





TEST REPORT

Part 15 C & RSS-247 (Issue 2)

Equipment under test THINKWARE DASH CAM
Model name U3000
FCC ID 2ADTG-U3000
IC Number 12594A-U3000
Applicant THINKWARE CORPORATION
Manufacturer THINKWARE CORPORATION
Date of test(s) 2022.08.30 ~ 2022.09.02
Date of issue 2022.10.20

Issued to
THINKWARE CORPORATION
 A, 9FL., Samwhan Hipex, 240, Pangyoyeok-ro, Bundang-gu,
 Seongnam-si, Gyeonggi-do, South Korea
 Tel: +82-2-589-9425 / Fax: +82-2-589-9600

Issued by
KES Co., Ltd.
 3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si,
 Gyeonggi-do, 14057, Korea
 473-21, Gayeo-ro, Yeosu-si, Gyeonggi-do, Korea
 Tel: +82-31-425-6200 / Fax: +82-31-424-0450

Test and report completed by :	Report approval by :
	
Do-won Ahn Test engineer	Young-Jin, Lee Technical manager

This test report is not related to KS Q ISO/IEC 17025 and KOLAS.



Revision history

Revision	Date of issue	Test report No.	Description
-	2022.10.20	KES-RF1-22T0145	Initial

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KES Co., Ltd.

3701, 40, Simin-daero 365beon-gil,
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

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Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea
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1. General information

Applicant: THINKWARE CORPORATION
Applicant address: A, 9FL., Samwhan Hipex, 240, Pangyoeyeok-ro, Bundang-gu, Seongnam-si,
Gyeonggi-do, South Korea
Test site: KES Co., Ltd.
Test site address: 3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si,
Gyeonggi-do, 14057, Korea
 473-29, Gayeo-ro, Yeosu-si, Gyeonggi-do, Korea
Test Facility FCC Accreditation Designation No.: KR0100, Registration No.: 444148
ISED Registration No.: 23298
FCC rule part(s): 15.247
IC rule part(s): RSS-247
FCC ID: 2ADTG-U3000
IC Number 12594A-U3000
Test device serial No.: Production Pre-production Engineering

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1.1. EUT description

Equipment under test	THINKWARE DASH CAM
Frequency range	2 402 MHz ~ 2 480 MHz (LE 1Mbps) 2 412 MHz ~ 2 462 MHz (802.11b/g/n_HT20) 2 422 MHz ~ 2 452 MHz (802.11n_HT40) 5 180 MHz ~ 5 240 MHz (802.11a/n_HT20) 5 190 MHz ~ 5 230 MHz (802.11n_HT40) 24.05 GHz ~ 24.25 GHz (CW)
Model	U3000
Modulation technique	GFSK, CCK, DQPSK, DBPSK, OFDM, QPSK, BPSK 16QAM, 64QAM CW
Number of channels	2 402 MHz ~ 2 480 MHz (LE 1Mbps): 40ch 2 412 MHz ~ 2 462 MHz (802.11b/g/n_HT20): 11 ch 2 422 MHz ~ 2 452 MHz (802.11n_HT40): 7 ch 5 180 MHz ~ 5 240 MHz (802.11a/n_HT20): 4 ch 5 190 MHz ~ 5 230 MHz (802.11n_HT40): 2 ch 24.05 GHz ~ 24.25 GHz (CW) : 1ch
Antenna specification	(BLE & WLAN) Chip Antenna // 2.4 GHz Peak gain: 2.24 dBi // 5 GHz Peak gain: 3.20 dBi (24 GHz Rader) PCB Array Antenna // Peak gain: 2.0 dBi
Power source	DC 12 , DC 24 V
H/W version	V3.0
S/W version	V3.0

1.2. Test configuration

The **THINKWARE CORPORATION // THINKWARE DASH CAM // U3000**

FCC ID: 2ADTG-U3000 // IC: 12594A-U3000 was tested according to the specification of EUT, the EUT must comply with following standards and KDB documents.

FCC Part 15.247
ISED RSS-247 Issue 2 and RSS-Gen Issue 5
KDB 558074 D01 v05 r02
ANSI C63.10-2013

1.3. Derivative Model Information

A derivative model was added at the buyer's request, and there is no other difference.

1.4. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
Rear view Camera	THINKWARE CORPORATION	-	-	V-IN port of U3000
Hardwiring cable	THINKWARE CORPORATION	-	-	-

1.5. 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.

$$\begin{aligned} \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\ &= 0.91 + 10 = 10.91 \text{ (dB)} \end{aligned}$$

For Radiation test :

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

1.6. Measurement Uncertainty

Test Item		Uncertainty
Uncertainty for Conduction emission test		2.38 dB
Uncertainty for Radiation emission test (include Fundamental emission)	Below 1GHz	4.10 dB
	Above 1GHz	4.90 dB
Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.		



