.000           | N    | 9.8        | 35.1              | 73.0               | 30.3              | 60.0               |
| 17.750000       | 38.6             | 32.0            | 9.000           | N    | 9.9        | 34.4              | 73.0               | 28.0              | 60.0               |
| 20.370000       | 42.5             | 35.0            | 9.000           | N    | 9.9        | 30.5              | 73.0               | 25.0              | 60.0               |

Mode #7

HOT LINE



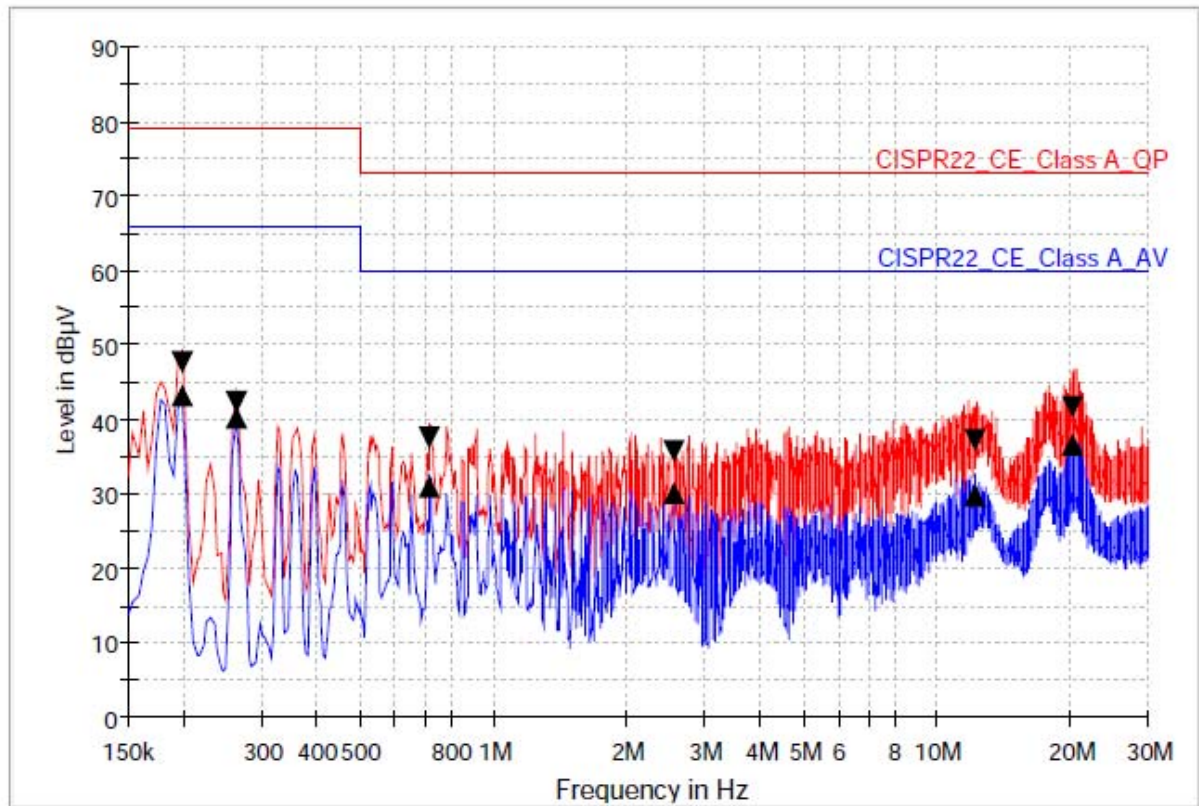
### Limit and Margin1

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) | Margin - CAV (dB) | Limit - CAV (dBµV) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.198000        | 47.3             | 42.8            | 9.000           | L1   | 9.6        | 31.7              | 79.0               | 23.2              | 66.0               |
| 0.262000        | 41.0             | 38.6            | 9.000           | L1   | 9.6        | 38.0              | 79.0               | 27.4              | 66.0               |
| 0.718000        | 38.1             | 31.5            | 9.000           | L1   | 9.6        | 34.9              | 73.0               | 28.5              | 60.0               |
| 12.714000       | 38.4             | 30.8            | 9.000           | L1   | 9.8        | 34.6              | 73.0               | 29.2              | 60.0               |
| 17.938000       | 38.9             | 33.4            | 9.000           | L1   | 9.9        | 34.1              | 73.0               | 26.6              | 60.0               |
| 20.694000       | 42.7             | 36.3            | 9.000           | L1   | 10.0       | 30.3              | 73.0               | 23.7              | 60.0               |



Mode #7

NEUTRAL LINE

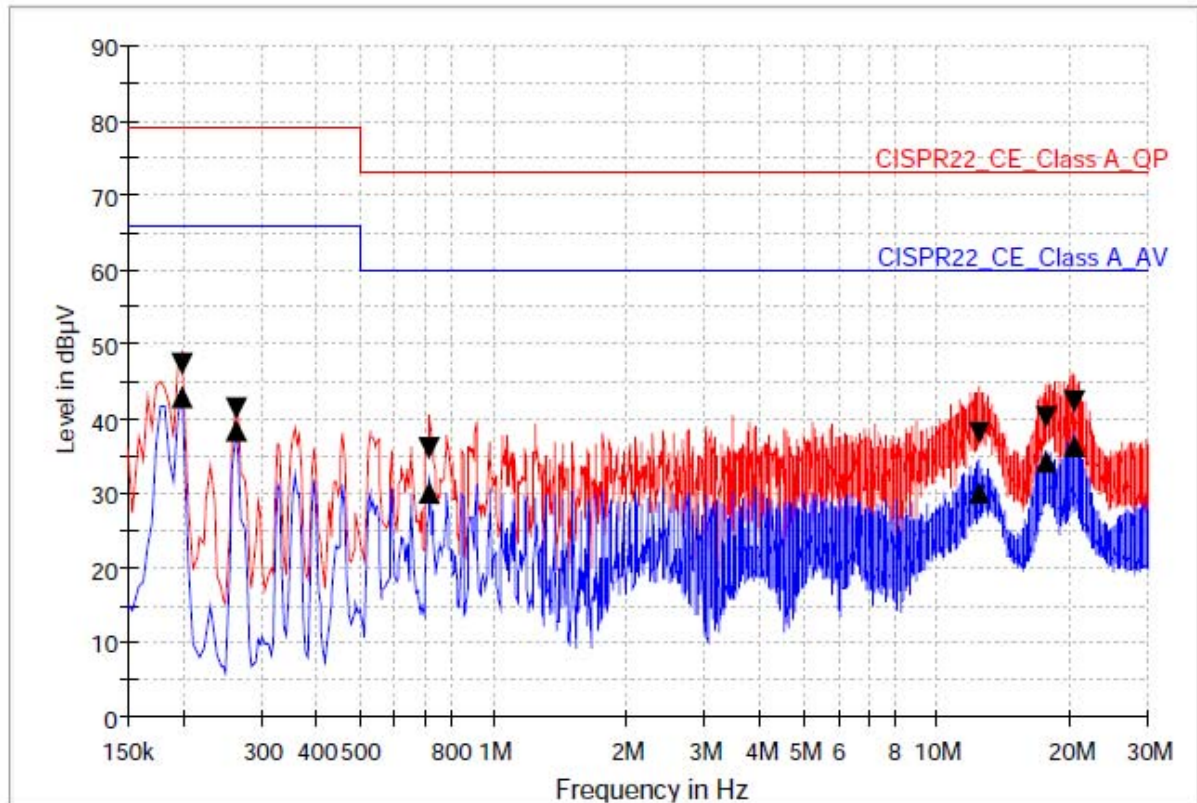


### Limit and Margin1

| 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        | 47.6             | 43.2            | 9.000           | N    | 9.6        | 31.4              | 79.0               | 22.8              | 66.0               |
| 0.262000        | 42.4             | 40.2            | 9.000           | N    | 9.6        | 36.6              | 79.0               | 25.8              | 66.0               |
| 0.718000        | 37.7             | 31.1            | 9.000           | N    | 9.6        | 35.3              | 73.0               | 28.9              | 60.0               |
| 2.554000        | 35.7             | 30.2            | 9.000           | N    | 9.7        | 37.3              | 73.0               | 29.8              | 60.0               |
| 12.146000       | 37.2             | 29.8            | 9.000           | N    | 9.8        | 35.8              | 73.0               | 30.2              | 60.0               |
| 20.234000       | 41.8             | 36.6            | 9.000           | N    | 9.9        | 31.2              | 73.0               | 23.4              | 60.0               |

Mode #8

HOT LINE

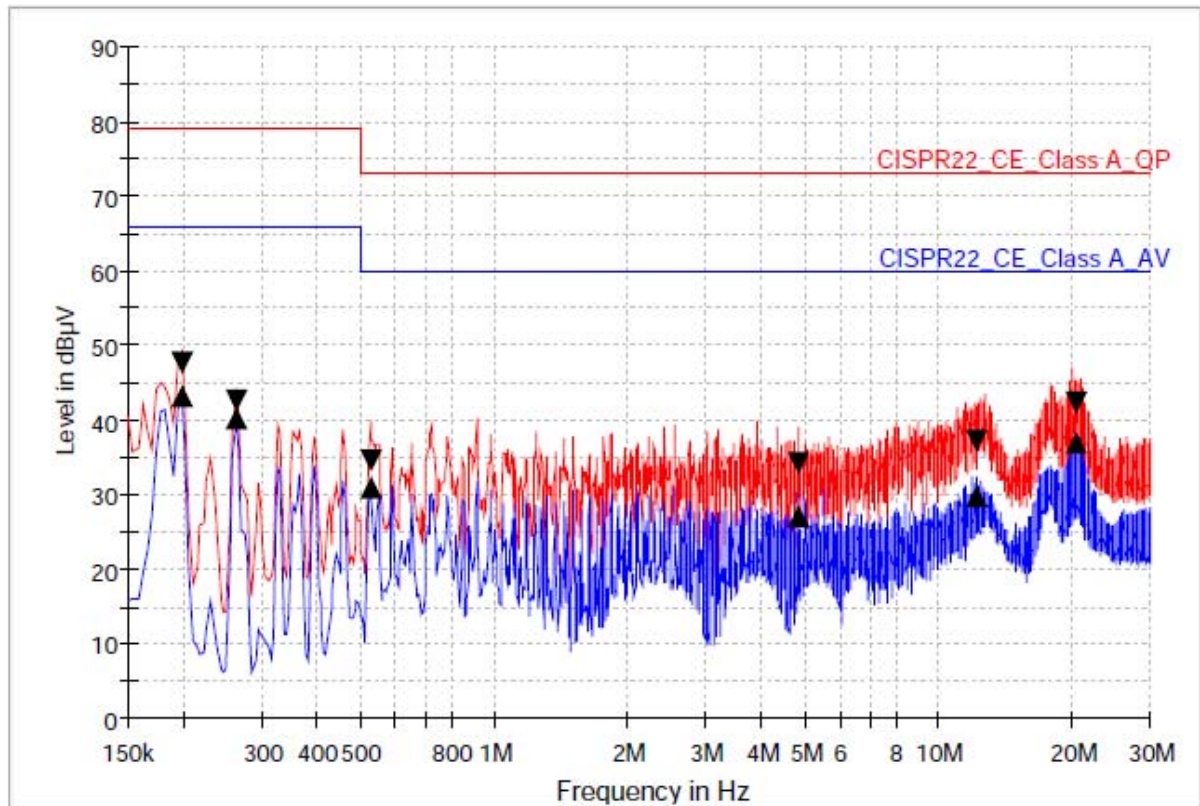


### Limit and Margin1

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) | Margin - CAV (dB) | Limit - CAV (dBµV) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.198000        | 47.3             | 42.8            | 9.000           | L1   | 9.6        | 31.7              | 79.0               | 23.2              | 66.0               |
| 0.262000        | 41.3             | 38.6            | 9.000           | L1   | 9.6        | 37.7              | 79.0               | 27.4              | 66.0               |
| 0.718000        | 36.1             | 30.2            | 9.000           | L1   | 9.6        | 36.9              | 73.0               | 29.8              | 60.0               |
| 12.502000       | 38.1             | 30.1            | 9.000           | L1   | 9.8        | 34.9              | 73.0               | 29.9              | 60.0               |
| 17.746000       | 40.3             | 34.3            | 9.000           | L1   | 9.9        | 32.7              | 73.0               | 25.7              | 60.0               |
| 20.562000       | 42.3             | 36.4            | 9.000           | L1   | 10.0       | 30.7              | 73.0               | 23.6              | 60.0               |

Mode #8

NEUTRAL LINE

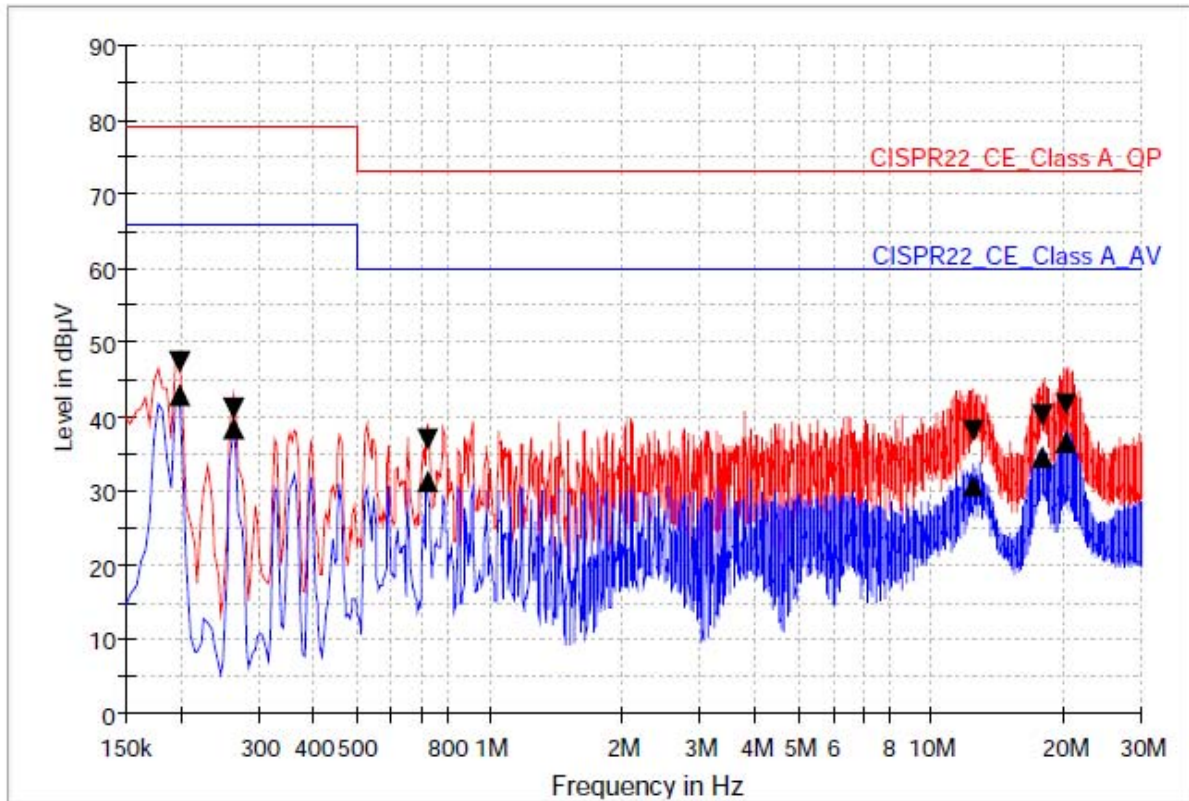


### Limit and Margin1

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) | Margin - CAV (dB) | Limit - CAV (dBµV) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.198000        | 47.6             | 43.3            | 9.000           | N    | 9.6        | 31.4              | 79.0               | 22.7              | 66.0               |
| 0.262000        | 42.5             | 40.3            | 9.000           | N    | 9.6        | 36.5              | 79.0               | 25.7              | 66.0               |
| 0.526000        | 34.5             | 31.1            | 9.000           | N    | 9.6        | 38.5              | 73.0               | 28.9              | 60.0               |
| 4.842000        | 34.3             | 27.1            | 9.000           | N    | 9.7        | 38.7              | 73.0               | 32.9              | 60.0               |
| 12.154000       | 37.1             | 29.7            | 9.000           | N    | 9.8        | 35.9              | 73.0               | 30.3              | 60.0               |
| 20.430000       | 42.2             | 37.0            | 9.000           | N    | 9.9        | 30.8              | 73.0               | 23.0              | 60.0               |

