



# TEST REPORT



Report No. : KES-RF240828

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**KES Co., Ltd.**

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## ■ FCC TEST REPORT

### 1. Client

- Name : BrainU Co.,Ltd.
- Address : 3F, 7, Yatap-ro 105beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do,  
Republic of Korea (13506)

### 2. Sample Description

- Product item : VET CAI
- Model name : VCAI-001
- Manufacturer etc. : BrainU Co.,Ltd.

3. Date of test : 2024.09.23 ~ 2024.10.11

4. Location of Test :  Permanent Testing Lab  On Site Testing  
○ Adress : 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea

5. Test method used : Part 15 Subpart C 15.247

6. Test result : PASS

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.

This laboratory is not accredited for the test results marked \*.

This test report is not related to KOLAS accreditation.

Affirmation	Tested by	Technical Manager	
	Name : Gu-Bong, Kang (Signature)	Name : Young-Jin, Lee (Signature)	

2024 . 11. 15.

**KES Co., Ltd.**

**Accredited by KOLAS, Republic of KOREA**



## REPORT REVISION HISTORY

Date	Test Report No.	Revision History
2024.11.15	KES-RF240828	Initial

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### Use of uncertainty of measurement for decisions on conformity (decision rule):

- No decision rule is specified by the standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty("simple acceptance" decision rule, previously known as "accuracy method").
- Other (to be specified, for example when required by the standard or client)



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## 1. General information

Applicant: BrainU Co.,Ltd.  
Applicant address: 3F, 7, Yatap-ro 105beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea (13506)  
Test site: KES Co., Ltd.  
Test site address:  #3002, #3503, #3701, 40, Simin-daero365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Republic of Korea  
 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea  
Test Facility FCC Accreditation Designation No.: KR0100, Registration No.: 444148  
FCC rule part(s): 15.247  
FCC ID: 2BBOF-VETCAI  
Test device serial No.:  Production  Pre-production  Engineering

### 1.1. EUT description

Equipment under test VET CAI  
Frequency range 2 402 MHz ~ 2 480 MHz (LE 2 Mbps)  
Model VCAI-001  
Modulation technique GFSK  
Number of channels 2 402 MHz ~ 2 480 MHz : 40 ch  
Antenna specification PCB Pattern Antenna // Peak gain: 0.6 dBi  
Power source Operating : DC 3.7 V (Battery)  
Charging : AC 120 V (AC/DC Adapter output DC 5 V)  
H/W version V1.1.0  
S/W version V1.2.0

### 1.2. Test configuration

The BrainU Co.,Ltd. // VET CAI // VCAI-001 // FCC ID: 2BBOF-VETCAI was tested according to the specification of EUT, the EUT must comply with following standards and KDB documents.

FCC Part 15.247  
KDB 558074 D01 v05 r02  
ANSI C63.10-2013

**1.3. Information about derivative model**

N/A

**1.4. Accessory information**

Equipment	Manufacturer	Model	Serial No.	Power source
AC/DC adapter	BRIDGEPOWER Vina Company Limited	BM010S05F	-	Input AC 120 V, Output DC 5 V
Sensor adapter	-	-	-	-
Sensor	-	-	-	-

**1.5. Device modifications**

N/A

**1.6. Sample calculation**

Where relevant, the following sample calculation is provided

For all conducted test items :

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

For Radiation test :

Field strength level (dB $\mu$ V/m) = Measured level (dB $\mu$ V) + Antenna factor (dB) + Cable loss (dB) – Amplifier gain (dB)

**1.7. Measurement Uncertainty**

Test Item	Uncertainty	
Uncertainty for Conduction emission test	2.22 dB ( SHIELD ROOM #6 )	
Uncertainty for Radiation emission test (include Fundamental emission)	Below 1 GHz	4.04 dB ( SAC #6 )
	Above 1 GHz	5.32 dB ( SAC #5 )
Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$ .		



### 1.8. Frequency/channel operations

Ch.	Frequency (MHz)	Mode
00	2 402	LE 2 Mbps
:	:	:
19	2 440	LE 2 Mbps
:	:	:
39	2 480	LE 2 Mbps



## 2. Summary of tests

Section in FCC Part 15	Test description	Test results
15.247(a)(2)	6 dB bandwidth	N/T <sup>Note.1</sup>
15.247(b)(3)	Output power	N/T <sup>Note.1</sup>
15.247(e)	Power spectral density	N/T <sup>Note.1</sup>
15.205, 15.209	Radiated restricted band and emission	Pass
15.247(d)	Conducted spurious emission and band edge	N/T <sup>Note.1</sup>
15.207(a)	AC Conducted emissions	Pass
15.203	Antenna Requirement	Pass

\*N/T: Not Tested

**Note:**

1. Only the test items requested by the applicant were performed.  
This product is equipped with an approved module, please refer to Module Report below for details.  
Report No. : DRTFCC2002-0049
2. By the applicant's request, test were performed condition below:  
Power setting : 8