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1.7. Frequency/channel operations

Ch.	Frequency (MHz)	Mode
00	2 402	LE 1Mbps
19	2 440	LE 1Mbps
39	2 480	LE 1Mbps

Ch.	Frequency (MHz)	Mode
1	2 412	802.11b/g/n_HT20
6	2 437	802.11b/g/n_HT20
11	2 462	802.11b/g/n_HT20

Ch.	Frequency (MHz)	Mode
3	2 422	802.11n_HT40
6	2 437	802.11n_HT40
9	2 452	802.11n_HT40

Ch.	Frequency (MHz)	Mode
36	5 180	802.11a/n_HT20
44	5 220	802.11a/n_HT20
48	5 240	802.11a/n_HT20

Ch.	Frequency (MHz)	Mode
38	5 190	802.11n_HT40
46	5 230	802.11n_HT40

Ch.	Frequency (GHz)	Mode
-	24.15	CW

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1.8. Worst case data rate

1. Radiated emission was performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.
2. Worst-case data rates were:
 - 802.11b : **1 Mbps**
 - 802.11g : **6 Mbps**
 - 802.11n_HT20 : **MCS0**
 - 802.11n_HT40 : **MCS0**

2. Summary of tests

Section in FCC Part 15	Section in RSS-247 & Gen	Parameter	Test results
-	RSS-Gen 6.7	99% Occupied bandwidth	N/A ⁽¹⁾
15.247(a)(2)	RSS-247 5.2(a)	6 dB bandwidth	N/A ⁽¹⁾
15.247(b)(3)	RSS-247 5.4(d)	Output power	Pass
15.247(e)	RSS-247 5.2(b)	Power spectral density	N/A ⁽¹⁾
15.205, 15.209	RSS-247 5.5, RSS-Gen 8.9, 8.10	Radiated restricted band and emission	Pass
15.247(d)	RSS-247 5.5	Conducted spurious emission and band edge	N/A ⁽¹⁾
15.207	RSS-Gen 8.8	AC Conducted emissions	N/A ⁽²⁾

Note :

1. This product is equipped with an approved module, please refer to Module Report Report No. : FCC : NTC1712033FV00(BLE), NTC1712035FV00(Wi-Fi 2.4 GHz), IC : EC1905007RI01(BLE), EC1905007RI03(Wi-Fi 2.4 GHz) for details.
2. This product is powered by DC 12 V, 24 V.
3. This report contains only the worst case results at the request of the applicant with condition below:
 Worst case: BLE (1 Mbps)
 802.11 b (1 Mbps)

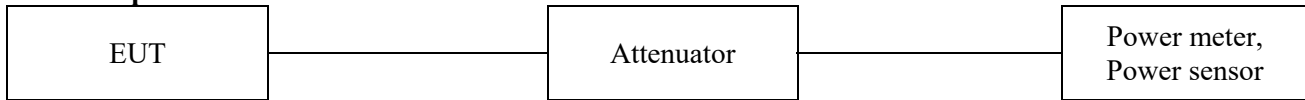
3. Test results

3.1. Output power

Test procedure

ANSI C63.10-2013 - Section 11.9.1.3 and 11.9.2.3.2

Test setup



ANSI C63.10-2013 - Section 11.9.1.3

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

ANSI C63.10-2013 - Section 11.9.2.3.2

Alternatively, measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Because the measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

Limit

According to §15.247(b)(3), For systems using digital modulation in the 902~928 MHz, 2 400~2 483.5 MHz, and 5 725~5 850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted out-put power. Maximum Conducted Out-put Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to §15.247(b)(4), The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to RSS-247 5.4 (d), For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in Section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.



Test results

Measured output power (dBm)						
Mode	2 402 MHz		2 440 MHz		2 480 MHz	
	Average	Peak	Average	Peak	Average	Peak
12 V_BLE (1 Mbps)	0.45	0.55	0.51	0.63	0.64	0.73
24 V_BLE (1 Mbps)	0.45	0.55	0.51	0.63	0.64	0.73

Measured output power (dBm)						
Mode	2 412 MHz		2 437 MHz		2 462 MHz	
	Average	Peak	Average	Peak	Average	Peak
12 V_802.11b (1 Mbps)	11.71	14.25	11.95	14.51	11.93	14.48
24 V_802.11b (1 Mbps)	11.73	14.26	11.95	14.50	11.96	14.52

Measured output power (dBm)						
Mode	2 412 MHz		2 437 MHz		2 462 MHz	
	Average	Peak	Average	Peak	Average	Peak
12 V_802.11g (6 Mbps)	10.13	16.45	10.62	16.80	10.58	16.83
24 V_802.11g (6 Mbps)	10.14	16.45	10.61	16.82	10.69	16.86

Measured output power (dBm)						
Mode	2 412 MHz		2 437 MHz		2 462 MHz	
	Average	Peak	Average	Peak	Average	Peak
12 V_802.11n_20 (MCS0)	9.93	16.59	10.28	16.94	10.42	17.03
24 V_802.11 n_20 (MCS0)	9.97	16.61	10.30	16.95	10.45	17.06