Mode #9

HOT LINE

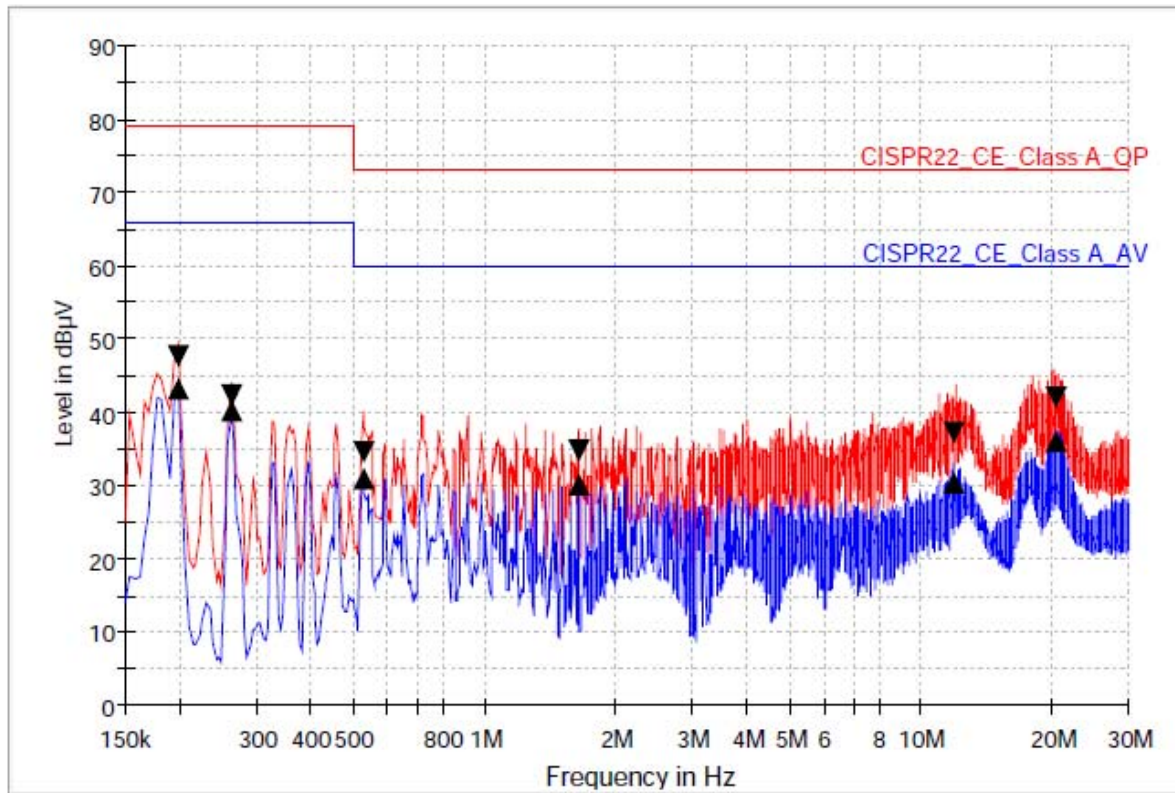


### Limit and Margin1

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) | Margin - CAV (dB) | Limit - CAV (dBµV) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.198000        | 47.3             | 42.8            | 9.000           | L1   | 9.6        | 31.7              | 79.0               | 23.2              | 66.0               |
| 0.262000        | 41.0             | 38.6            | 9.000           | L1   | 9.6        | 38.0              | 79.0               | 27.4              | 66.0               |
| 0.722000        | 37.1             | 31.2            | 9.000           | L1   | 9.6        | 35.9              | 73.0               | 28.8              | 60.0               |
| 12.490000       | 38.1             | 30.6            | 9.000           | L1   | 9.8        | 34.9              | 73.0               | 29.4              | 60.0               |
| 17.942000       | 40.1             | 34.4            | 9.000           | L1   | 9.9        | 32.9              | 73.0               | 25.6              | 60.0               |
| 20.298000       | 41.8             | 36.7            | 9.000           | L1   | 9.9        | 31.2              | 73.0               | 23.3              | 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) |
|-----------------|------------------|-----------------|-----------------|------|------------|-------------------|--------------------|-------------------|--------------------|
| 0.198000        | 47.6             | 43.2            | 9.000           | N    | 9.6        | 31.4              | 79.0               | 22.8              | 66.0               |
| 0.262000        | 42.4             | 40.2            | 9.000           | N    | 9.6        | 36.6              | 79.0               | 25.8              | 66.0               |
| 0.526000        | 34.4             | 31.0            | 9.000           | N    | 9.6        | 38.6              | 73.0               | 29.0              | 60.0               |
| 1.638000        | 34.9             | 30.1            | 9.000           | N    | 9.6        | 38.1              | 73.0               | 29.9              | 60.0               |
| 11.962000       | 37.2             | 30.3            | 9.000           | N    | 9.8        | 35.8              | 73.0               | 29.7              | 60.0               |
| 20.498000       | 41.9             | 36.2            | 9.000           | N    | 10.0       | 31.1              | 73.0               | 23.8              | 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            | 2018-07-09         |                   |   |                      |
| Temperature             | 23.5 °C            | Relative humidity | 51.9 % 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            | 2018-07-09 ~ 07-10 |                   |   |                      |
| Temperature             | (22.7 ~ 24.4) °C   | Relative humidity | 52.4 ~ 52.6 % 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       |                   |   |                      |
| <b>Test Result</b>      | <b>Pass</b>        | Tested By         | Kim, Kwang-hyun  |                      |