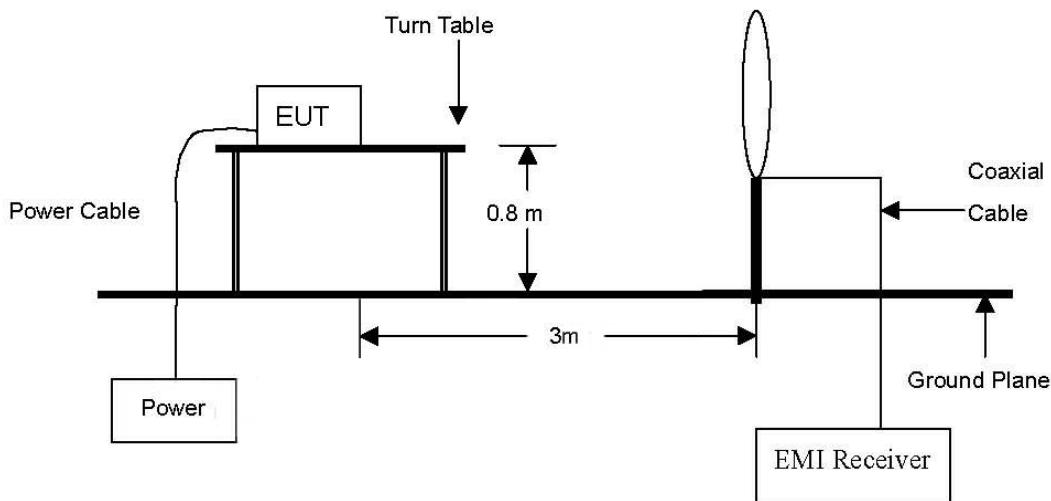


### 3. Test results

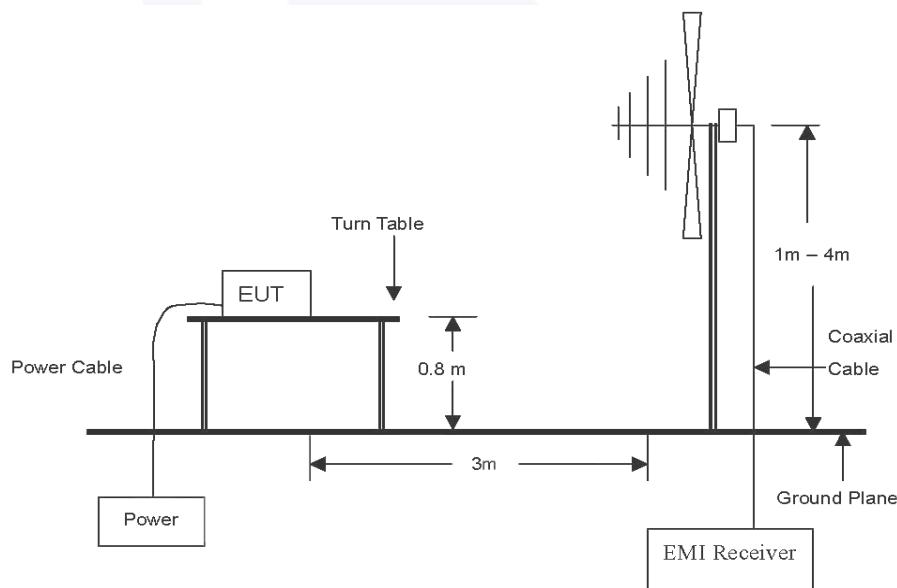
#### 3.1. Radiated restricted band and emissions

##### Test setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.

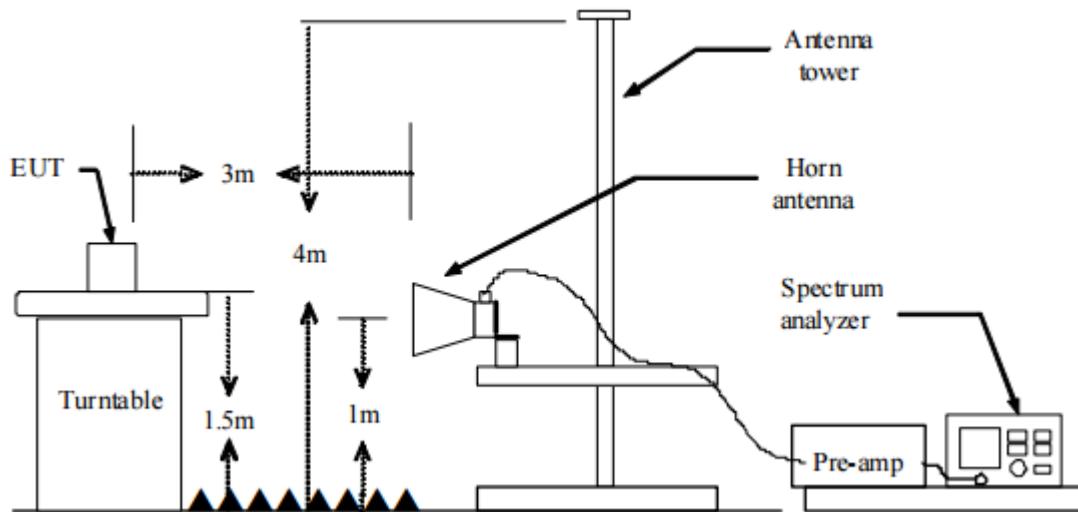


The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.





The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz emissions, whichever is lower.



### Test procedure

Radiated emissions from the EUT were measured according to the dictates in section 11.11 & 11.12 of ANSI C63.10-2013.

#### Test procedure below 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel, ground parallel and perpendicular of the antenna are set to make the measurement. It was determined that parallel was worst-case orientation; therefore, all final radiated testing was performed with the EUT in parallel.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum hold mode.

#### Test procedure above 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground for 30 MHz-1 GHz and 1.5 meters for above 1 GHz at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The antenna is a bi-log antenna, a horn antenna ,and its height are varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
5. Spectrum analyzer settings for  $f < 1$  GHz:
  - ① Span = wide enough to fully capture the emission being measured
  - ② RBW = 120 kHz
  - ③ VBW  $\geq$  RBW
  - ④ Detector = quasi peak
  - ⑤ Sweep time = auto
  - ⑥ Trace = max hold

6. Spectrum analyzer settings for  $f \geq 1 \text{ GHz}$ : Peak

- ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- ② RBW = 1 MHz
- ③ VBW  $\geq 3 \text{ MHz}$
- ④ Detector = peak
- ⑤ Sweep time = auto
- ⑥ Trace = max hold
- ⑦ Trace was allowed to stabilize

7. Spectrum analyzer settings for  $f \geq 1 \text{ GHz}$ : Average

- ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- ② RBW = 1 MHz
- ③ VBW  $\geq 3 \times \text{RBW}$
- ④ Detector = RMS, if span/(# of points in sweep)  $\leq (\text{RBW}/2)$ . Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
- ⑤ Averaging type = power(i.e., RMS)
  - 1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
  - 2) Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.
- ⑥ Sweep = auto
- ⑦ Trace = max hold
- ⑧ Perform a trace average of at least 100 traces.
- ⑨ A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
  - 1) If power averaging (RMS) mode was used in step ⑤, then the applicable correction factor is  $10 \log(1/x)$ , where x is the duty cycle.
  - 2) If linear voltage averaging mode was used in step ⑤, then the applicable correction factor is  $20 \log(1/x)$ , where x is the duty cycle.
  - 3) If a specific emission is demonstrated to be continuous ( $\geq 98$  percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