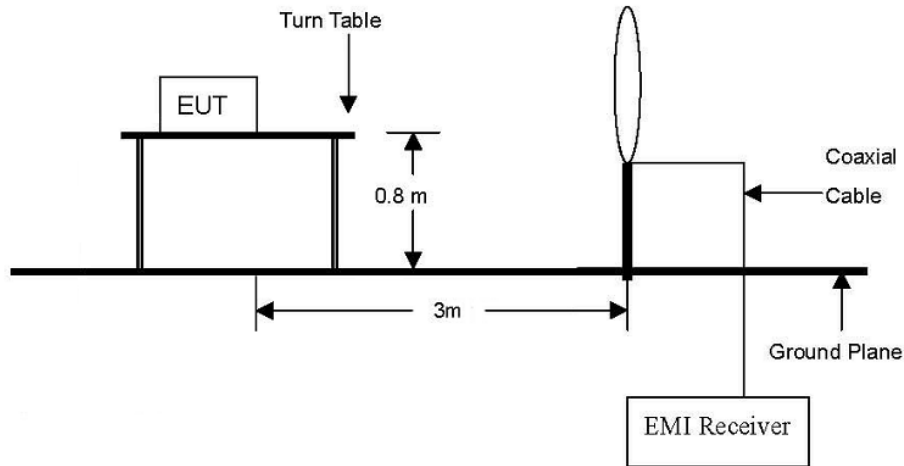
Measured output power (dBm)						
Mode	2 422 MHz		2 437 MHz		2 452 MHz	
	Average	Peak	Average	Peak	Average	Peak
12 V_802.11 n_40 (MCS0)	10.06	17.20	10.31	17.35	10.35	17.35
24 V_802.11 n_40 (MCS0)	10.15	17.21	10.37	17.38	10.37	17.33

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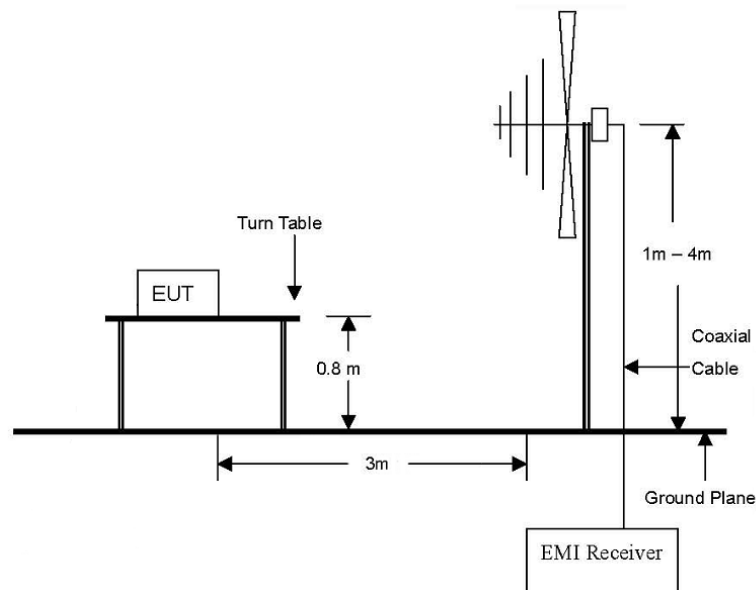
3.2. Radiated restricted band and emissions

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.

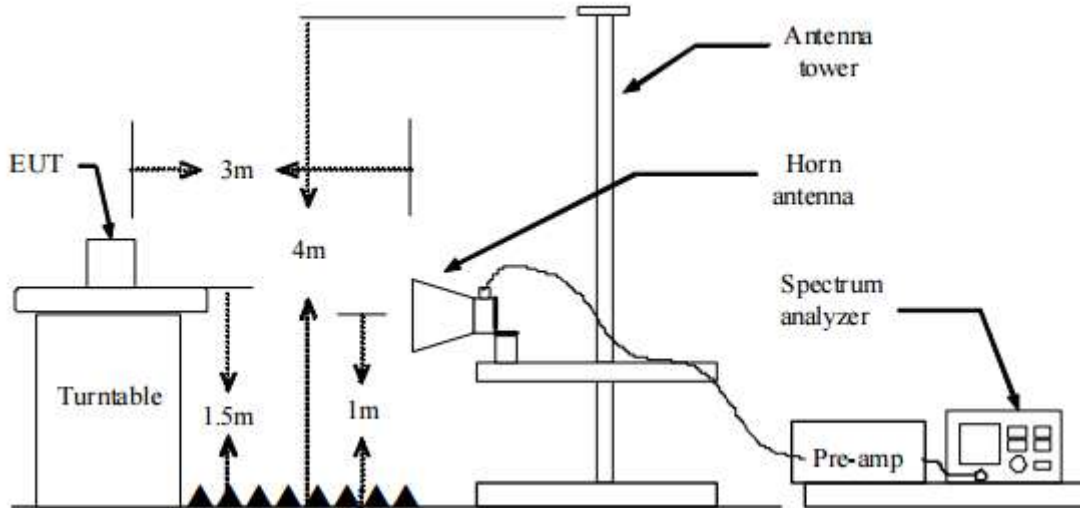


The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



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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.