### 3.2.5 Sample Calculated Example

At 80 MHz

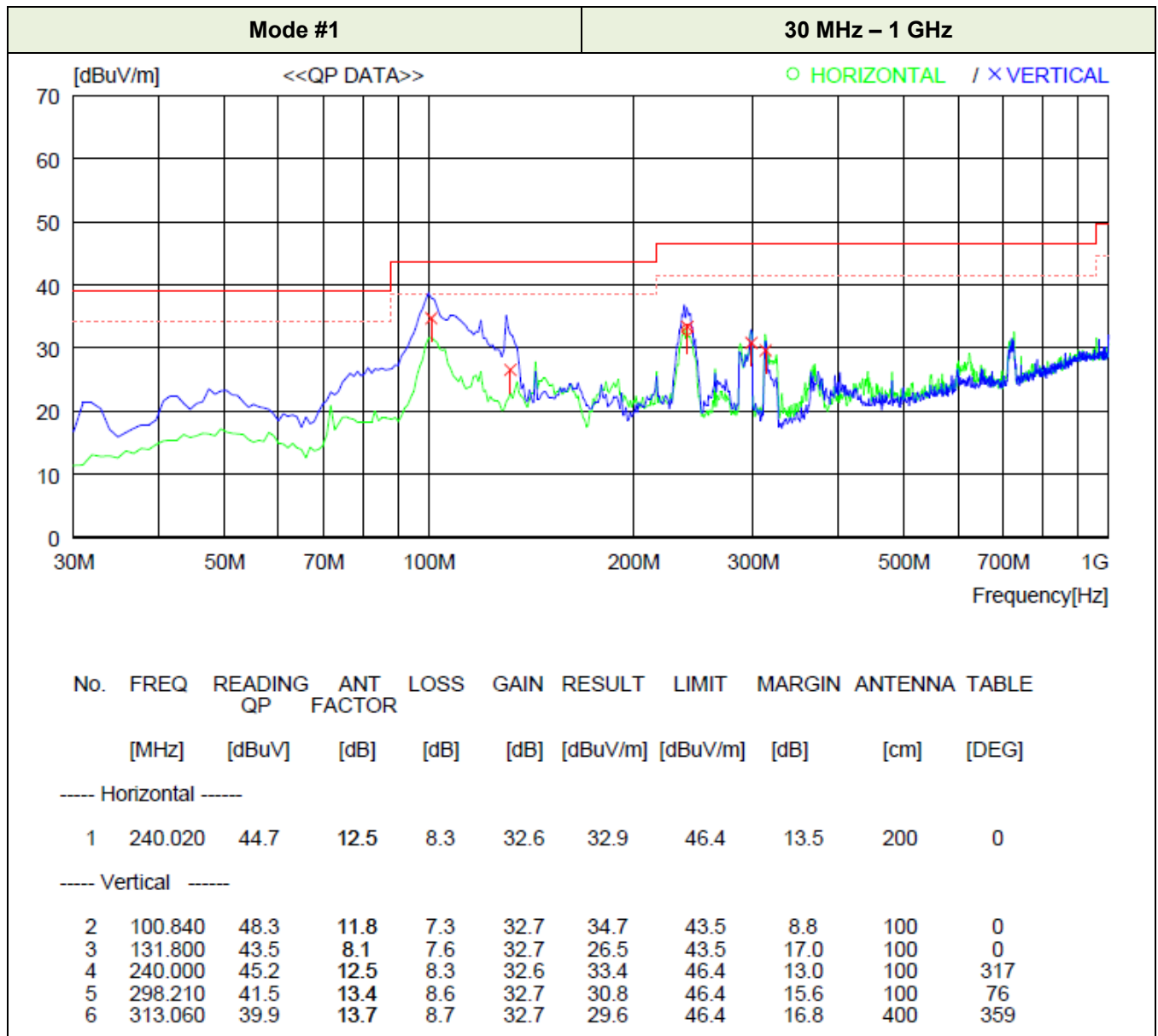
Limit = 40.0 dB $\mu$ V/m

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

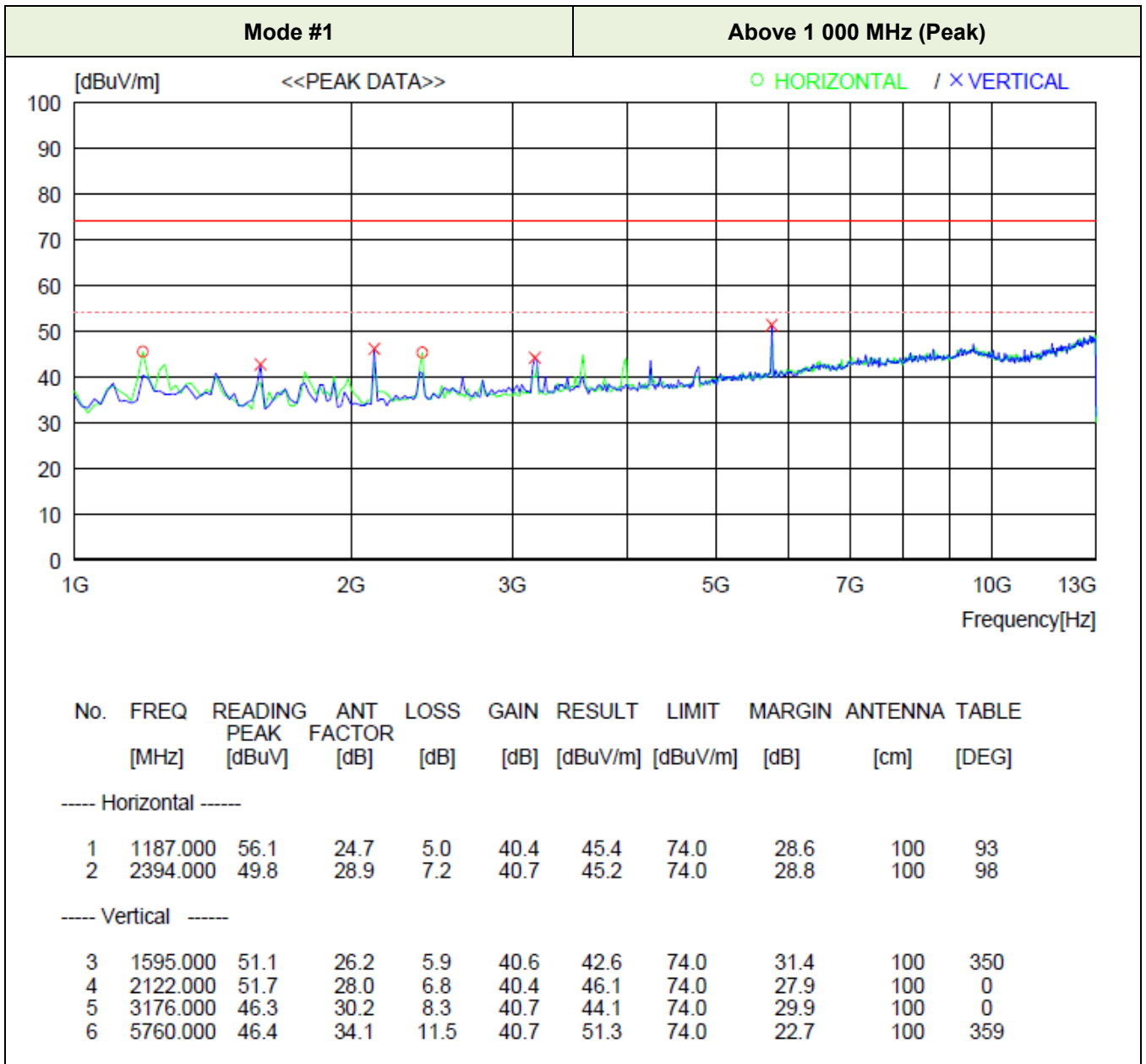
Margin = Limit - Result = 40 - 30 = 10

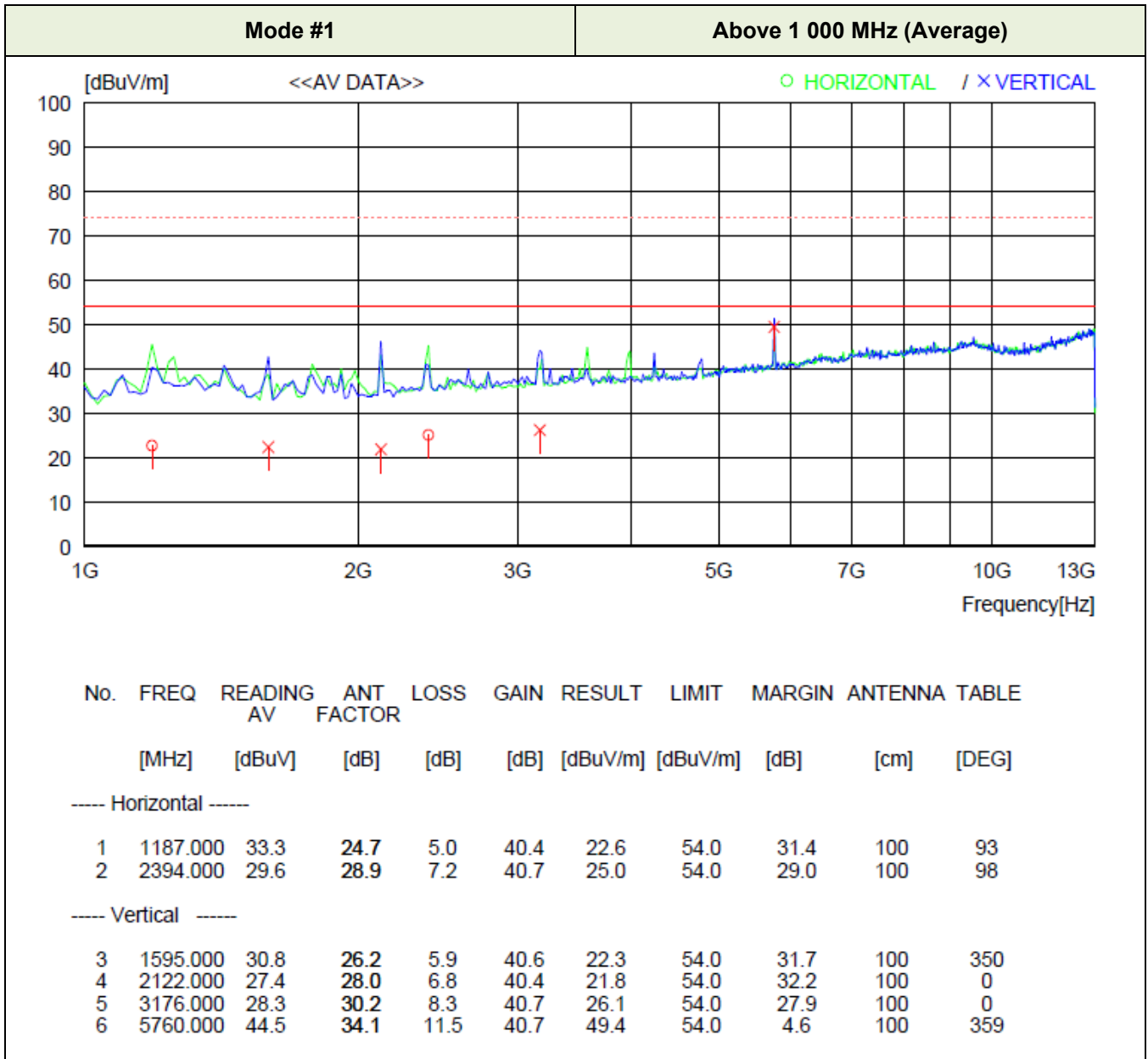
so the EUT has 10.0 dB margin at 80 MHz

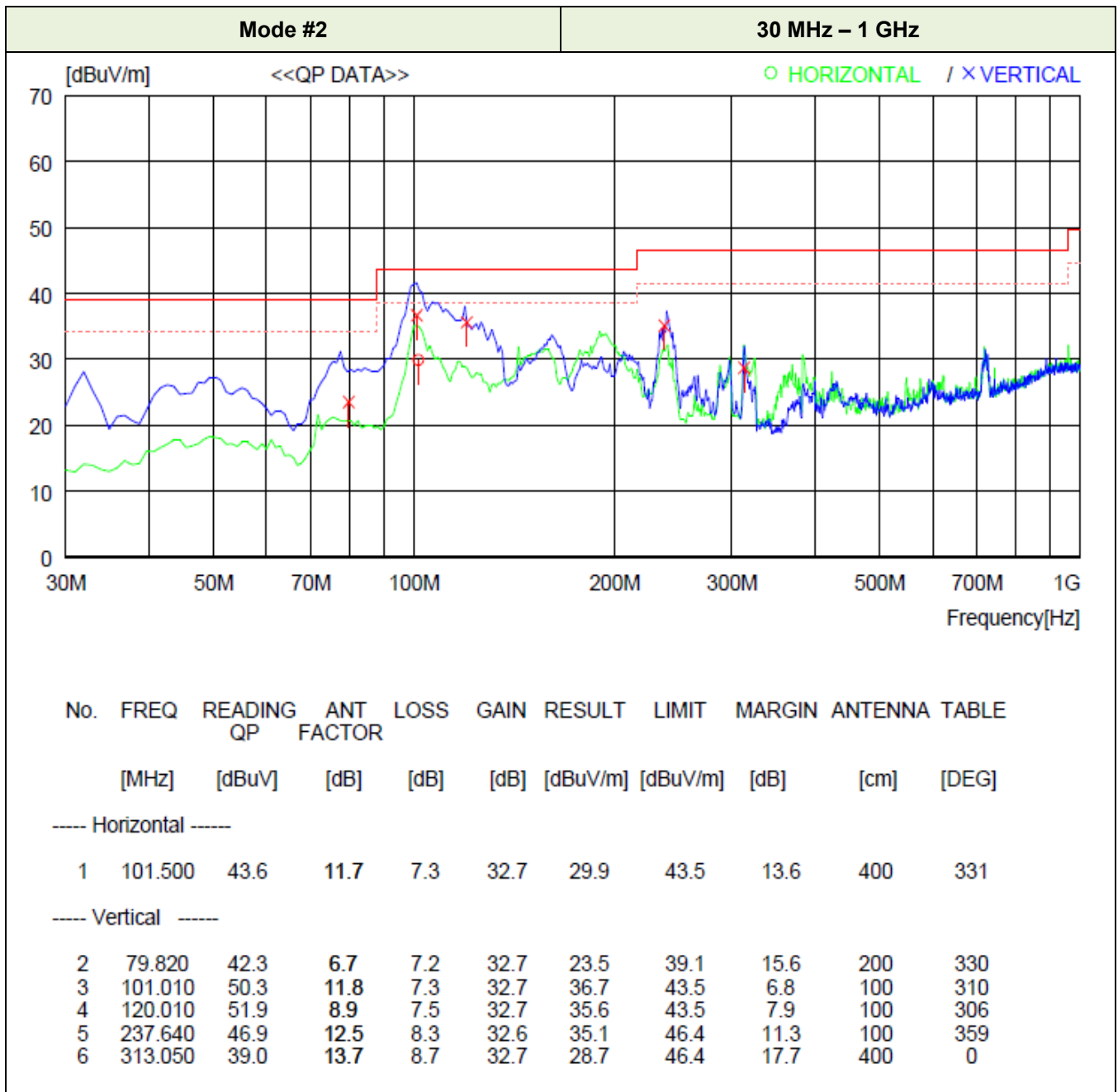
### 3.2.6 Test Data

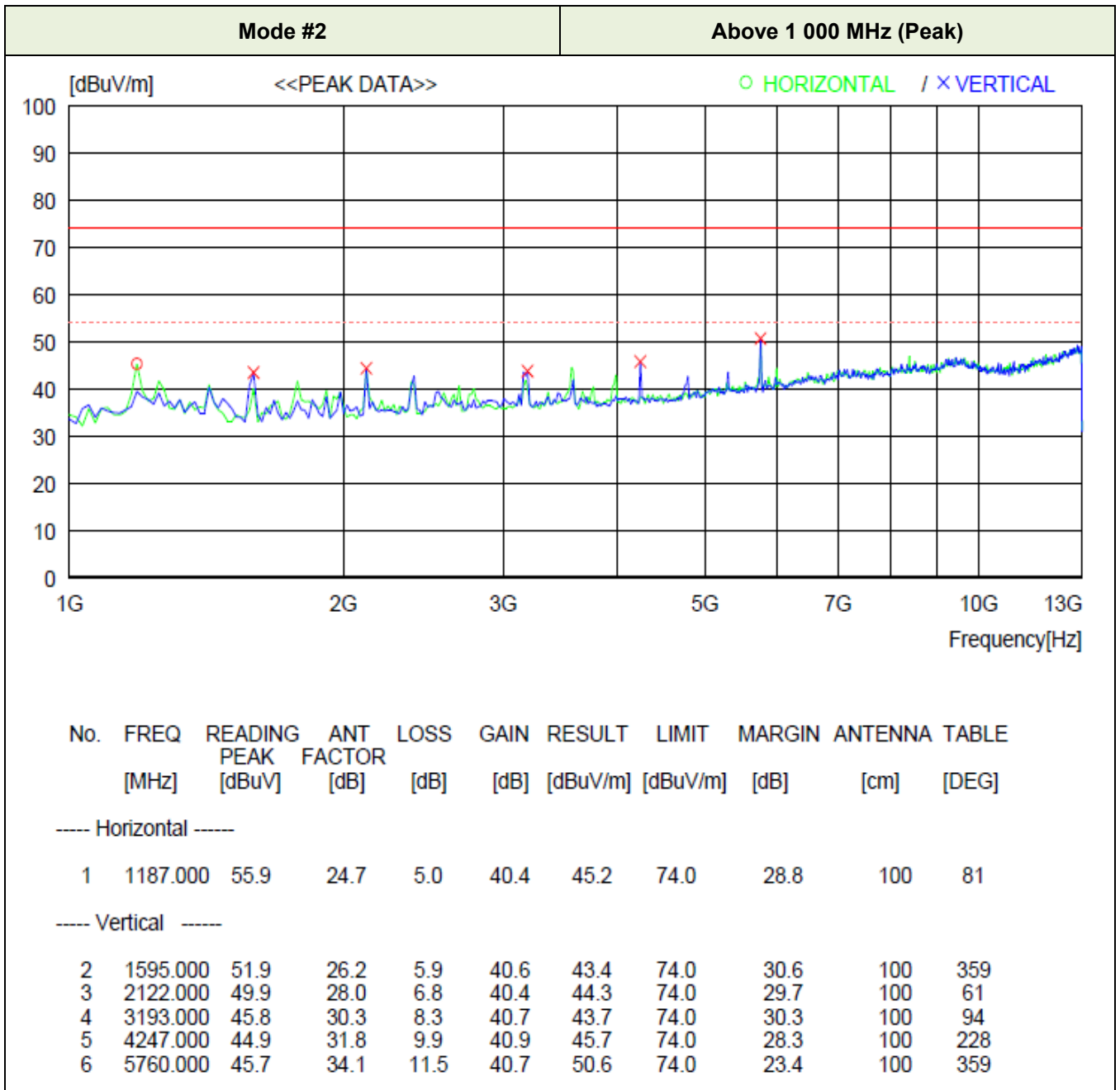


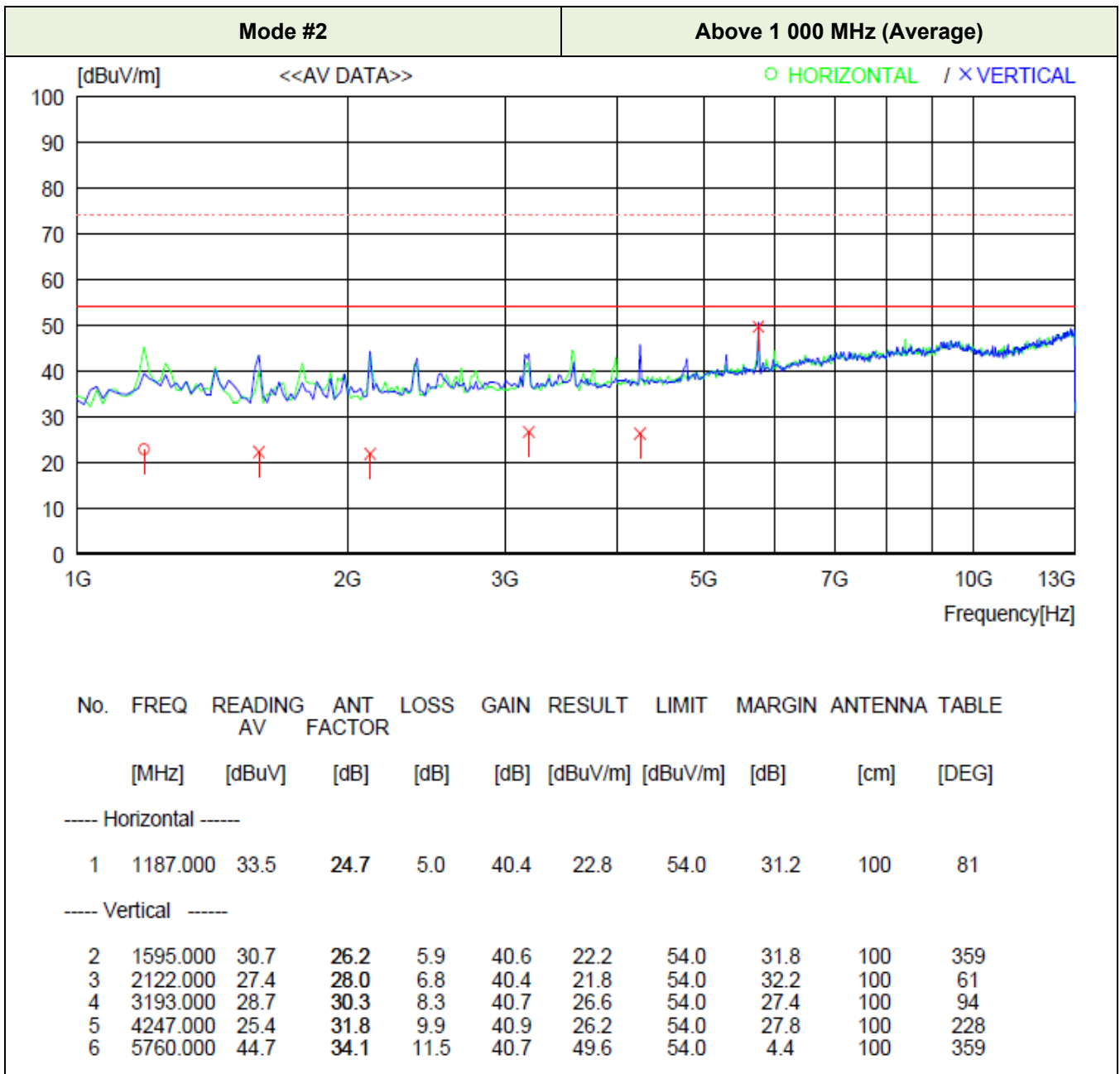


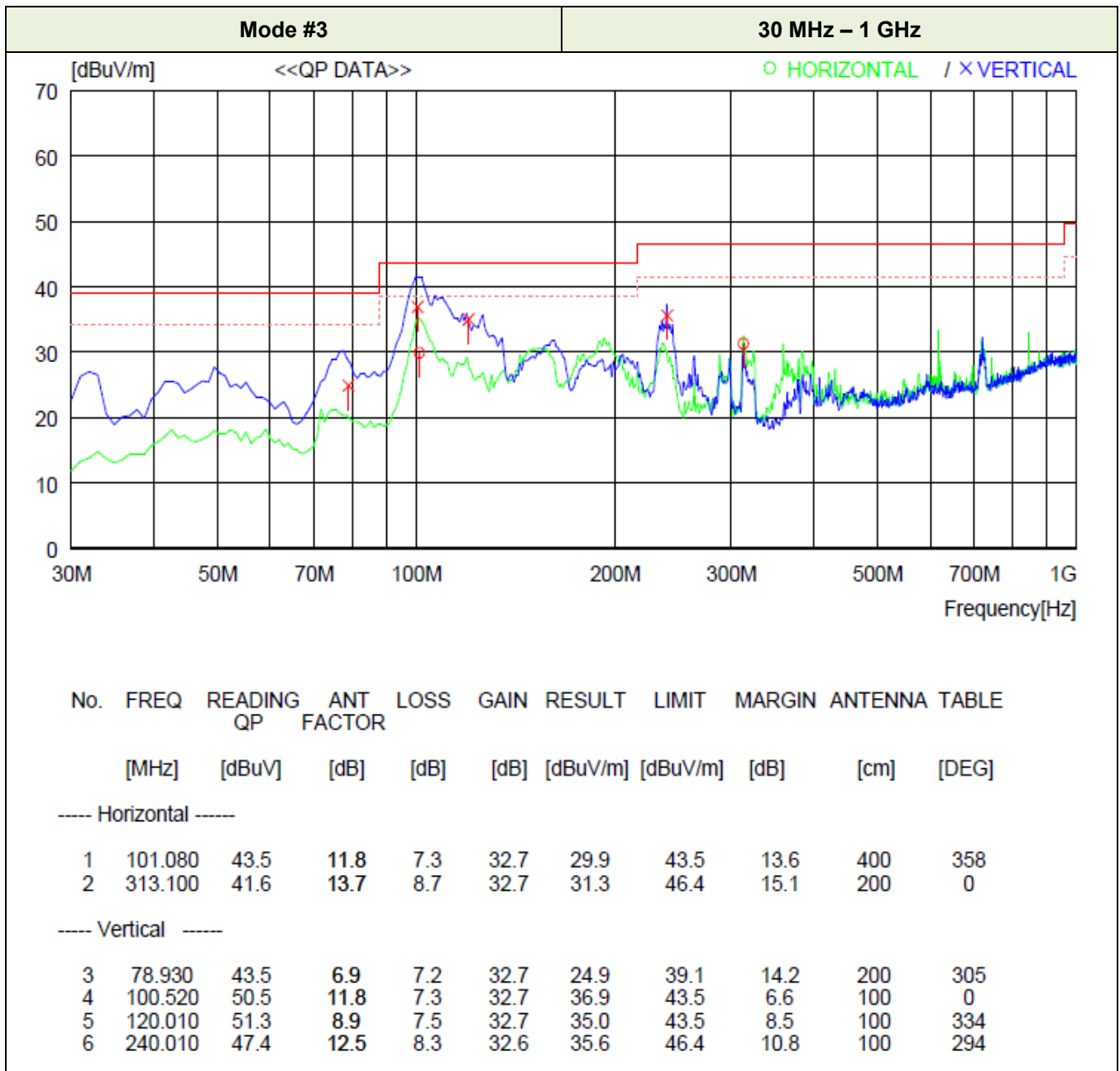


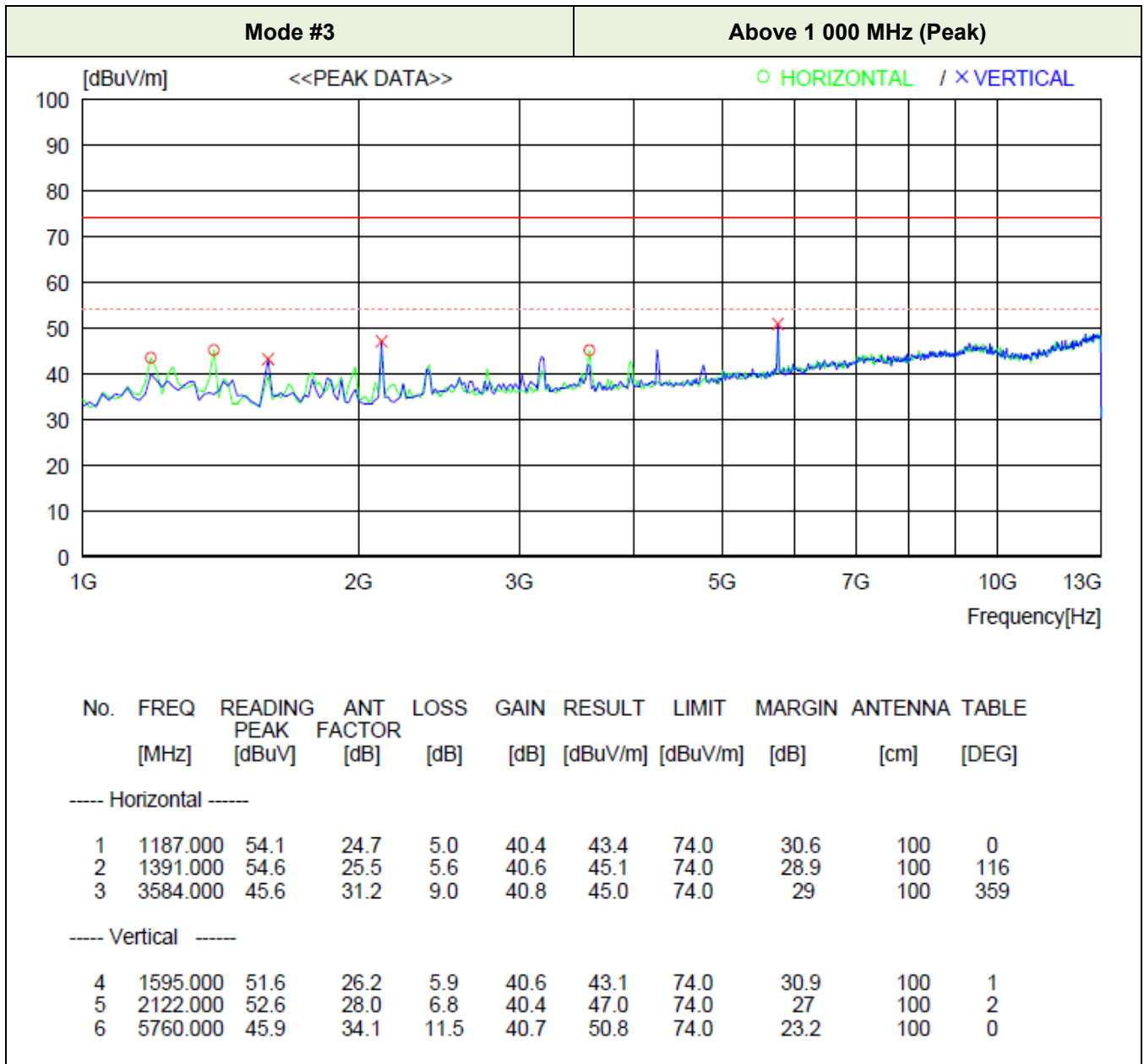


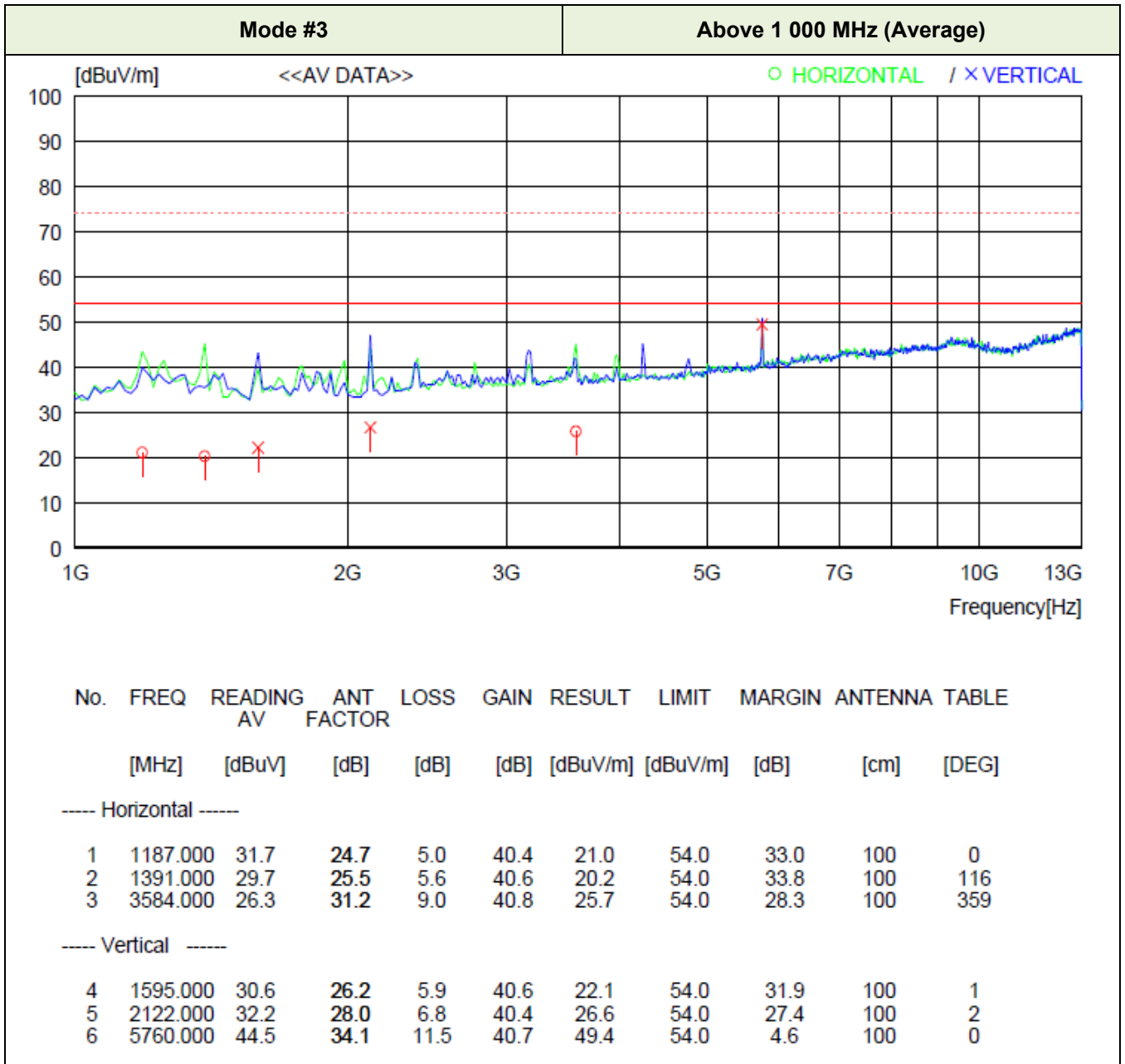




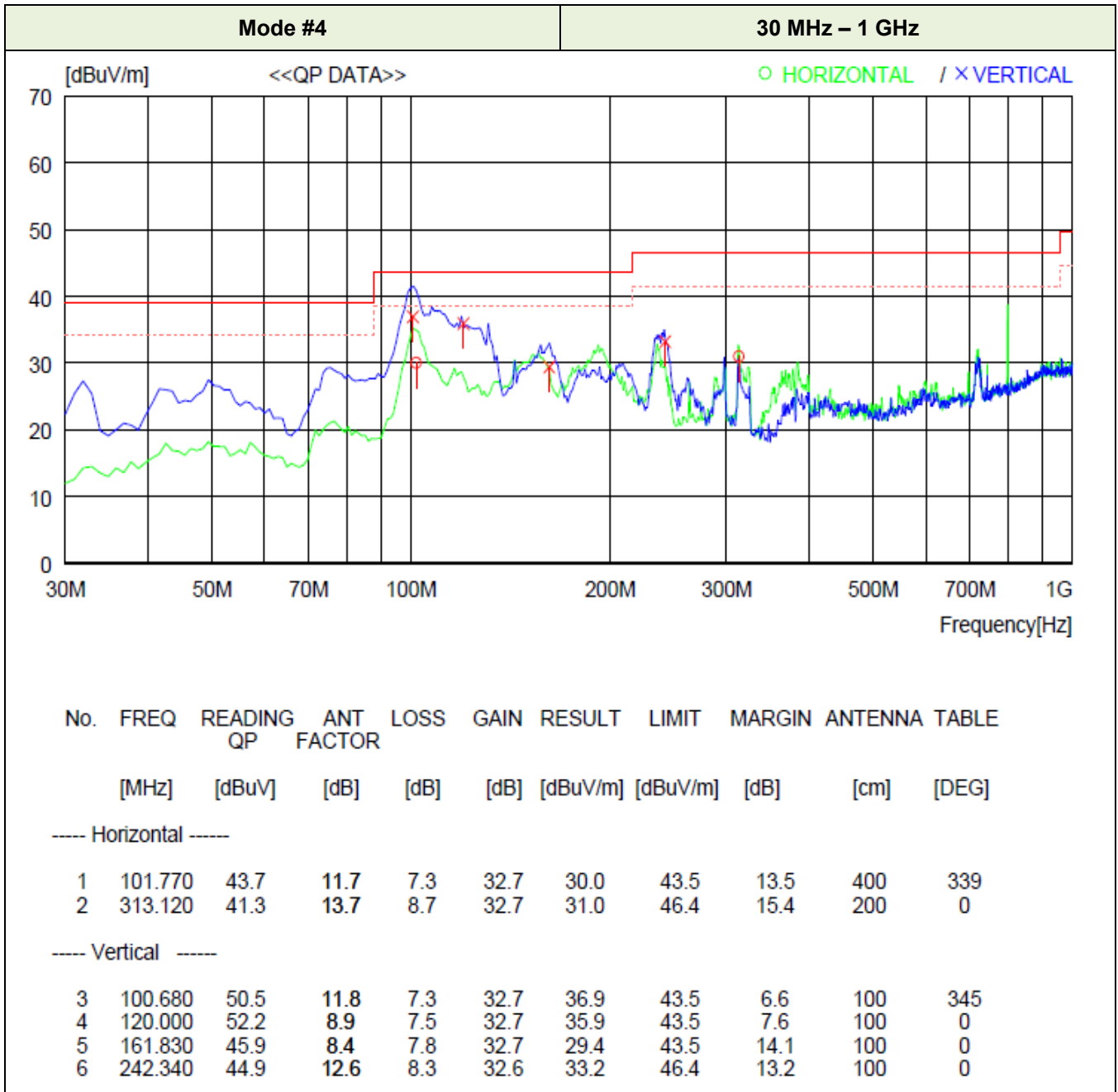




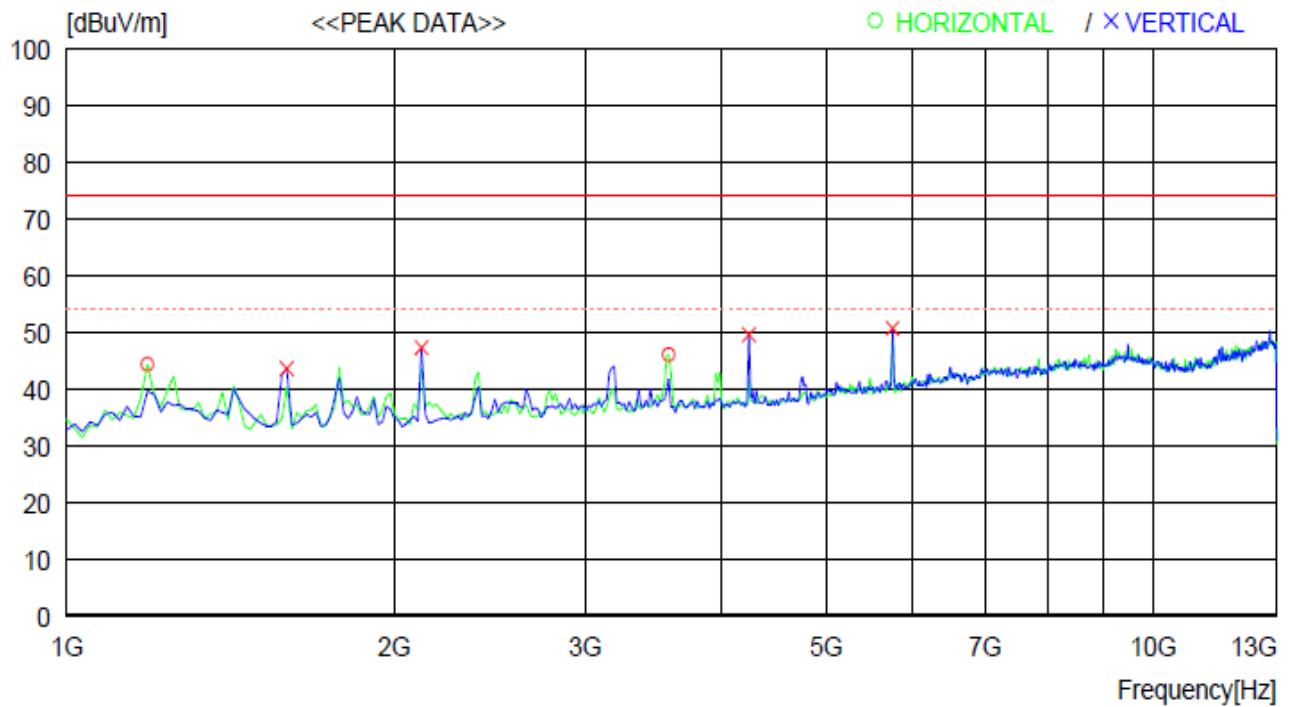