**Note.**

1.  $f < 30 \text{ MHz}$ , extrapolation factor of 40 dB/decade of distance.  $F_d = 40 \log(D_m/D_s)$   
 $f \geq 30 \text{ MHz}$ , extrapolation factor of 20 dB/decade of distance.  $F_d = 20 \log(D_m/D_s)$   
Where:
  - $F_d$  = Distance factor in dB
  - $D_m$  = Measurement distance in meters
  - $D_s$  = Specification distance in meters
2. Field strength(dB $\mu$ V/m) = Level(dB $\mu$ V) + CF (dB) + or DCF(dB)
3. Margin(dB) = Limit(dB $\mu$ V/m) – Field strength(dB $\mu$ V/m)
4. Emissions below 18 GHz were measured at a 3 meter test distance while emissions above 18 GHz were measured at a 1 meter test distance with the application of a distance correction factor.
5. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.
6. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
7. According to exploratory test no any obvious emission were detected from 9 kHz to 30 MHz. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

**Limit**

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

Frequency (MHz)	Distance (Meters)	Radiated ( $\mu$ V/m)
0.009 ~ 0.490	300	2400/F(kHz)
0.490 ~ 1.705	30	24000/F(kHz)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

\*\*Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 ~ 72 MHz, 76 ~ 88 MHz, 174 ~ 216 MHz or 470 ~ 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.



## Duty cycle

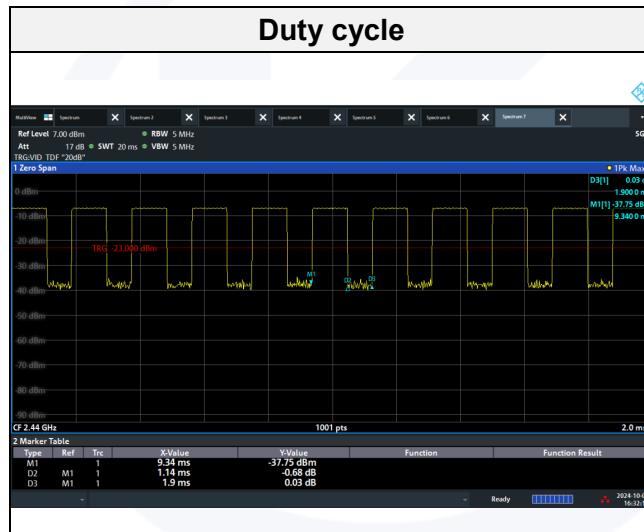
Regarding to KDB 558074 D01\_v05 r02, 6. Measurements of duty cycle and transmission duration shall be performed using one of the following techniques:

- A diode detector and an oscilloscope that together have sufficiently short response time to permit accurate measurements of the on- and off-times of the transmitted signal.
- The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on- and off-times of the transmitted signal.

Mode	T <sub>on</sub> time (ms)	Period (ms)	Duty cycle (Linear)	Duty cycle (%)	Duty cycle correction factor (dB)
LE 2 Mbps	1.14	1.90	0.60	60.00	2.22

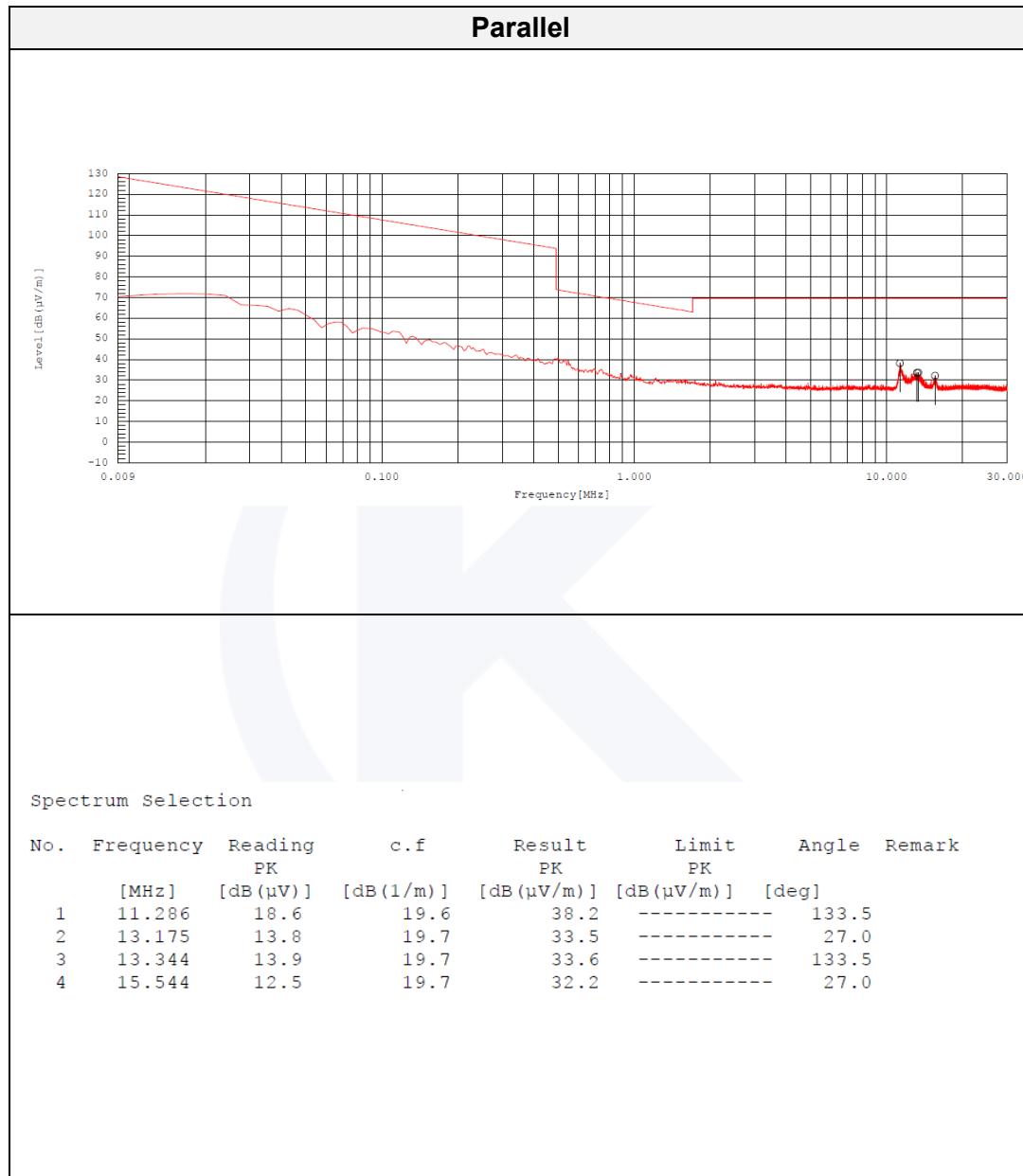
Duty cycle (Linear) = T<sub>on</sub> time/Period