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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 1.5 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. 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 = 100 kHz
 - ③ VBW \geq RBW
 - ④ Detector = quasi peak
 - ⑤ Sweep time = auto
 - ⑥ Trace = max hold
6. Spectrum analyzer settings for $f \geq 1$ 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 MHz
 - ④ Detector = peak
 - ⑤ Sweep time = auto
 - ⑥ Trace = max hold
 - ⑦ Trace was allowed to stabilize

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

- ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- ② RBW = 1 MHz
- ③ VBW $\geq 3 \times$ RBW
- ④ Detector = RMS, if span/(# of points in sweep) \leq (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 (≥ 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. $f < 30$ MHz, extrapolation factor of 40 dB/decade of distance. $F_d = 40\log(D_m/D_s)$
 $f \geq 30$ 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 μ V/m) = Level(dB μ V) + CF (dB) + or DCF(dB)
3. Margin(dB) = Limit(dB μ V/m) - Field strength(dB μ 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.
7. 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**.
8. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
9. 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 ($\mu\text{V}/\text{m}$)
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.

According to RSS-Gen, Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits :

Frequency (MHz)	Distance (Meters)	Radiated ($\mu\text{V}/\text{m}$)
0.009 ~ 0.490	300	2 400 / F(kHz)
0.490 ~ 1.705	30	24 000 / F(kHz)
1.705 ~ 30.0	30	30
30 ~ 88	3	100
88 ~ 216	3	150
216 ~ 960	3	200
Above 960*	3	500

* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.



Duty cycle

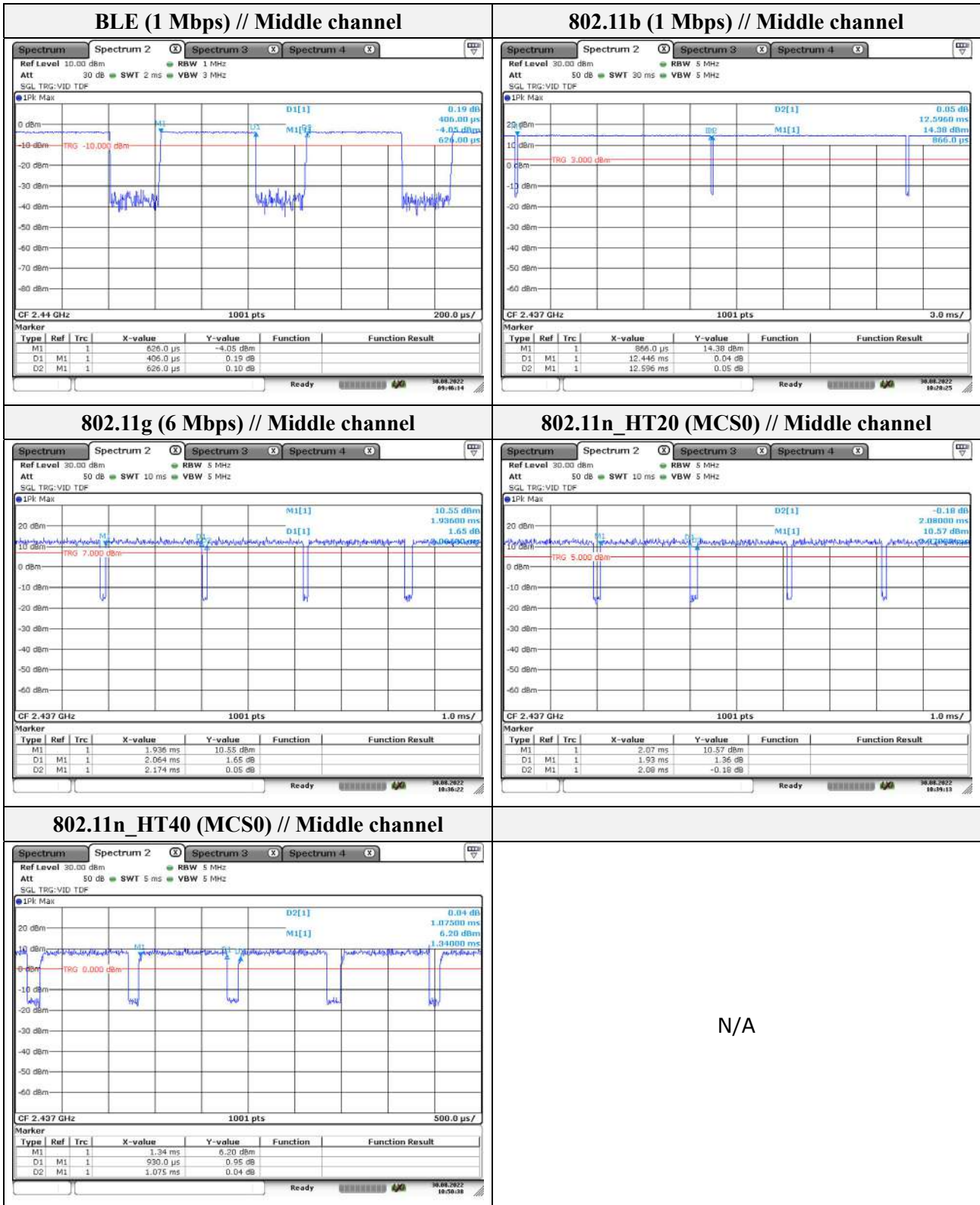
Regarding to KDB 558074 D01_v04, 6.0, the maximum duty cycles of all modes were investigated and set the spectrum analyzer as below.

Set $RBW \geq OBW$ if possible; otherwise, set RBW to the largest available value. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are $> 50/T$ and the number of sweep points across duration T exceeds 100.