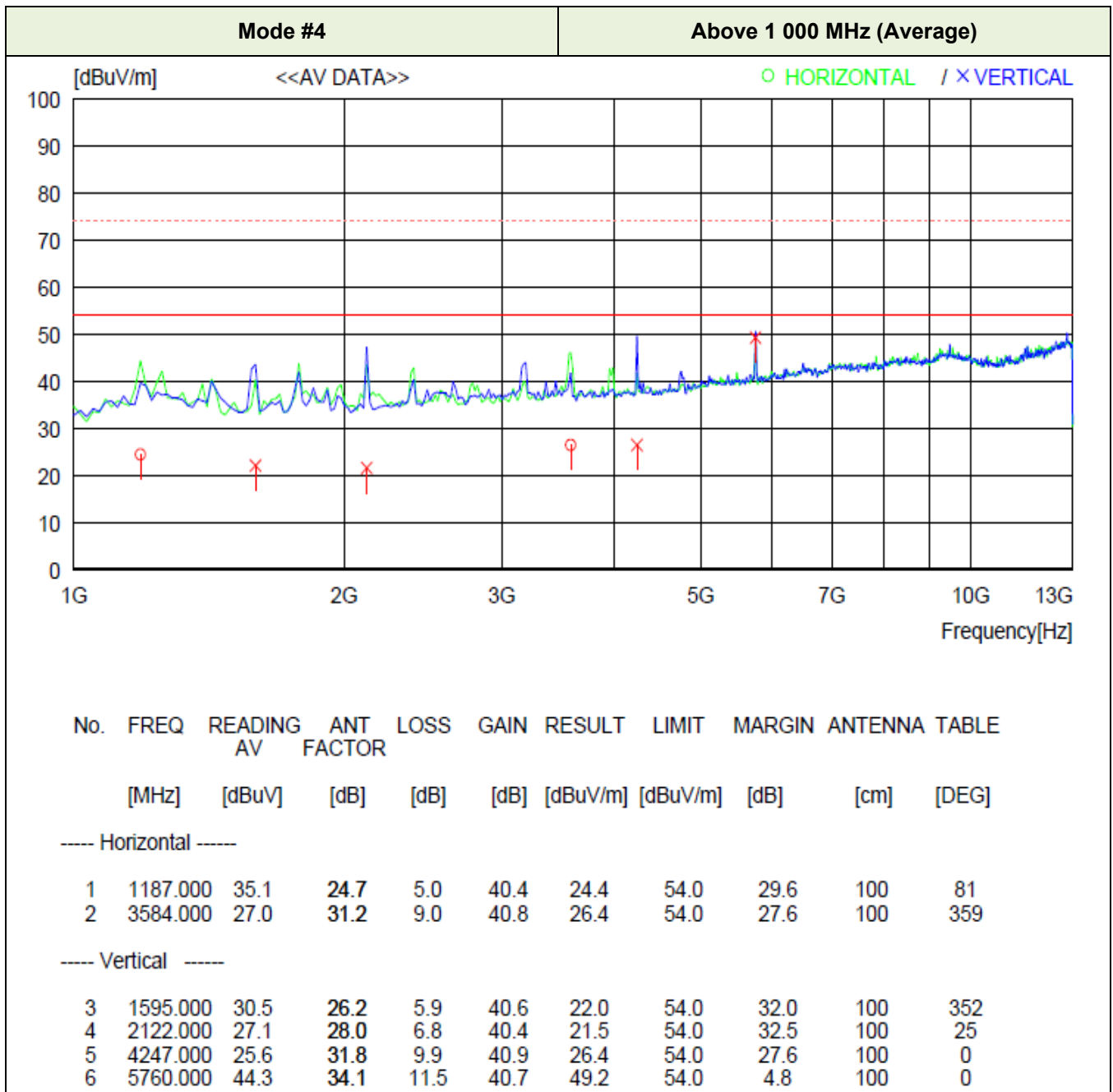


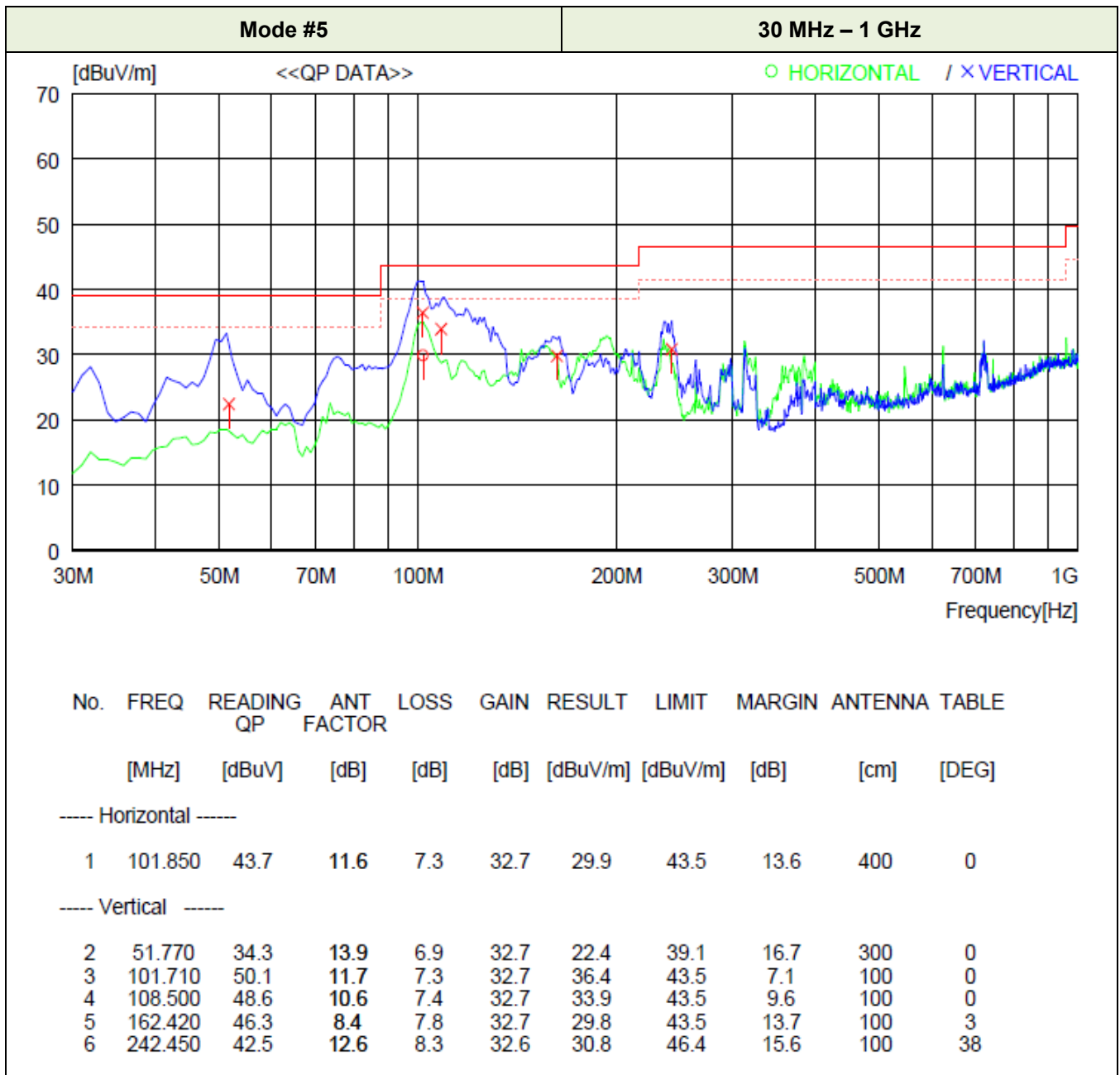


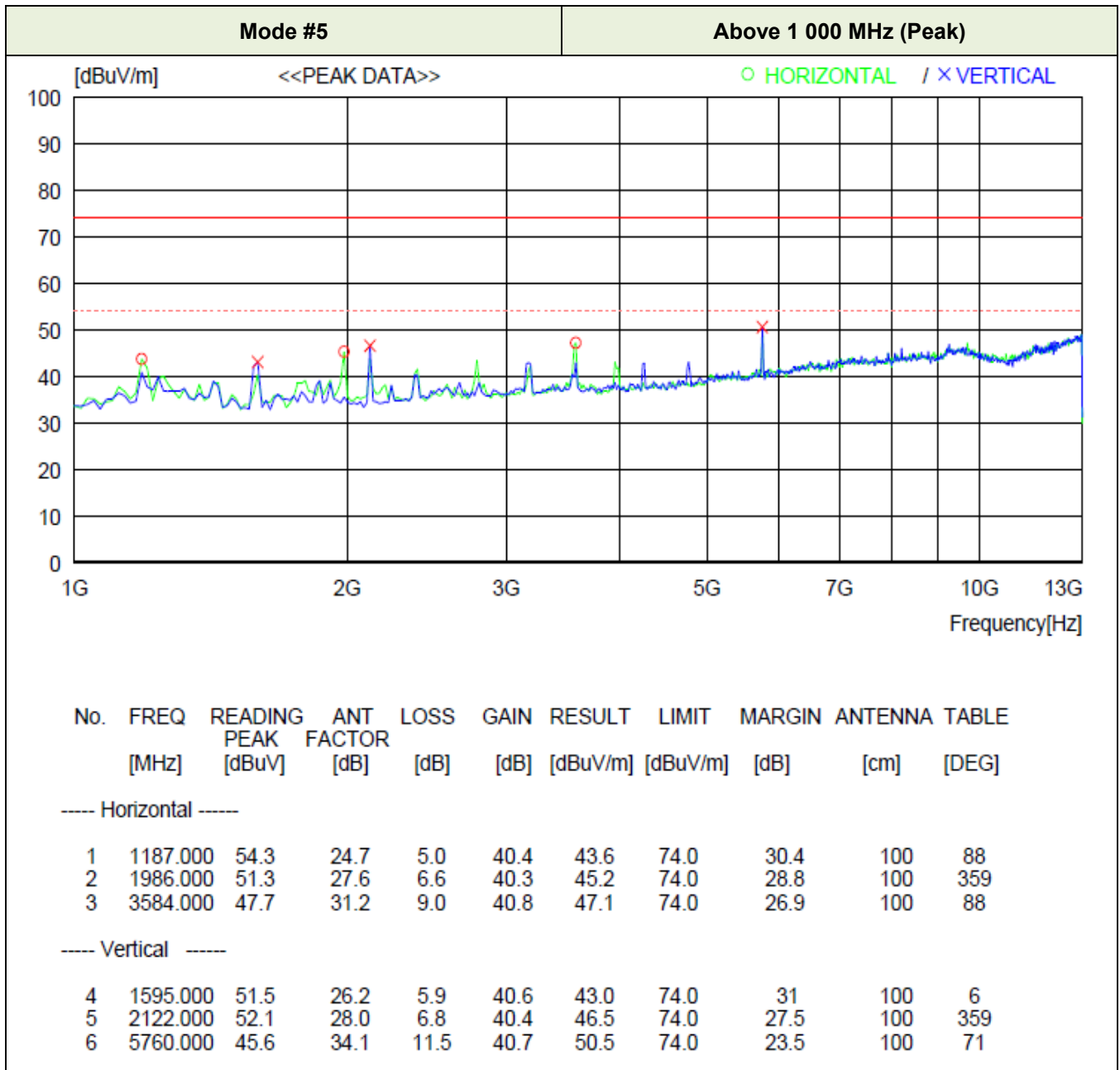
**Mode #4** **Above 1 000 MHz (Peak)**

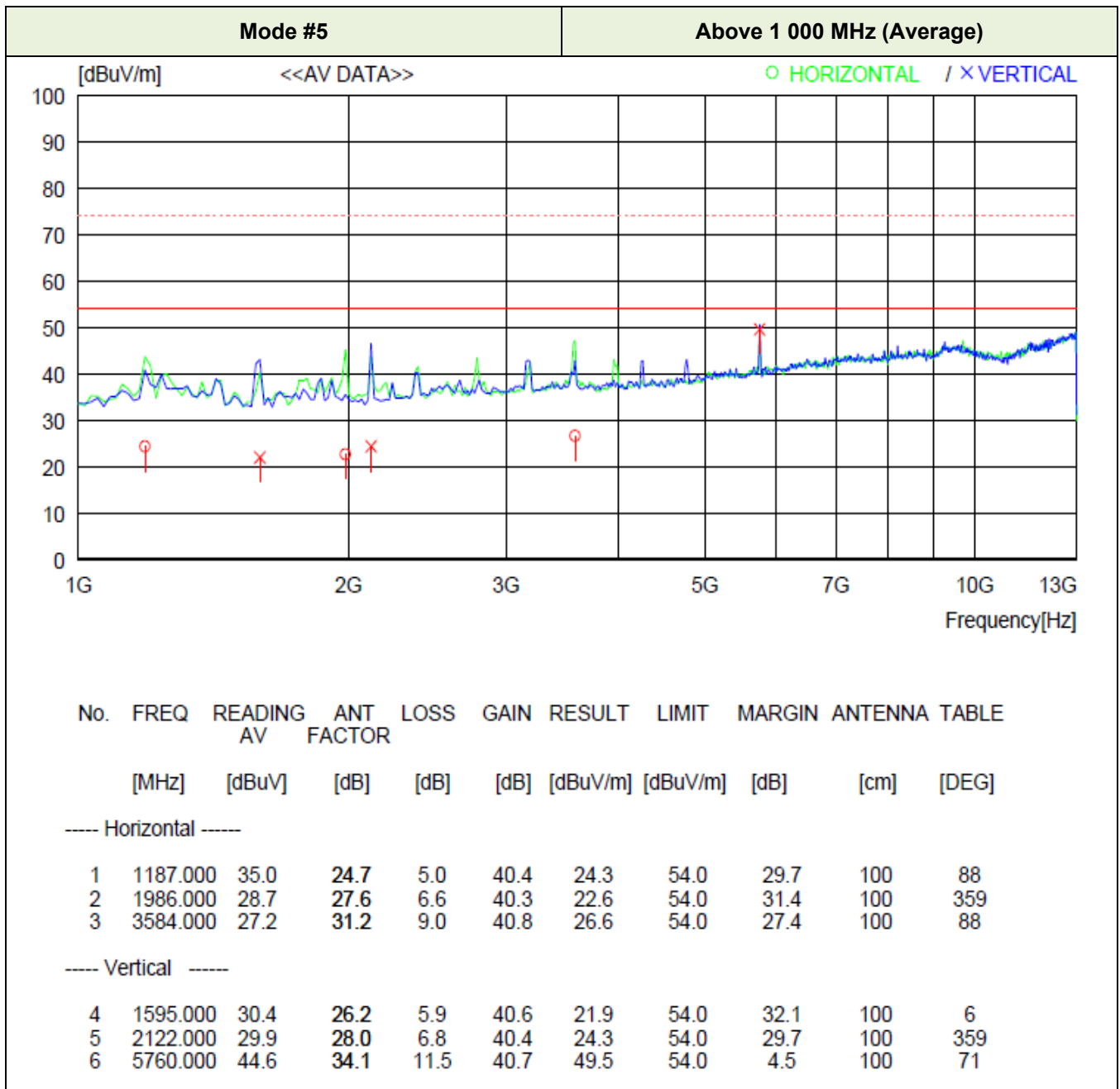


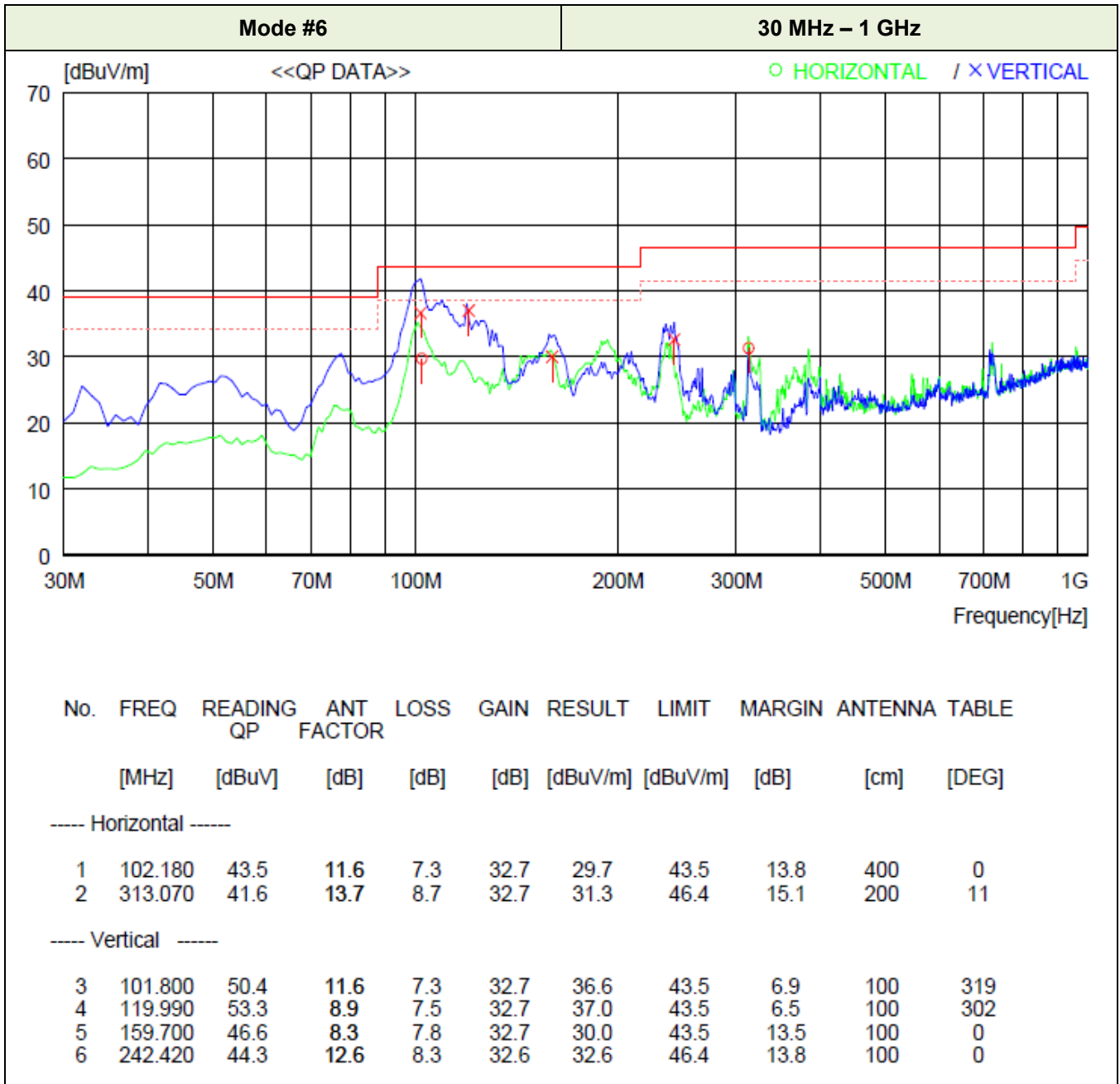
| No.                  | FREQ [MHz] | READING PEAK [dBuV] | ANT FACTOR [dB] | LOSS [dB] | GAIN [dB] | RESULT [dBuV/m] | LIMIT [dBuV/m] | MARGIN [dB] | ANTENNA [cm] | TABLE [DEG] |
|----------------------|------------|---------------------|-----------------|-----------|-----------|-----------------|----------------|-------------|--------------|-------------|
| ---- Horizontal ---- |            |                     |                 |           |           |                 |                |             |              |             |
| 1                    | 1187.000   | 55.0                | 24.7            | 5.0       | 40.4      | 44.3            | 74.0           | 29.7        | 100          | 81          |
| 2                    | 3584.000   | 46.6                | 31.2            | 9.0       | 40.8      | 46.0            | 74.0           | 28          | 100          | 359         |
| ---- Vertical ----   |            |                     |                 |           |           |                 |                |             |              |             |
| 3                    | 1595.000   | 52.0                | 26.2            | 5.9       | 40.6      | 43.5            | 74.0           | 30.5        | 100          | 352         |
| 4                    | 2122.000   | 52.8                | 28.0            | 6.8       | 40.4      | 47.2            | 74.0           | 26.8        | 100          | 25          |
| 5                    | 4247.000   | 48.7                | 31.8            | 9.9       | 40.9      | 49.5            | 74.0           | 24.5        | 100          | 0           |
| 6                    | 5760.000   | 45.7                | 34.1            | 11.5      | 40.7      | 50.6            | 74.0           | 23.4        | 100          | 0           |