DCF(Duty cycle correction factor (dB)) = 10log(1/duty cycle)



**Test results (Below 30 MHz)**

Mode: LE 2 Mbps  
Distance of measurement: 3 meter  
Channel: 39 (Worst case)

**Note.**

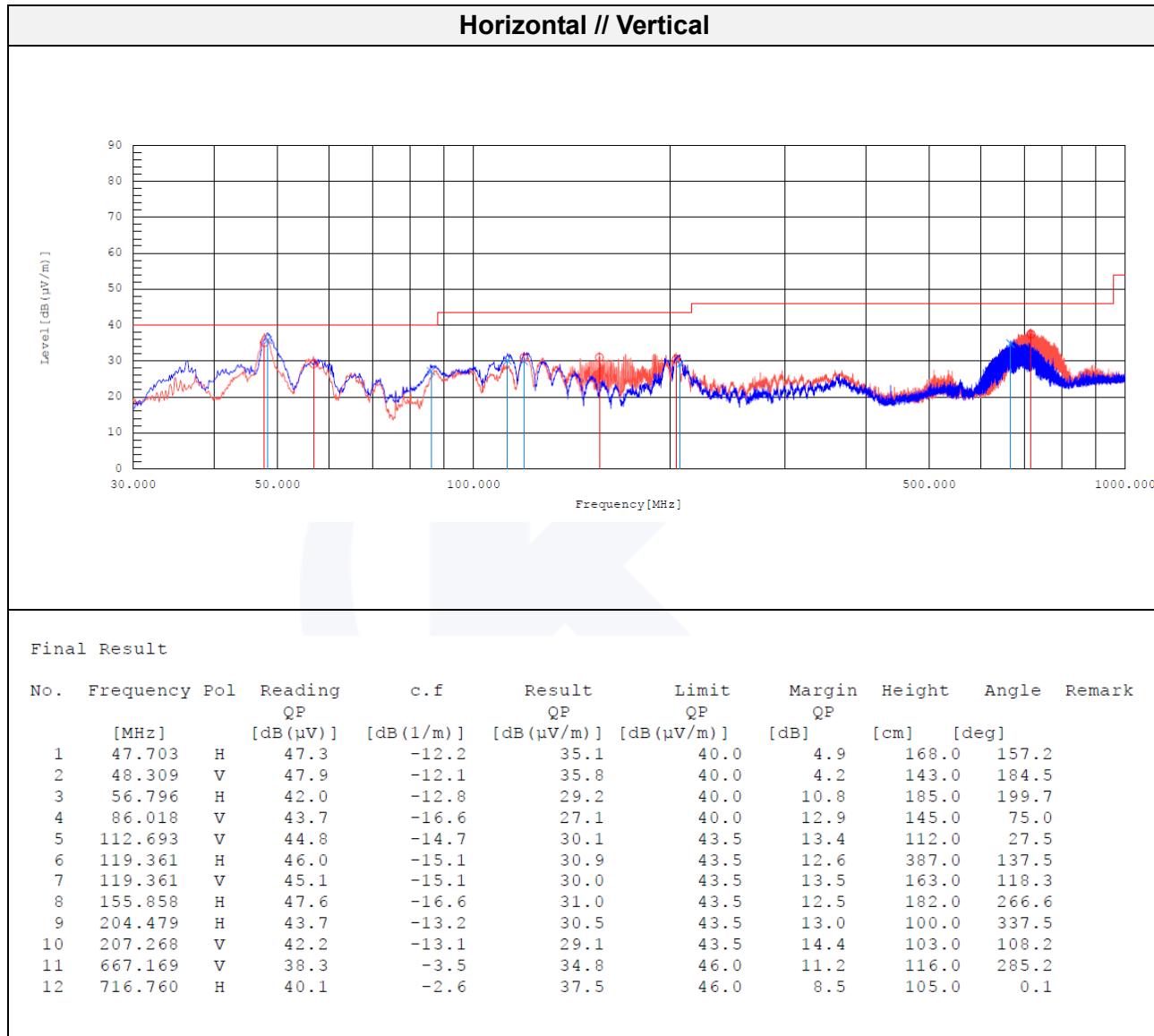
1. Spurious emissions are quite low compared to the limit, above data is peak result.

**Test results (Below 1 000 MHz)**

Mode: LE 2 Mbps

Distance of measurement: 3 meter

Channel: 39 (Worst case)



**Test results (Above 1 000 MHz)**

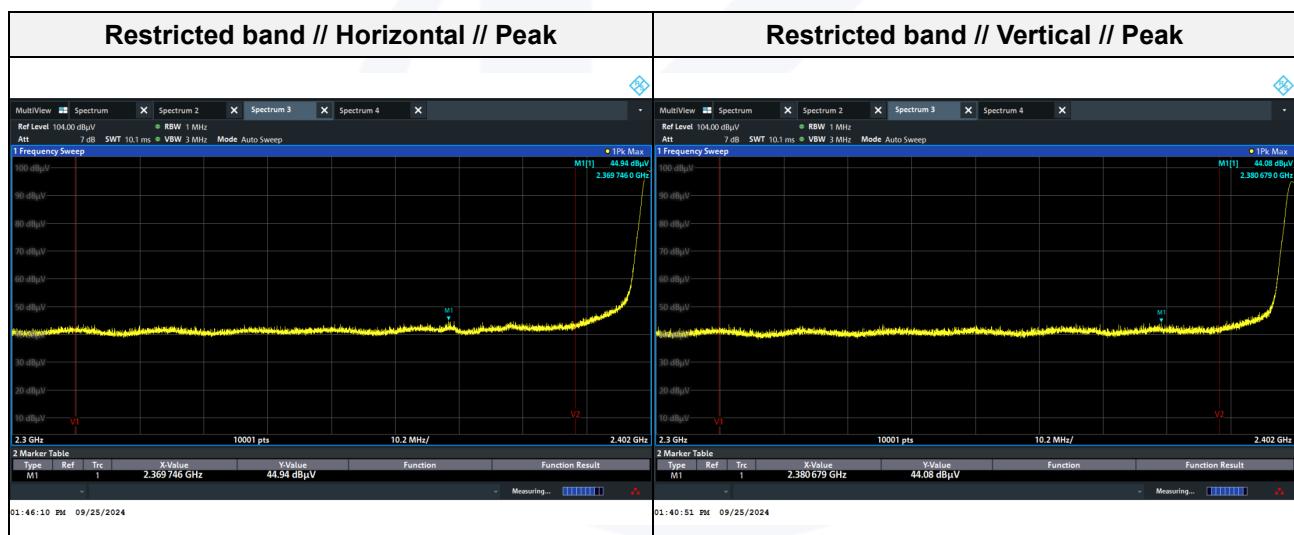
Mode:	LE 2 Mbps
Distance of measurement:	3 meter
Channel:	00