Test mode	T _{on} time (ms)	Period (ms)	Duty cycle (Linear)	Duty cycle (%)	Duty cycle correction factor (dB)
BLE (1 Mbps)	0.406	0.626	0.649	64.86	1.88
802.11b (1 Mbps)	12.446	12.596	0.988	98.81	0.05
802.11g (6 Mbps)	2.064	2.174	0.949	94.94	0.23
802.11n_HT20 (MCS0)	1.93	2.08	0.928	92.79	0.33
802.11n_HT40 (MCS0)	0.93	1.075	0.865	86.51	0.63

Duty cycle (Linear) = T_{on} time/Period

DCF(Duty cycle correction factor (dB)) = $10\log(1/\text{duty cycle})$

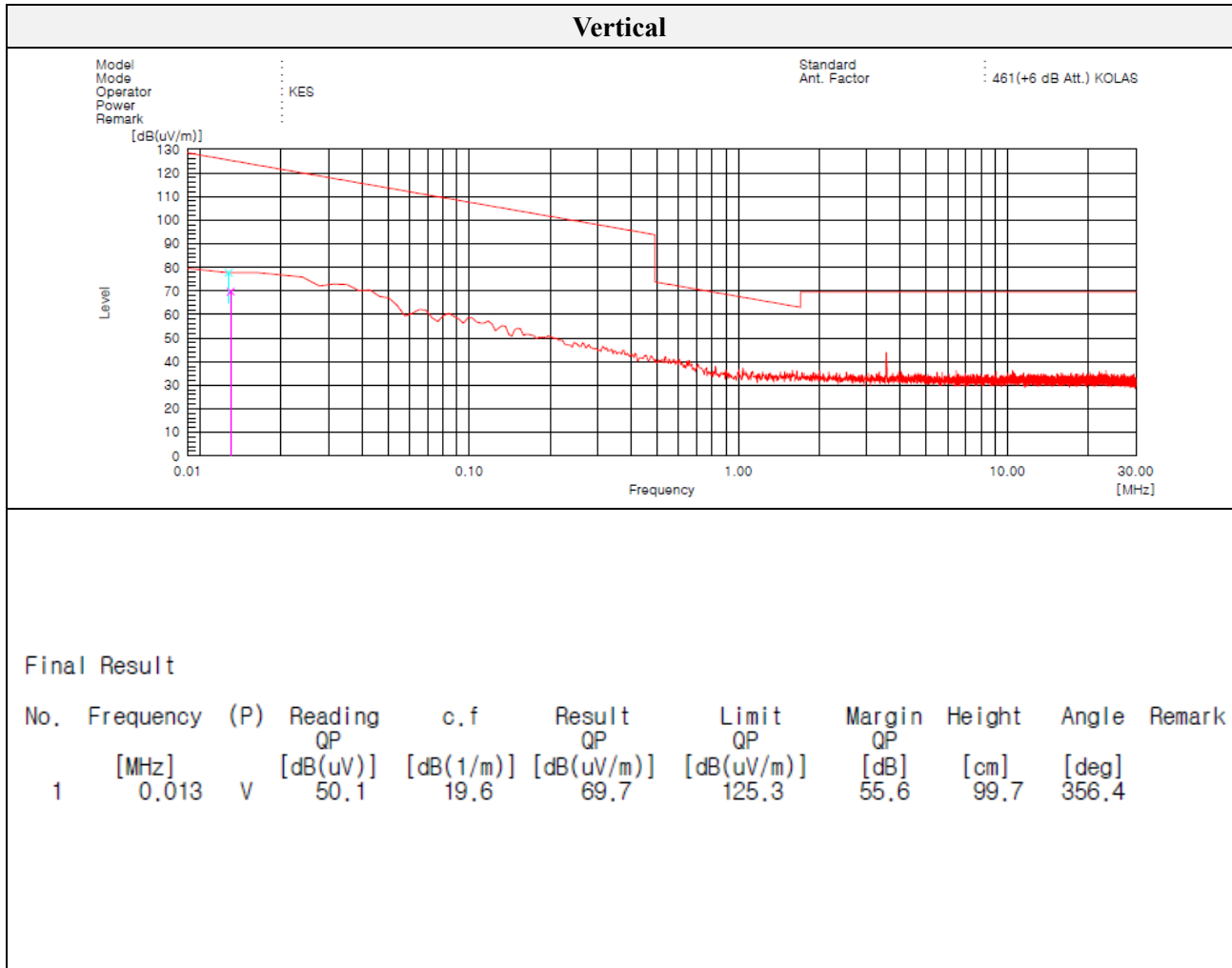


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Test results (Below 30 MHz)