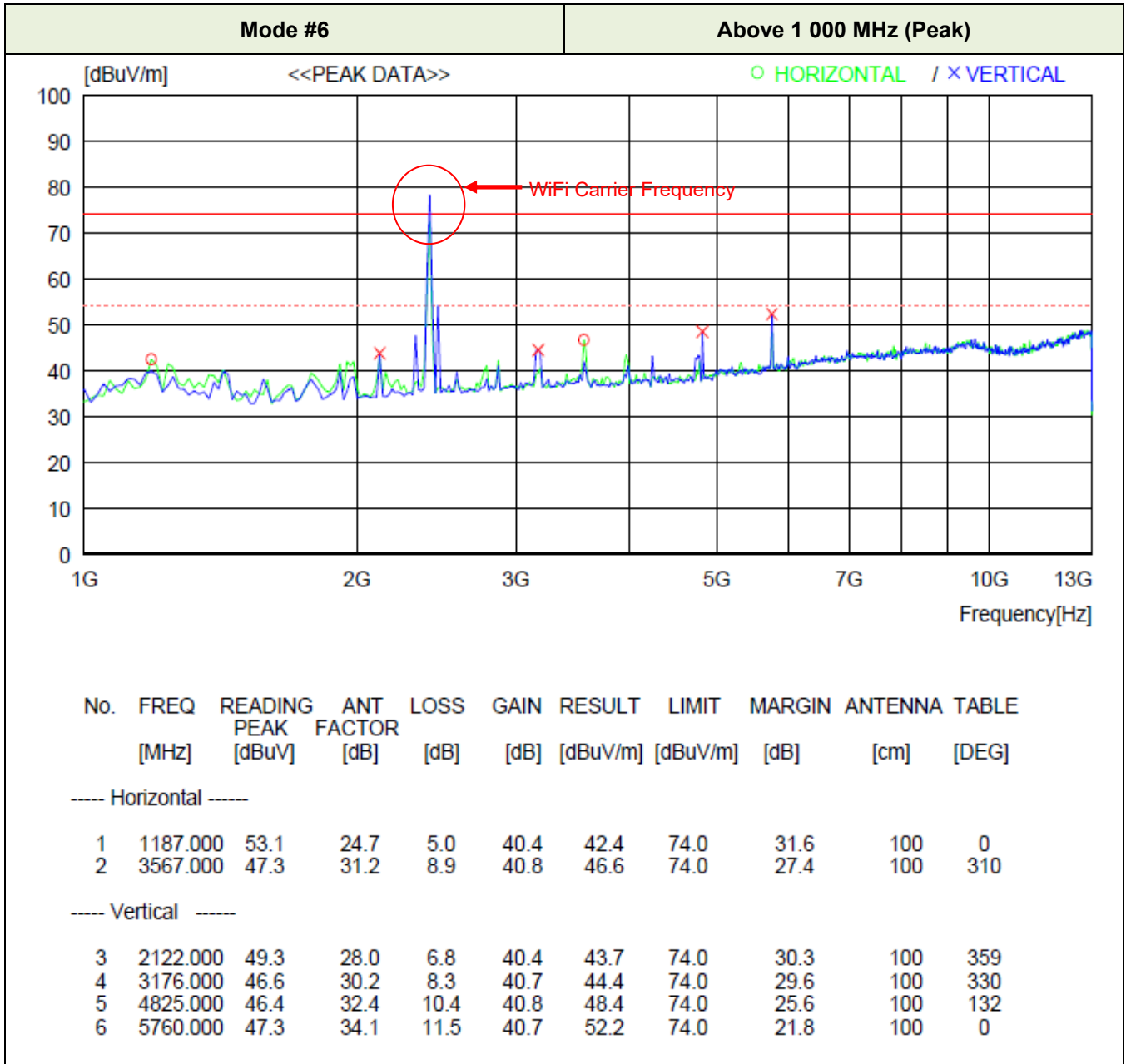




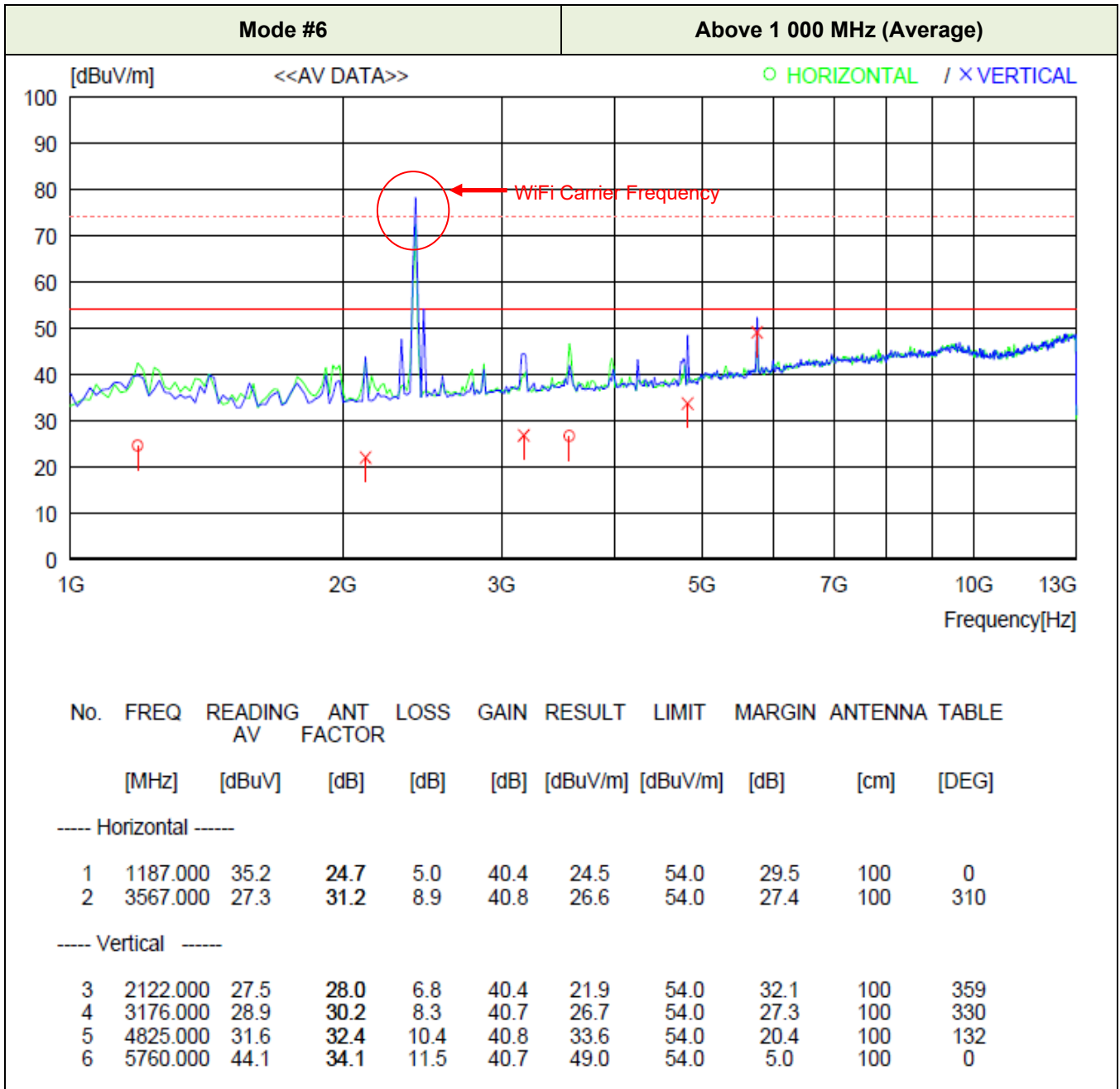


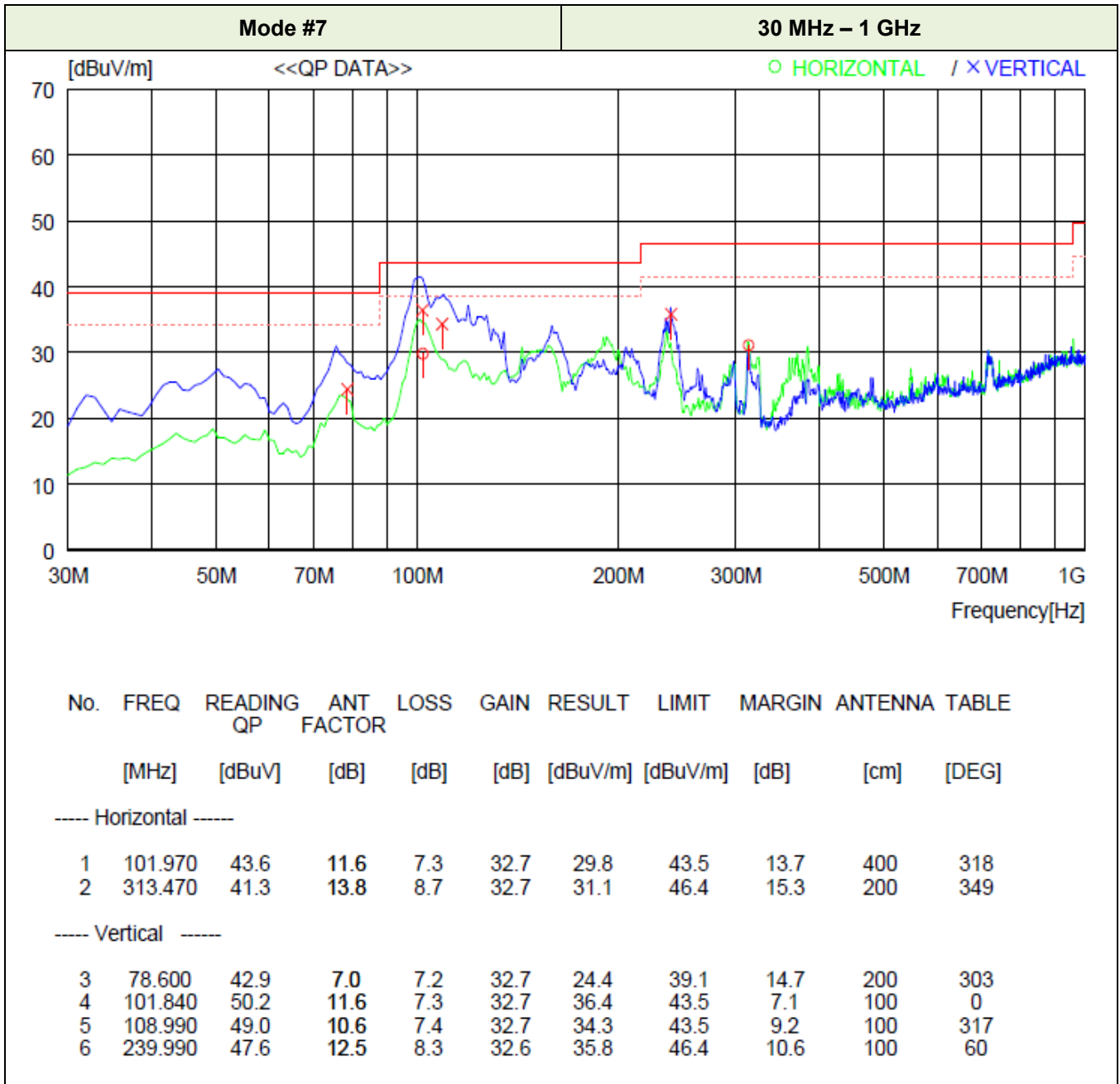


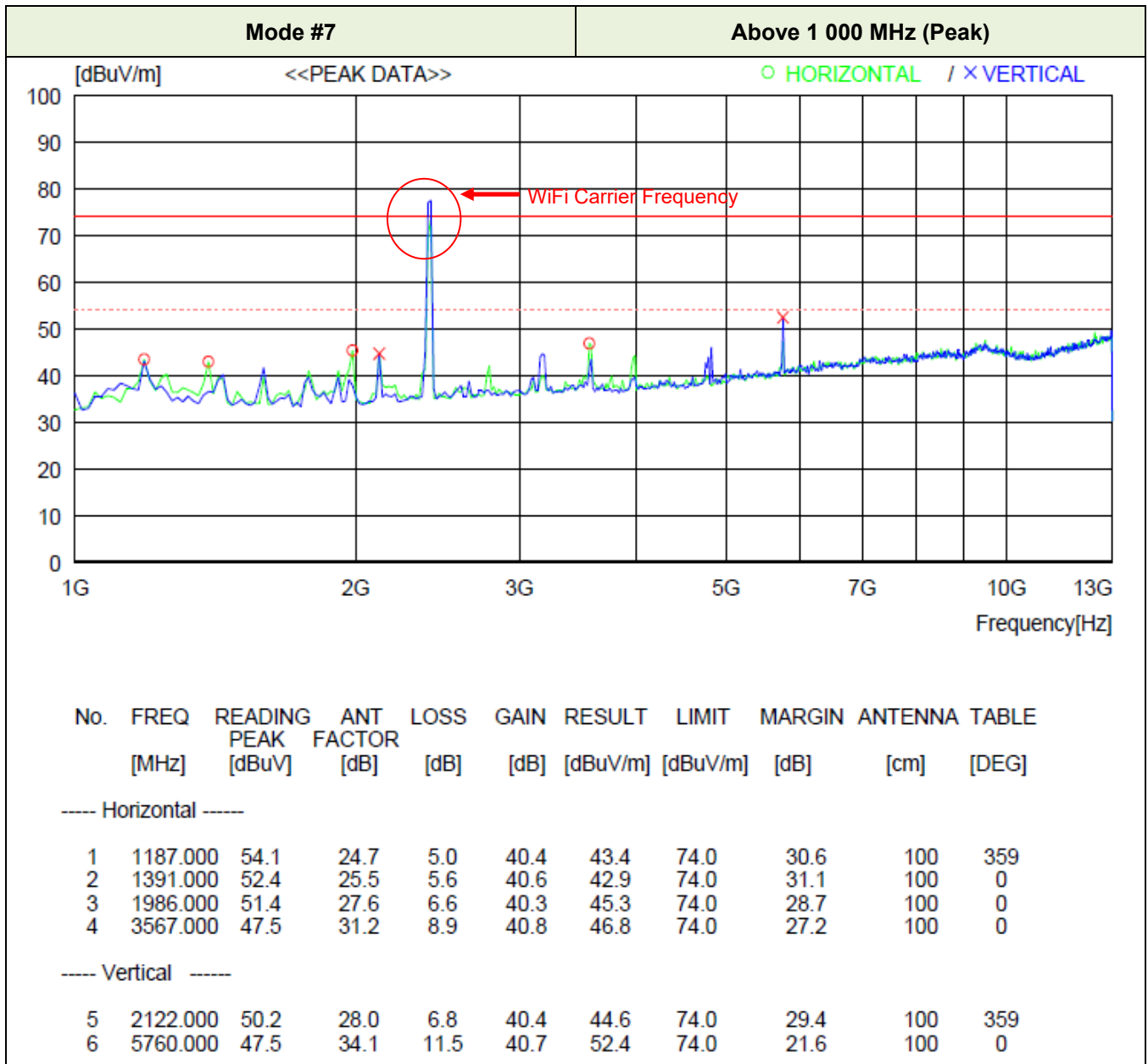


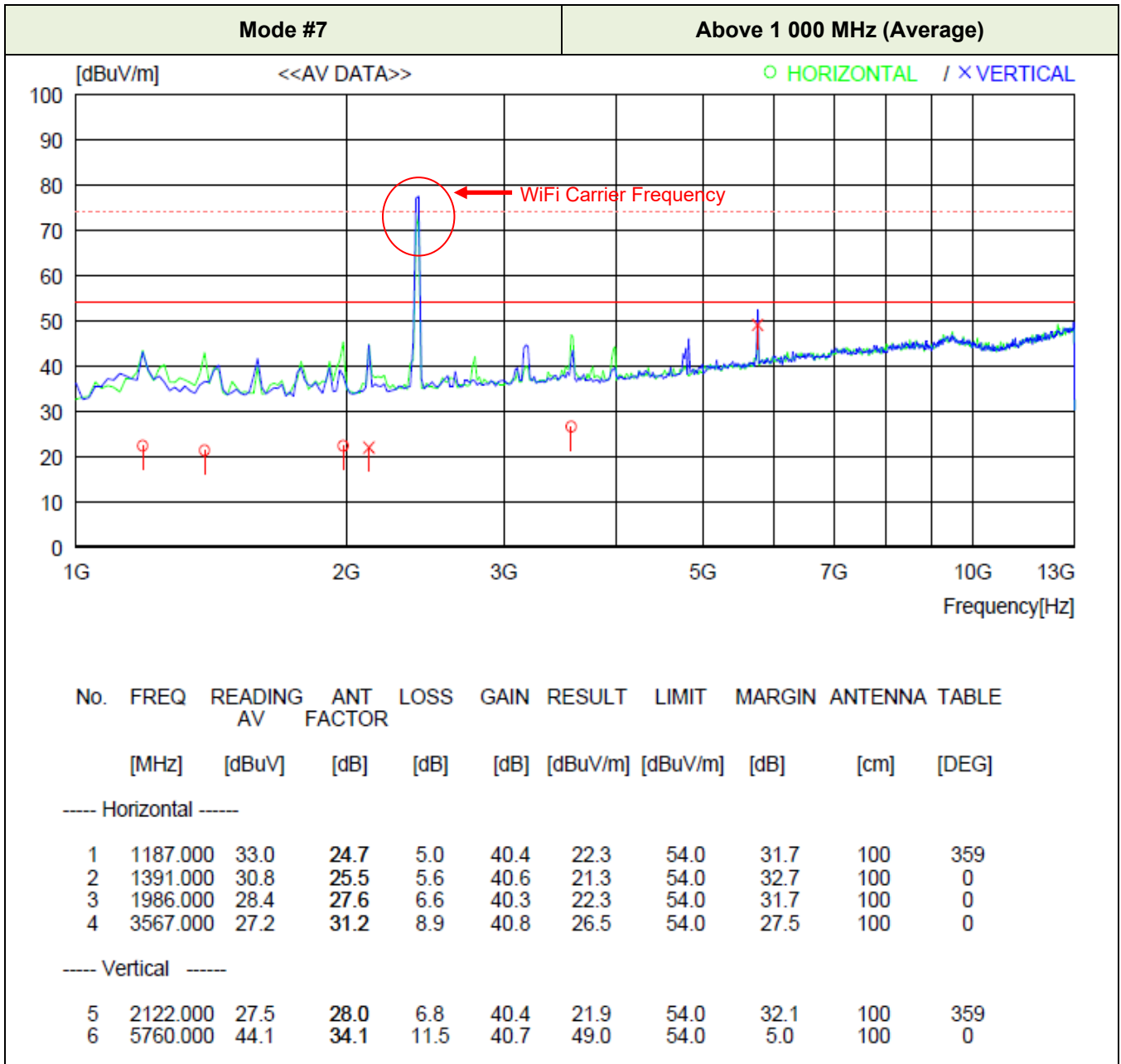


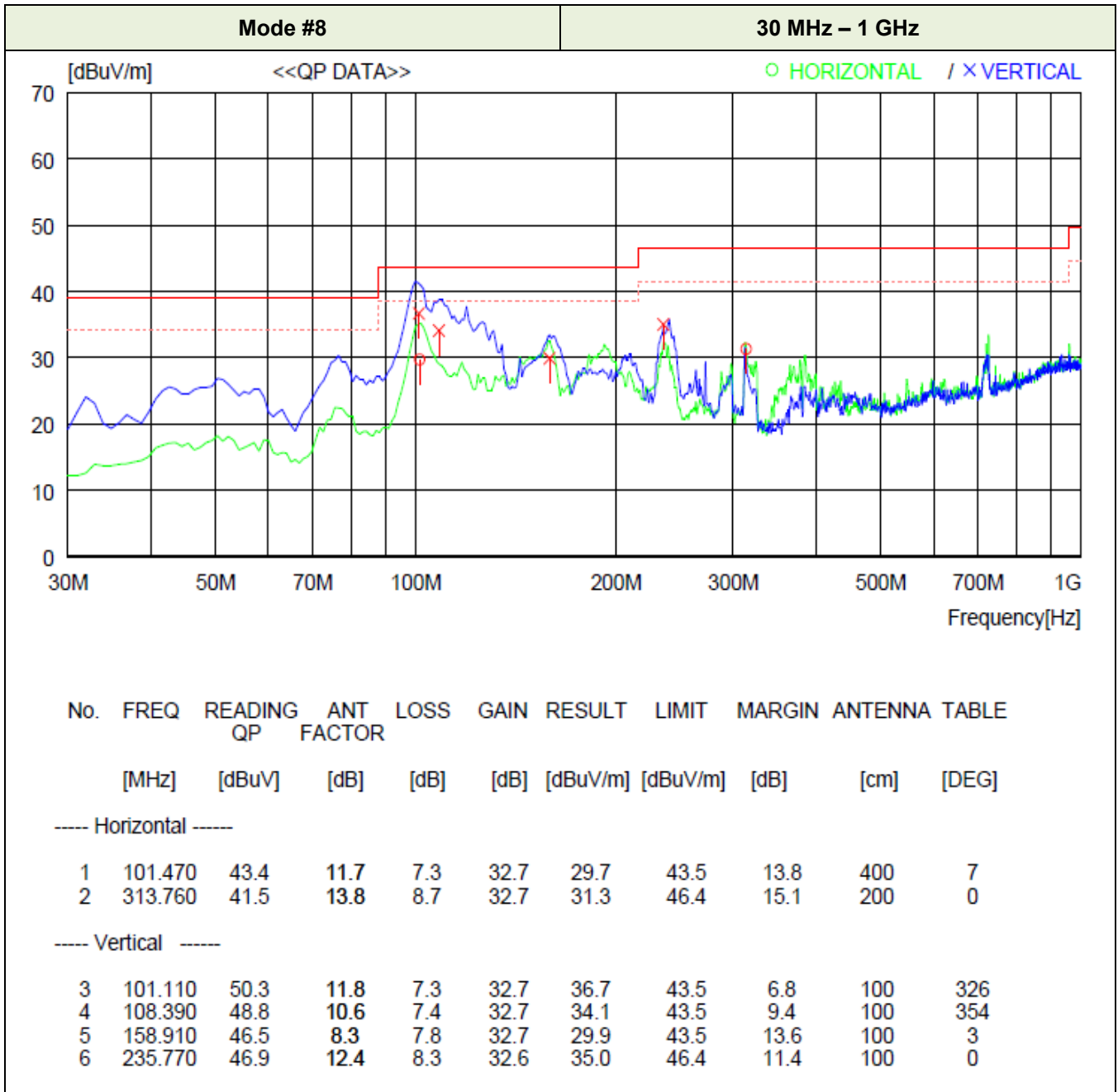


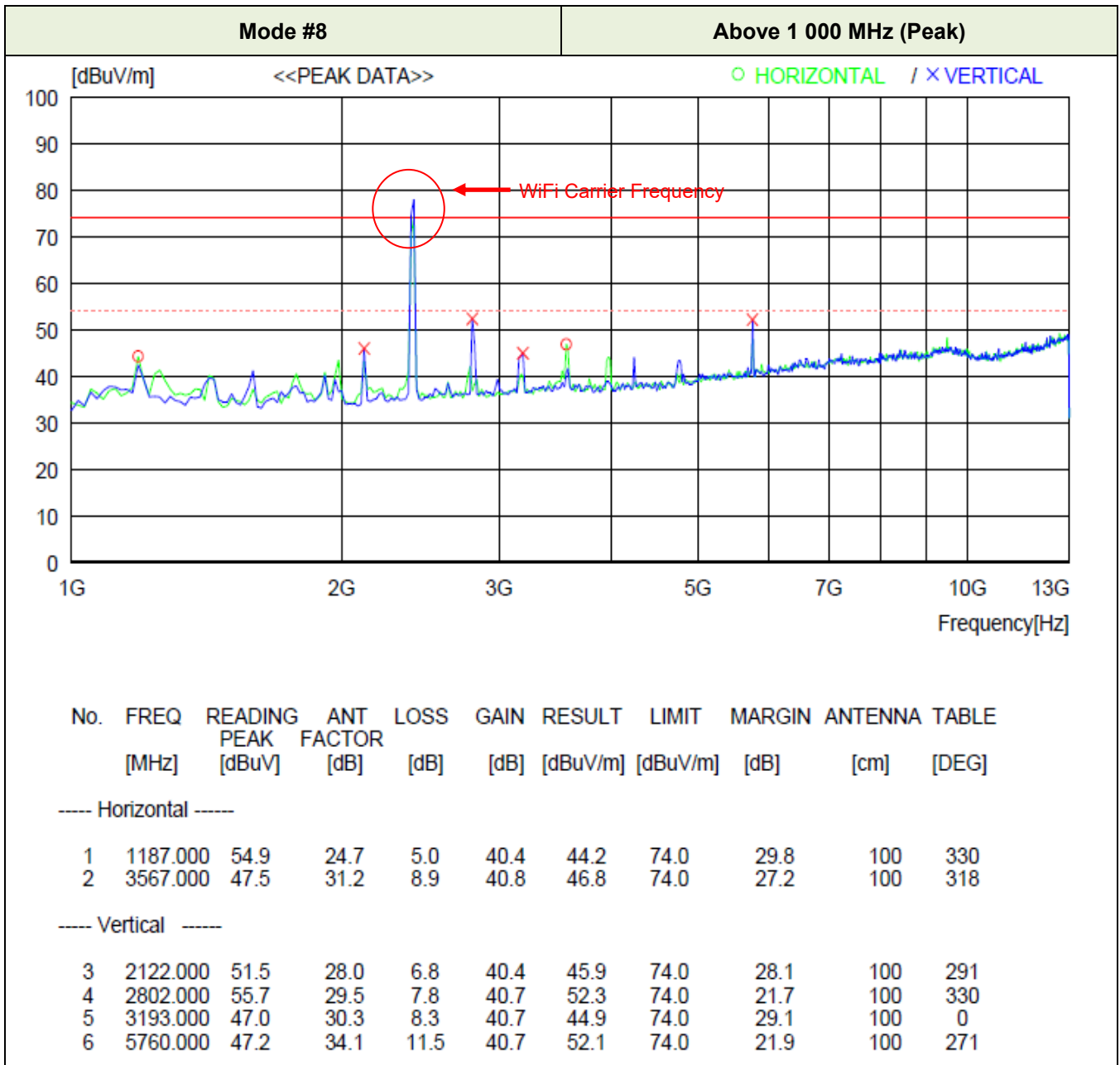




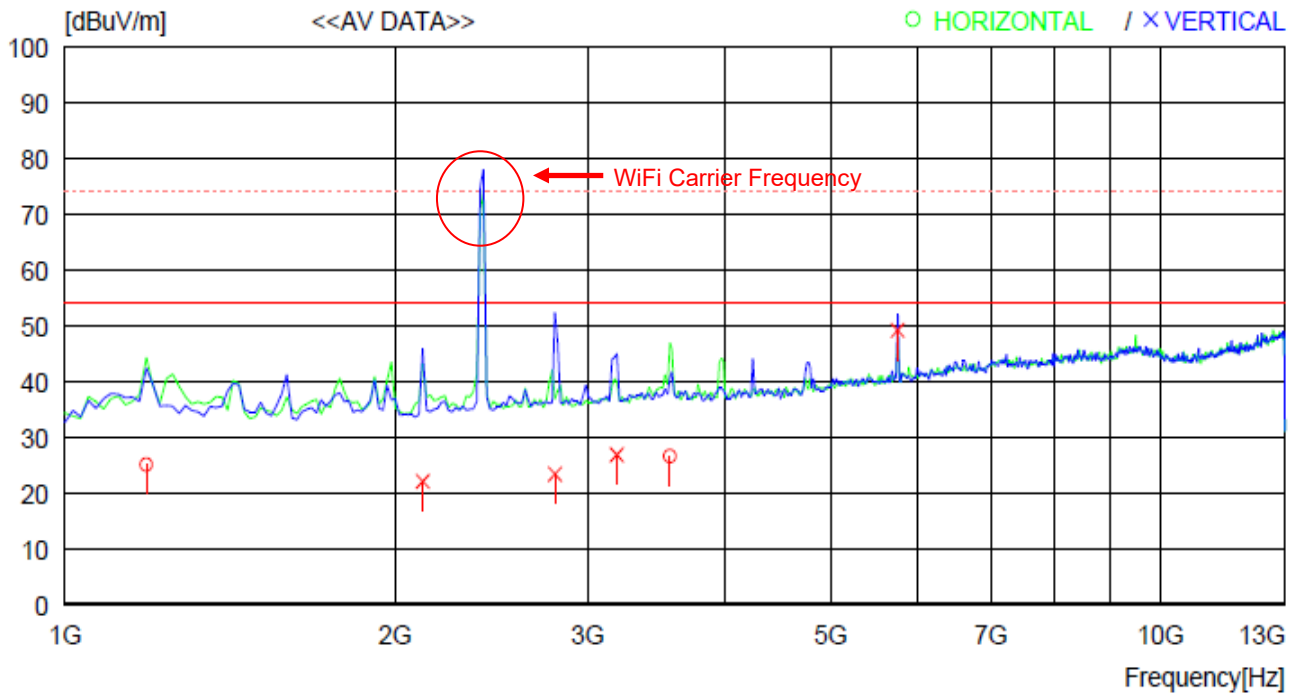




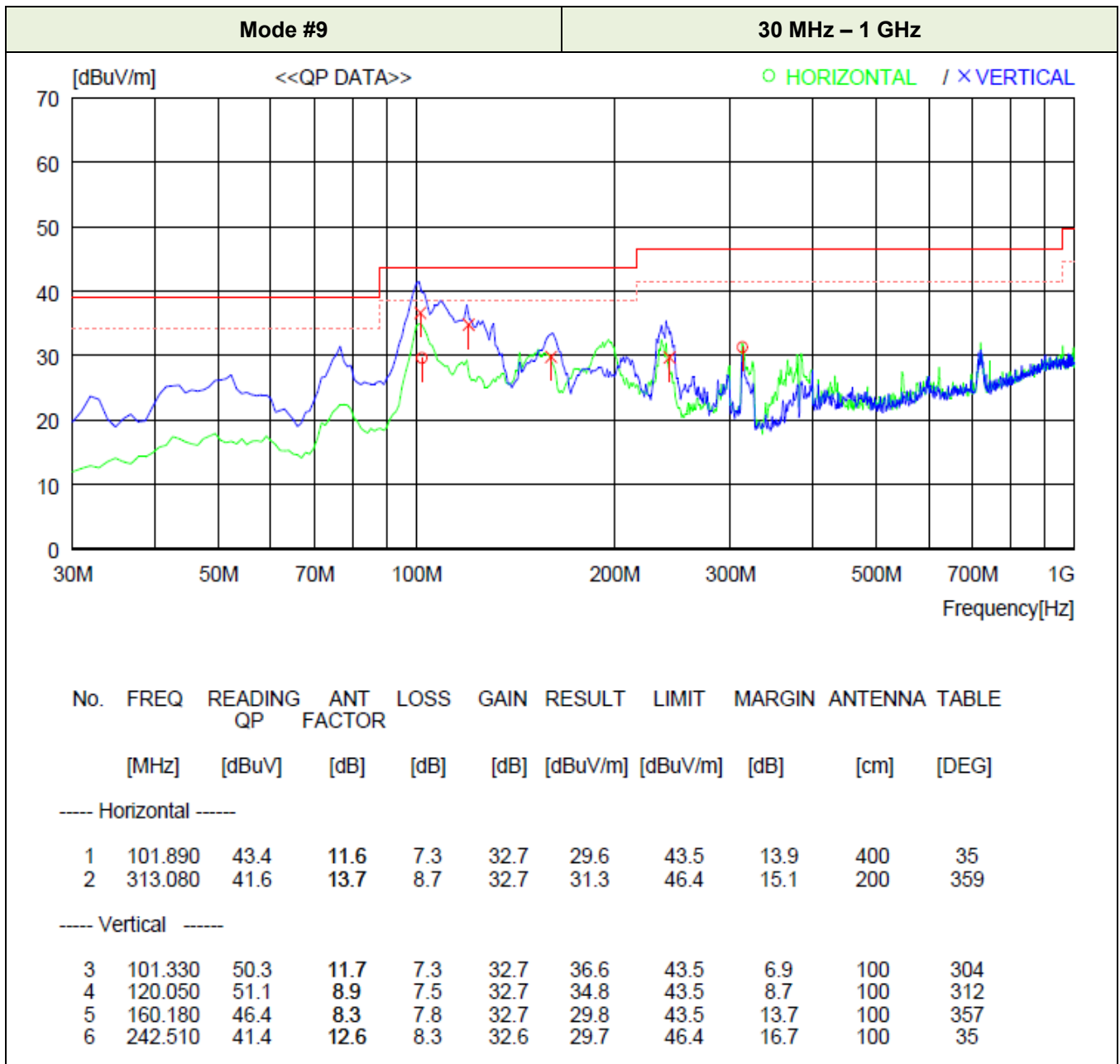




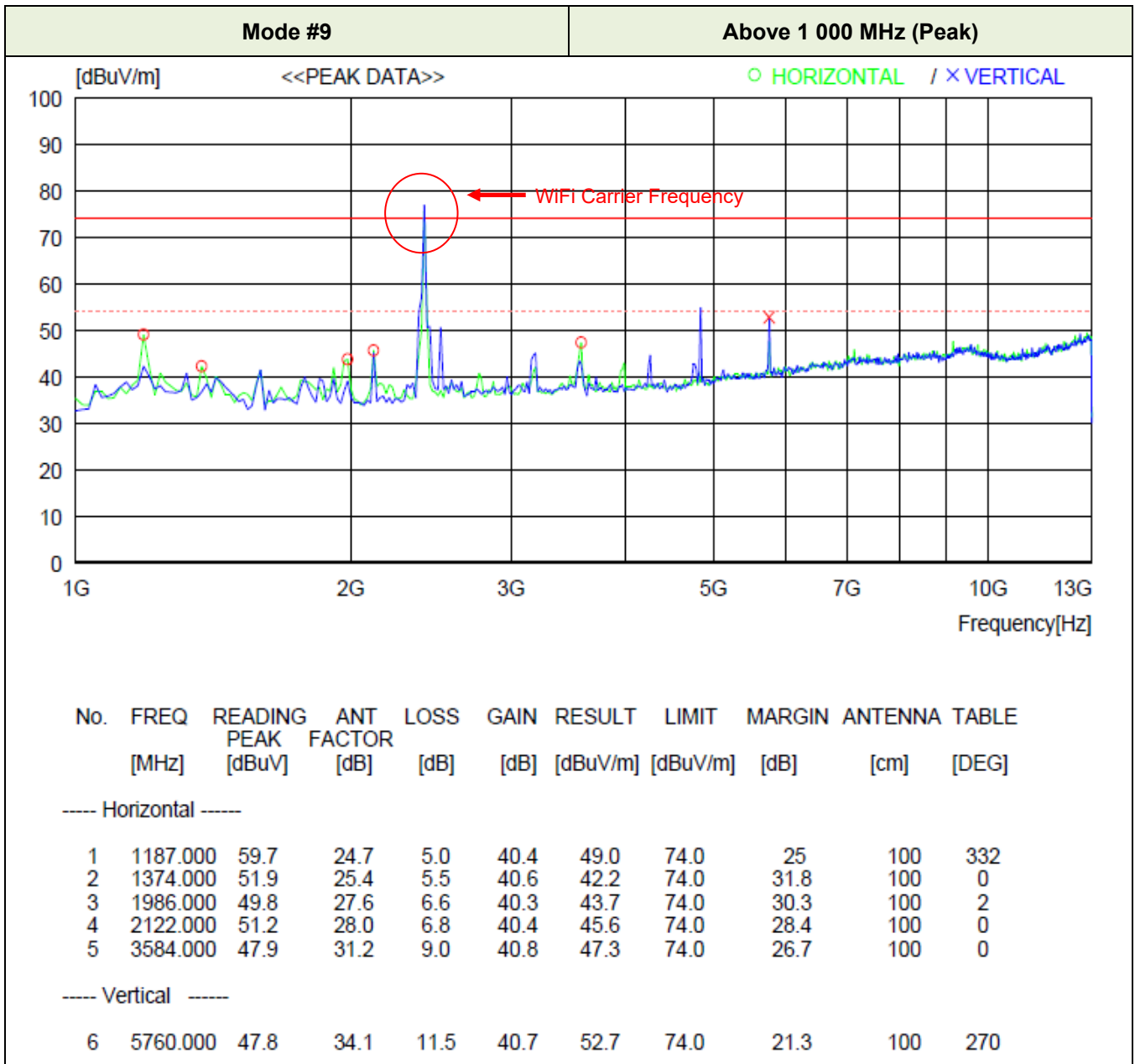
**Mode #8** **Above 1 000 MHz (Average)**

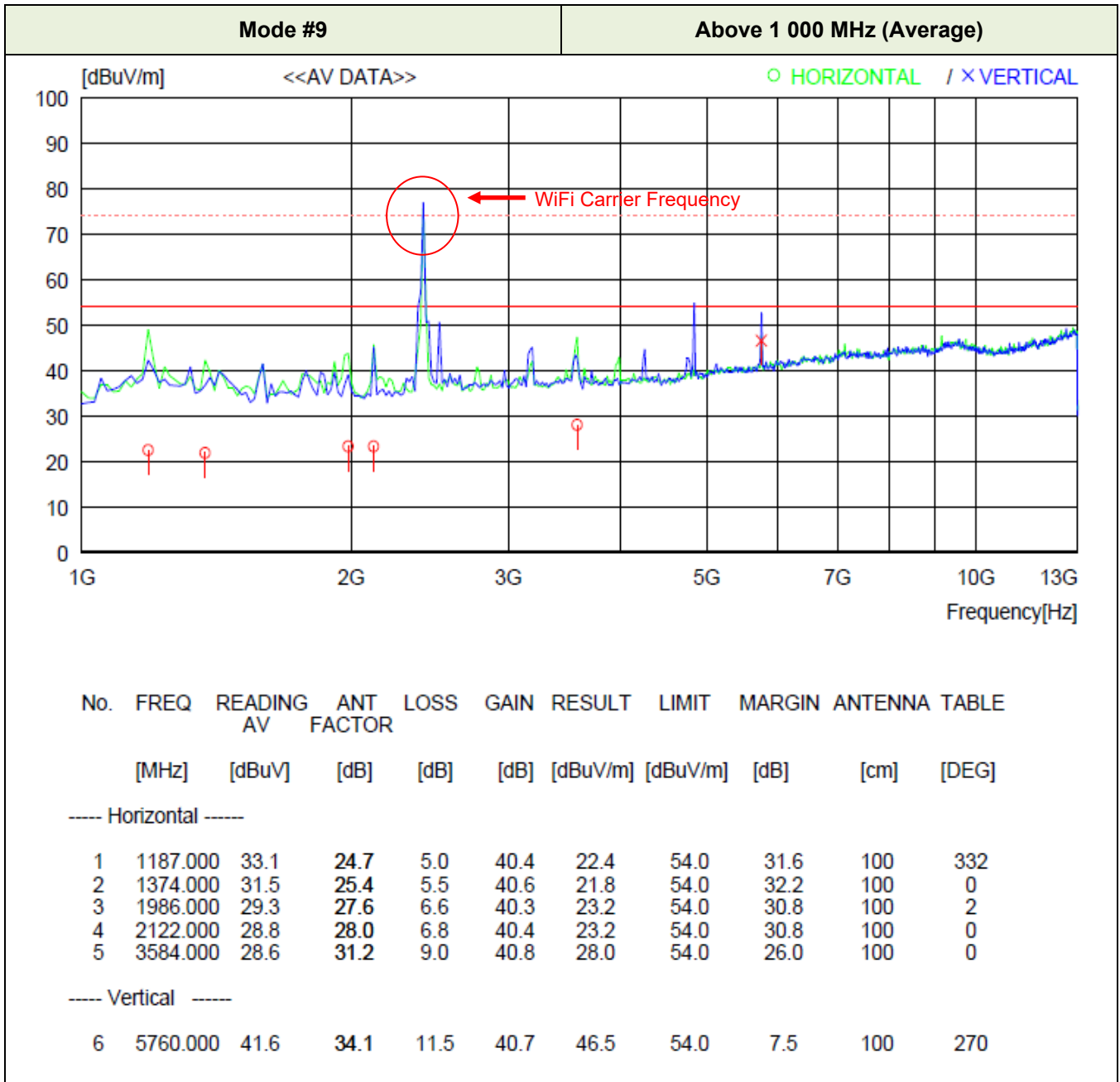


| No.                  | FREQ<br>[MHz] | READING<br>AV<br>[dBuV] | ANT<br>FACTOR<br>[dB] | LOSS<br>[dB] | GAIN<br>[dB] | RESULT<br>[dBuV/m] | LIMIT<br>[dBuV/m] | MARGIN<br>[dB] | ANTENNA<br>[cm] | TABLE<br>[DEG] |
|----------------------|---------------|-------------------------|-----------------------|--------------|--------------|--------------------|-------------------|----------------|-----------------|----------------|
| ---- Horizontal ---- |               |                         |                       |              |              |                    |                   |                |                 |                |
| 1                    | 1187.000      | 35.7                    | 24.7                  | 5.0          | 40.4         | 25.0               | 54.0              | 29.0           | 100             | 330            |
| 2                    | 3567.000      | 27.2                    | 31.2                  | 8.9          | 40.8         | 26.5               | 54.0              | 27.5           | 100             | 318            |
| ---- Vertical ----   |               |                         |                       |              |              |                    |                   |                |                 |                |