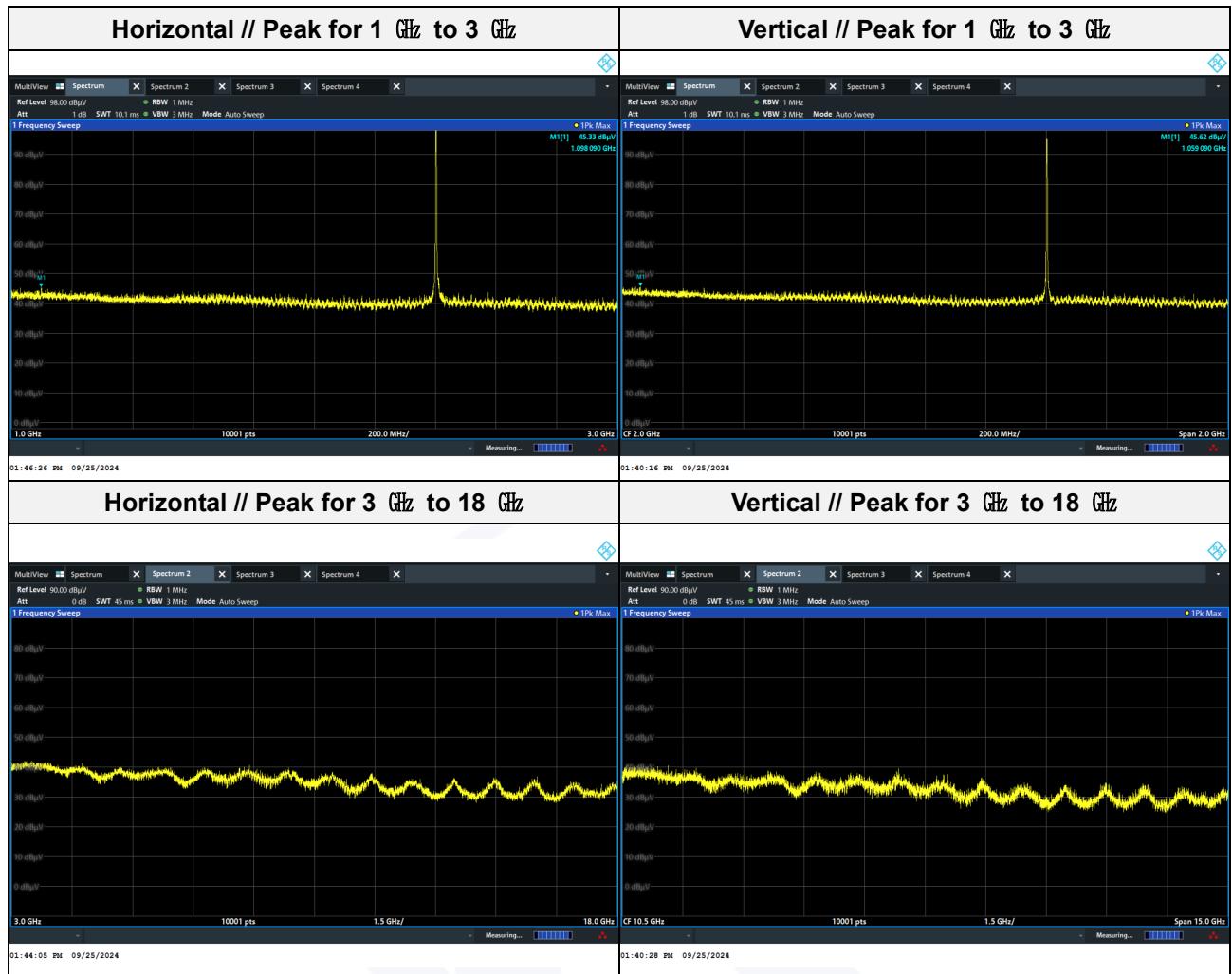
**- Spurious**

Frequency (MHz)	Level (dB $\mu$ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB $\mu$ W/m)	Limit (dB $\mu$ W/m)	Margin (dB)
1 059.09	45.62	Peak	V	-9.33	-	36.29	74.00	37.71
1 098.09	45.33	Peak	H	-9.09	-	36.24	74.00	37.76

**- Band edge**

Frequency (MHz)	Level (dB $\mu$ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB $\mu$ W/m)	Limit (dB $\mu$ W/m)	Margin (dB)
2 369.75	44.94	Peak	H	-0.98	-	43.96	74.00	30.04
2 380.68	44.08	Peak	V	-0.95	-	43.13	74.00	30.87





Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.