Mode: 12 V_BLE (1 Mbps)
 Channel: 40
 Distance of measurement: 3 meter

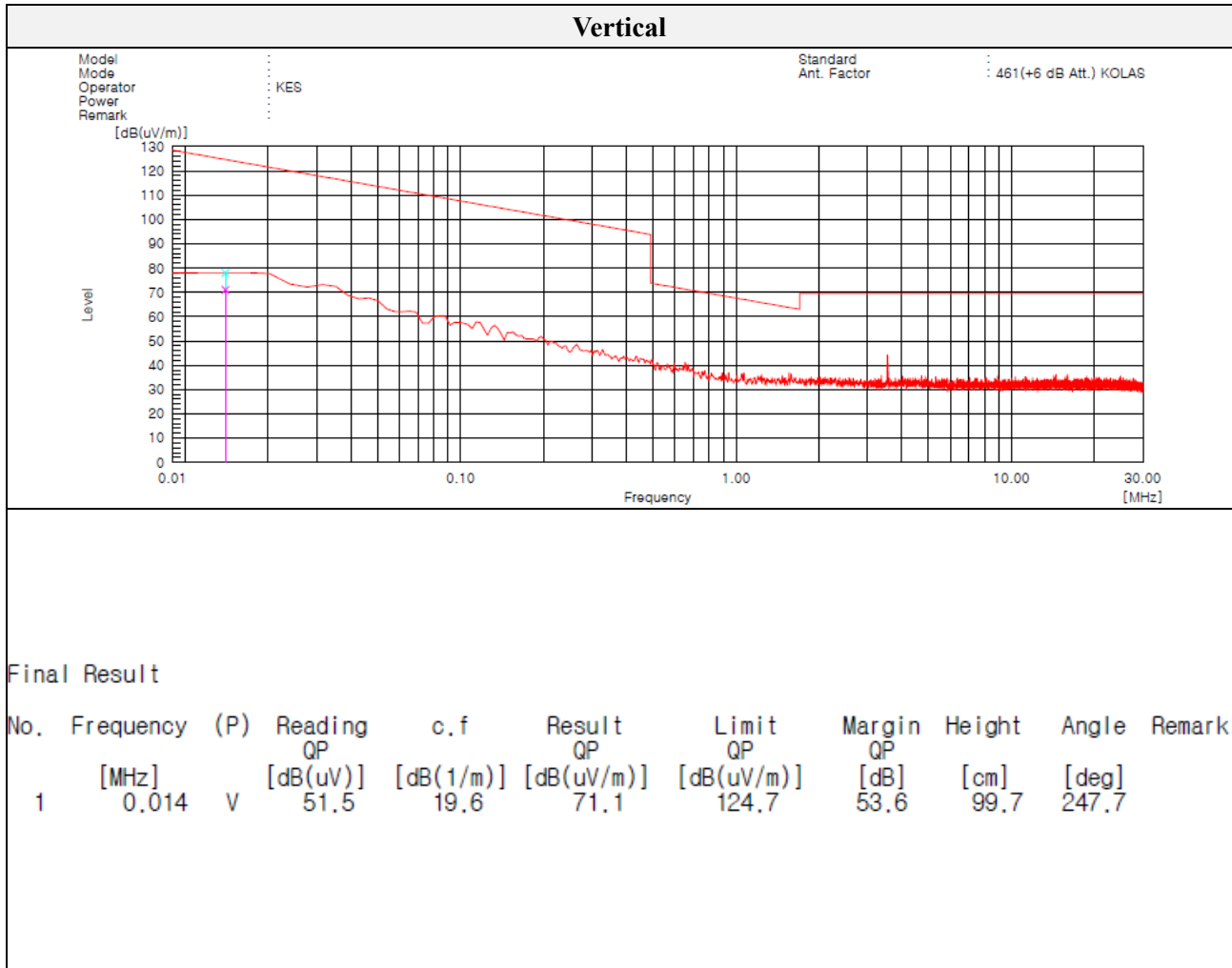


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Test results (Below 30 MHz)