| 3                    | 2122.000      | 27.6                    | 28.0                  | 6.8          | 40.4         | 22.0               | 54.0              | 32.0           | 100             | 291            |
| 4                    | 2802.000      | 26.7                    | 29.5                  | 7.8          | 40.7         | 23.3               | 54.0              | 30.7           | 100             | 330            |
| 5                    | 3193.000      | 28.9                    | 30.3                  | 8.3          | 40.7         | 26.8               | 54.0              | 27.2           | 100             | 0              |
| 6                    | 5760.000      | 44.2                    | 34.1                  | 11.5         | 40.7         | 49.1               | 54.0              | 4.9            | 100             | 271            |









## Appendix I - Test Instrumentation

| Name of Equipment                             | Model Number | Manufacturer      | Serial Number             | Last Cal. (Interval) | USE |
|---|--------------|-------------------|---------------------------|----------------------|-----|
| <b>For EMISSION</b>                           |              |                   |                           |                      |     |
| 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                    | 2017-07-28(1Y)       | ■   |
| LISN  | LS16C        | AFJ               | 16011403310               | 2017-07-28(1Y)       | ■   |
| LISN  | NNLK8121     | SchwarzBeck       | 8121-163                  | 2017-08-04(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)       | ■   |
| 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<br>814/L | N/A                  | ■   |
| CO3000 Controller (Above 1 GHz)               | CO3000-4PORT | INNCO SYSTEM      | CO3000/807/34130<br>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               | 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.