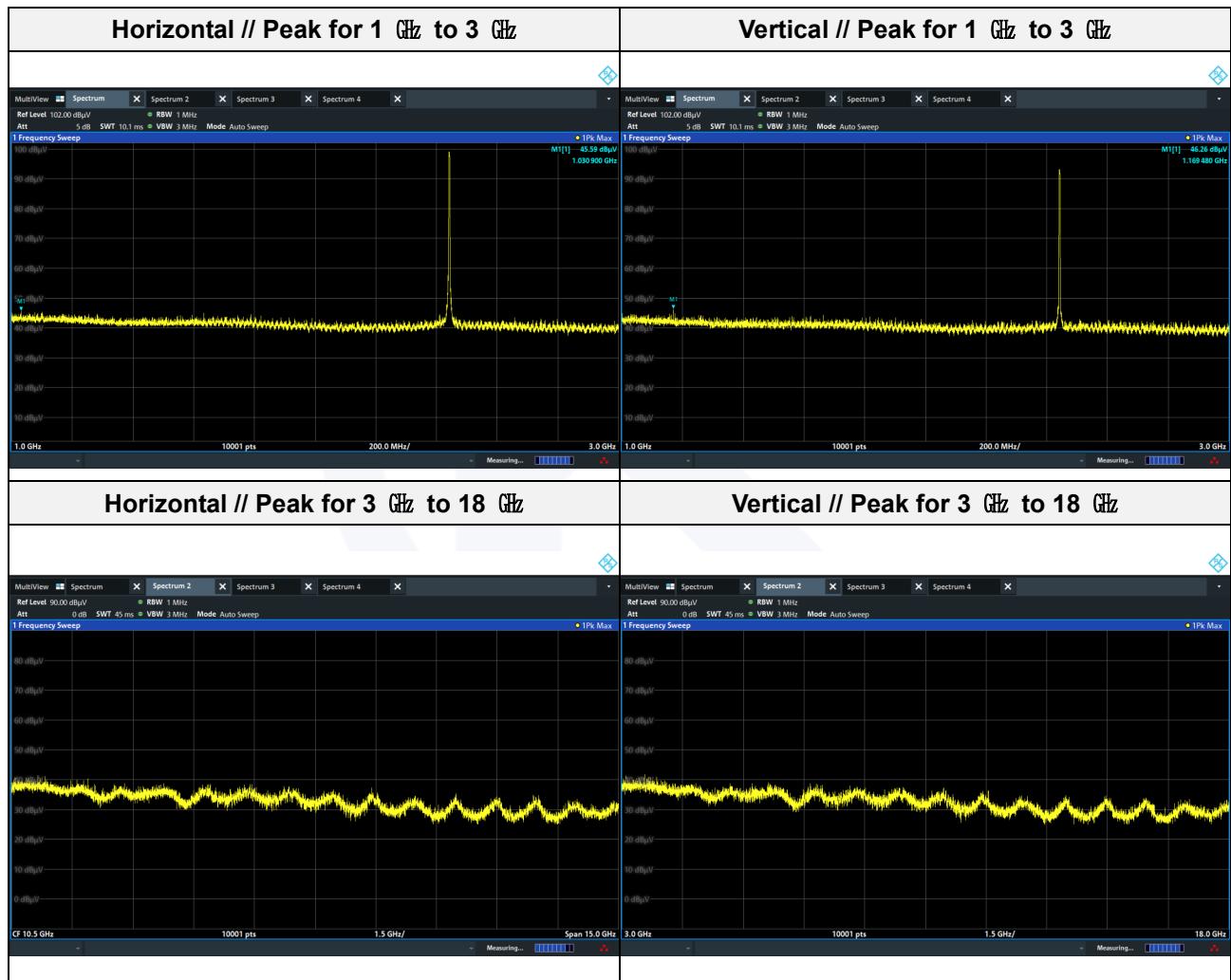
Mode: LE 2 Mbps

Distance of measurement: 3 meter

Channel: 19

#### - Spurious

Frequency (MHz)	Level (dB $\mu$ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
1 030.90	45.59	Peak	H	-9.51	-	36.08	74.00	37.92
1 169.48	46.26	Peak	V	-8.64	-	37.62	74.00	36.38



#### Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.