Mode: 24 V_BLE (1 Mbps)
 Channel: 40
 Distance of measurement: 3 meter

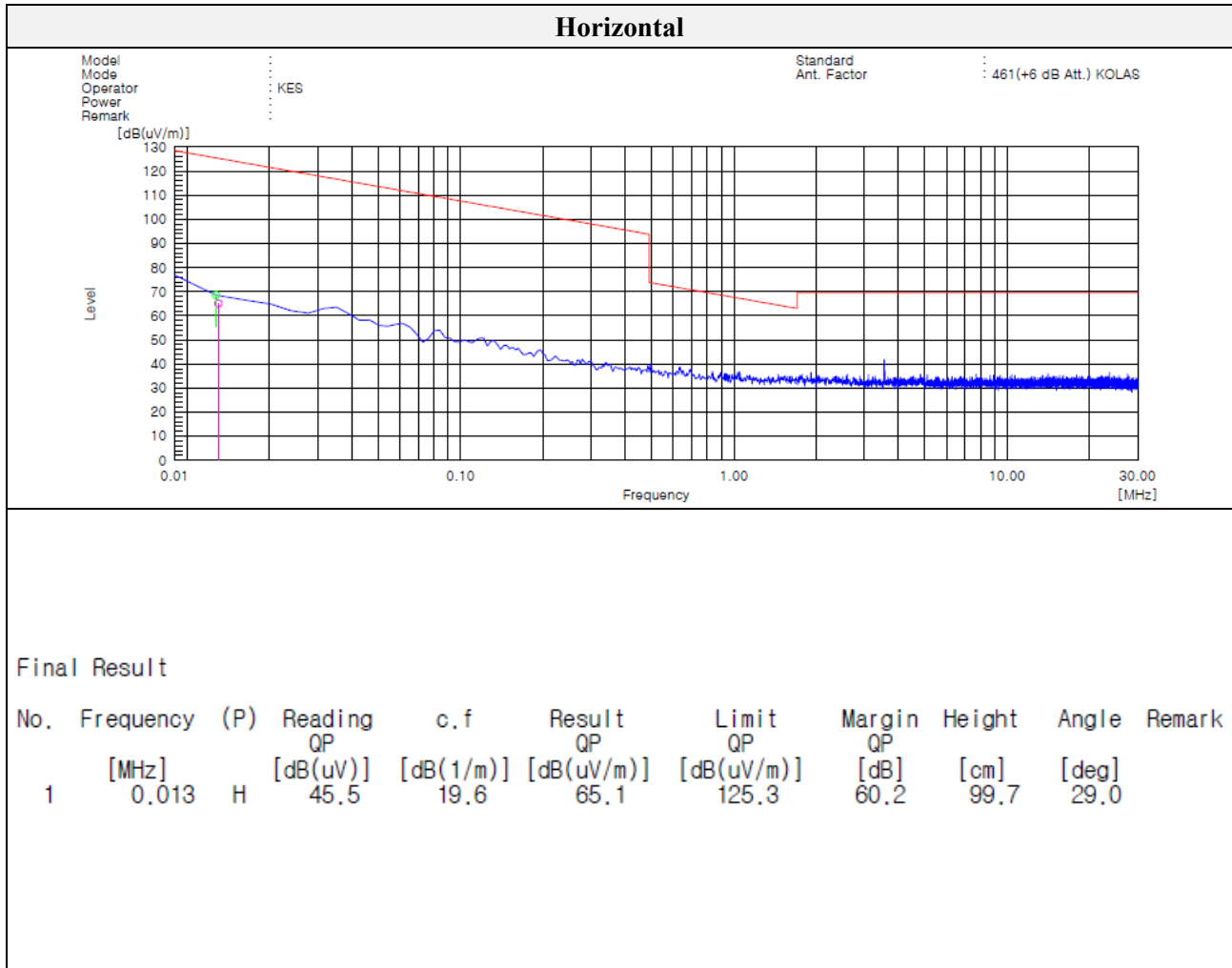


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Test results (Below 30 MHz)

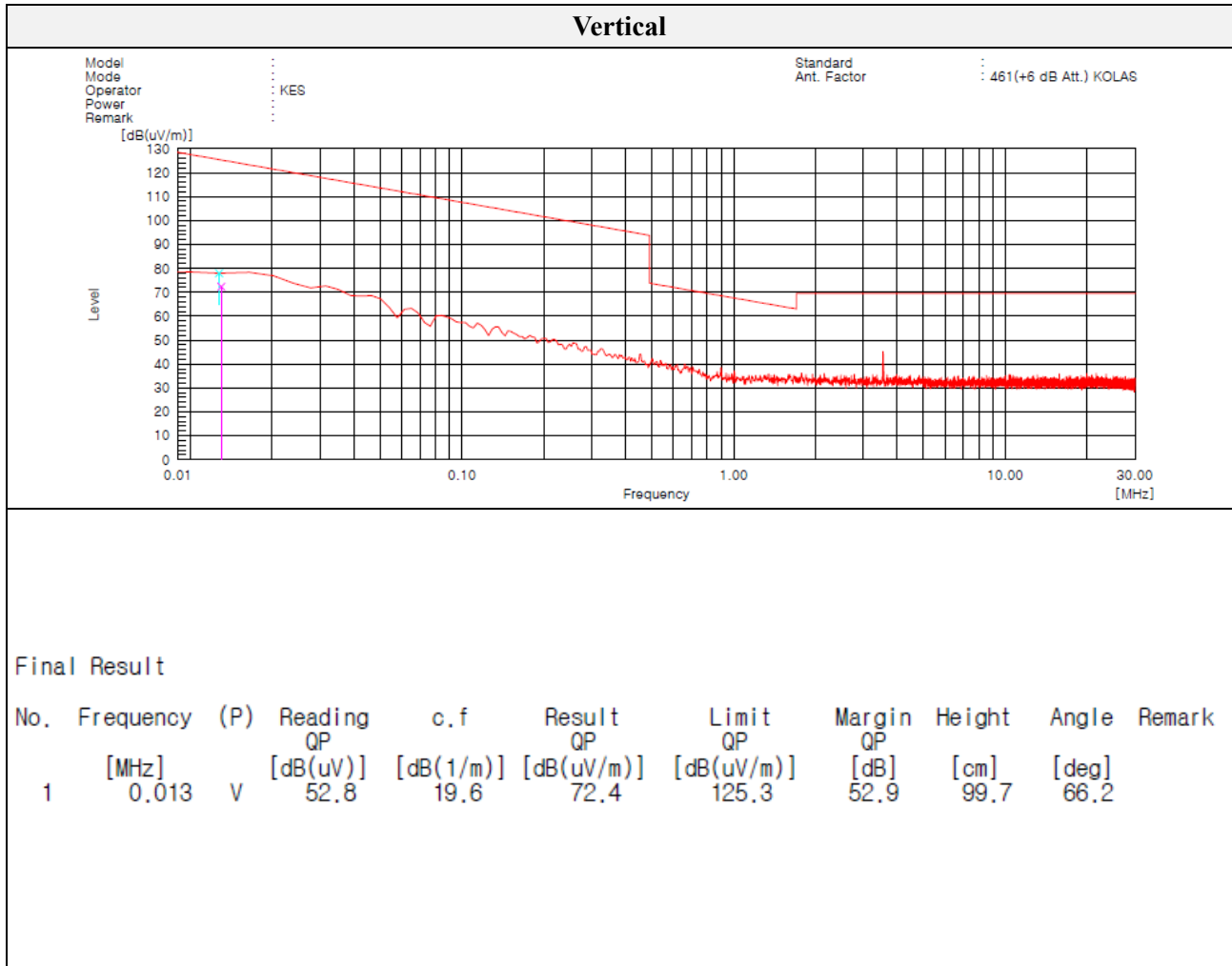
Mode: 12 V_802.11b (1 Mbps)
 Channel: 11
 Distance of measurement: 3 meter