Mode: LE 2 Mbps

Distance of measurement: 3 meter

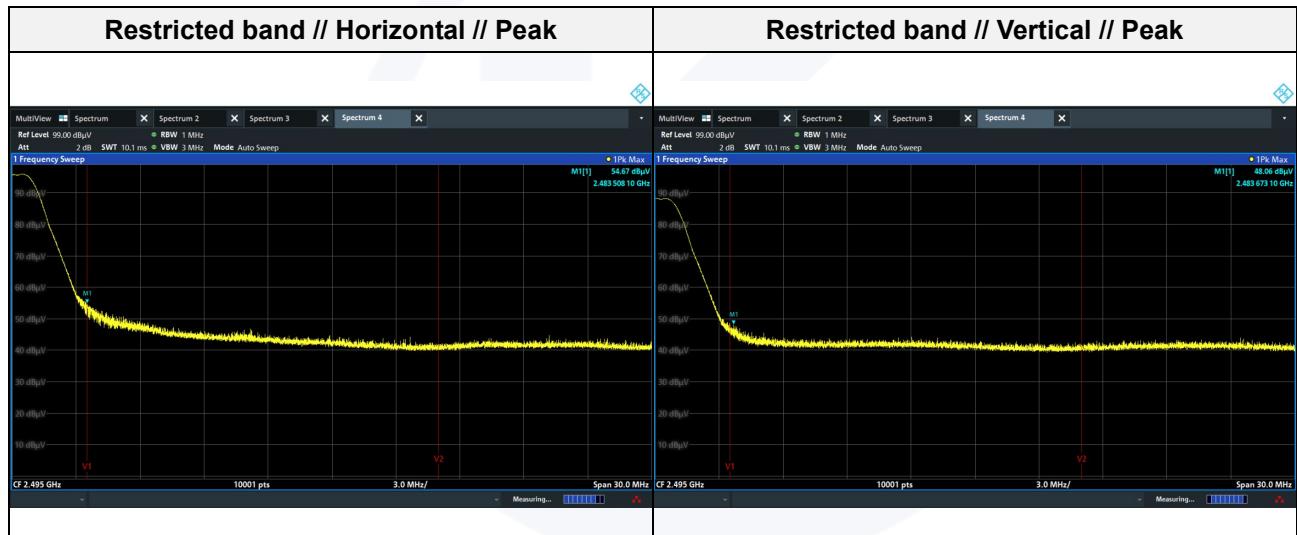
Channel: 39

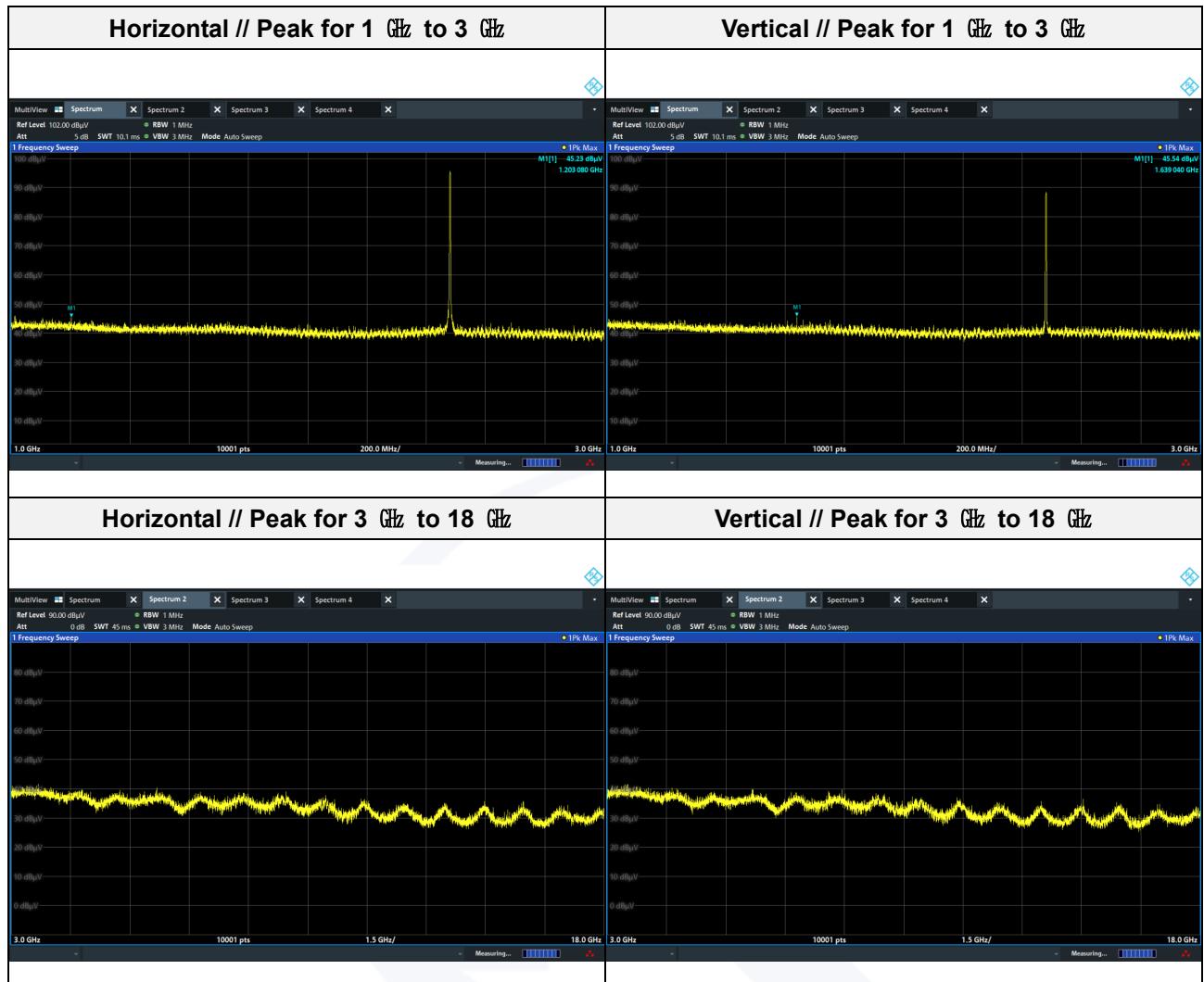
**- Spurious**

Frequency (MHz)	Level (dB $\mu$ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
1 203.08	45.23	Peak	H	-8.43	-	36.80	74.00	37.20
1 639.04	45.54	Peak	V	-5.34	-	40.20	74.00	33.80

**- Band edge**

Frequency (MHz)	Level (dB $\mu$ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
2 483.51	54.67	Peak	H	-0.72	-	53.95	74.00	20.05
2 483.67	48.06	Peak	V	-0.72	-	47.34	74.00	26.66



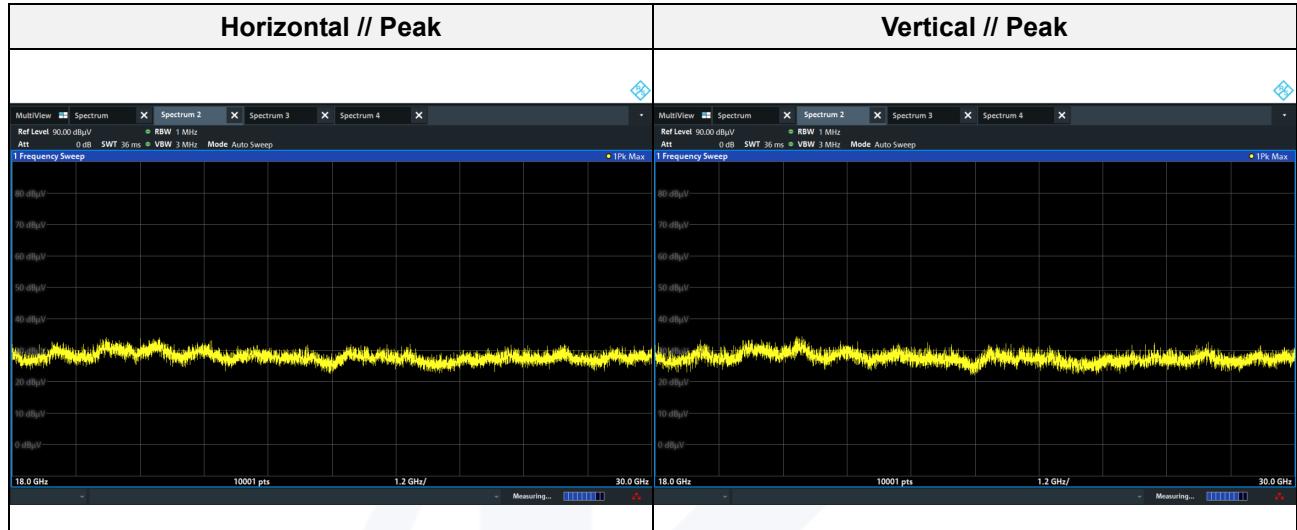


Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.

**Test results (18 GHz to 30 GHz) – Worst case**

Mode:	LE 2 Mbps
Distance of measurement:	3 meter
Channel:	39 (Worst case)



Note.

1. No spurious emission were detected above 18 GHz.



### 3.2. AC conducted emissions

#### Limit

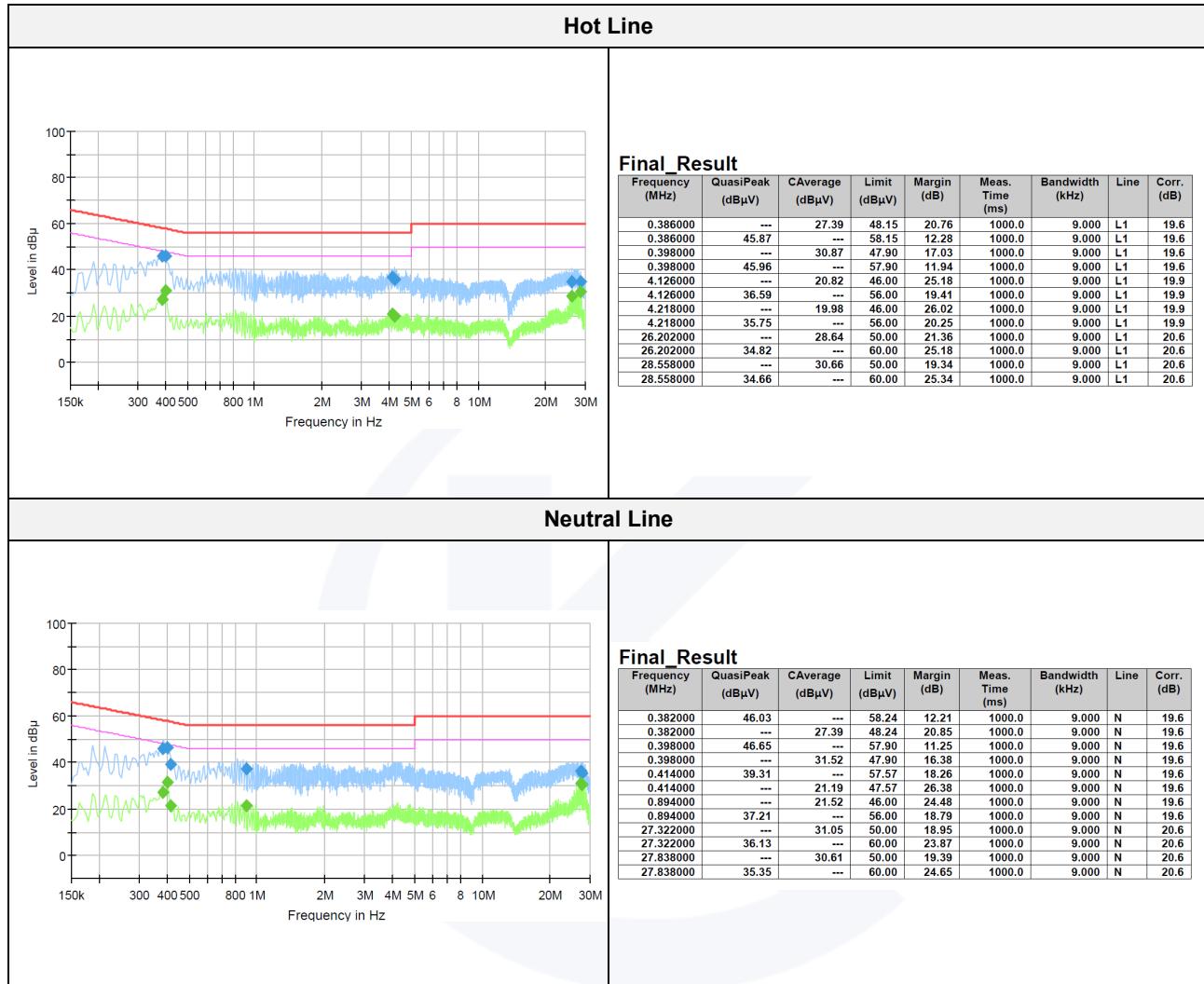
According to 15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted limit (dB <sub>AV</sub> )	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

**Test results**

Mode LE 2 Mbps

Channel: 39 (Worst case)





### 3.3. Antenna Requirement

According to 15.207(a), An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.



## Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum analyzer	R&S	FSV40	101725	1 year	2025.06.12
Spectrum analyzer	R&S	FSV3044	101272	1 year	2025.03.12
SIGNAL GENERATOR	KEYSIGHT	N5182B	MY59100115	1 year	2025.04.15
SIGNAL GENERATOR	Anritsu	68369B	002118	1 year	2025.04.15
ACTIVE LOOP ANTENNA	SCHWARZBECK	FMZB 1513	1513-257	2 years	2025.11.16
TRILOG-BROADBAND ANTENNA	Schwarzbeck	VULB 9163	714	2 years	2026.04.19
Attenuator	HUBER+SHHNER	6806.17.A	NONE	1 year	2025.02.13
Horn Antenna	A.H.	SAS-571	414	1 year	2025.01.16
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA 9170550	1 year	2025.01.16
Amplifier	SONOMA INSTRUMENT	310N	401123	1 year	2025.02.13
PREAMPLIFIER	HP	8449B	3008A00538	1 year	2025.04.30
BROADBAND AMPLIFIER	SCHWARZBECK	BBV9721	PS9721-003	1 year	2025.01.15
DC POWER SUPPLY	AGILENT	6632B	MY43004090	1 year	2025.06.17
EMI Test Receiver	R&S	ESU26	100552	1 year	2025.02.13
EMI Test Receiver	R&S	ESR3	101783	1 year	2024.11.08 2025.11.06
PULSE LIMITER	R&S	ESH2-Z2	101915	1 year	2024.11.08 2025.11.06
LISN	R&S	ENV216	101786	1 year	2025.01.10

\* Statement of Traceability: KES Co., Ltd. attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

## Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook computer	LG Electronics Inc.,	LGS53	306QCZP560949
Test Jig Board	N/A	N/A	N/A

**The End.**