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Mode: 24 V_802.11b (1 Mbps)
 Channel: 11
 Distance of measurement: 3 meter

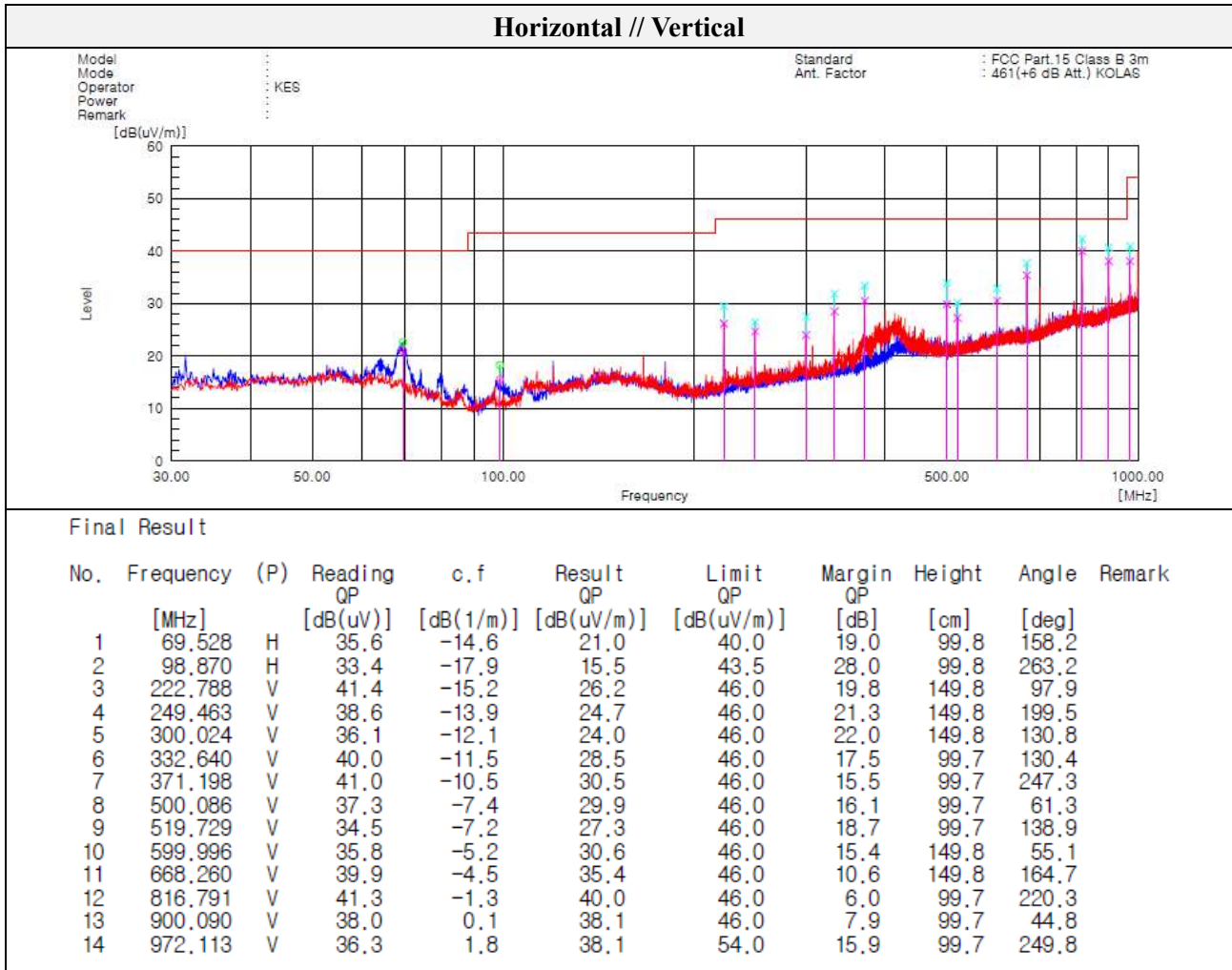


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Test results (Below 1 000 MHz)

Mode: 12 V_BLE (1 Mbps)
 Channel: 40
 Distance of measurement: 3 meter

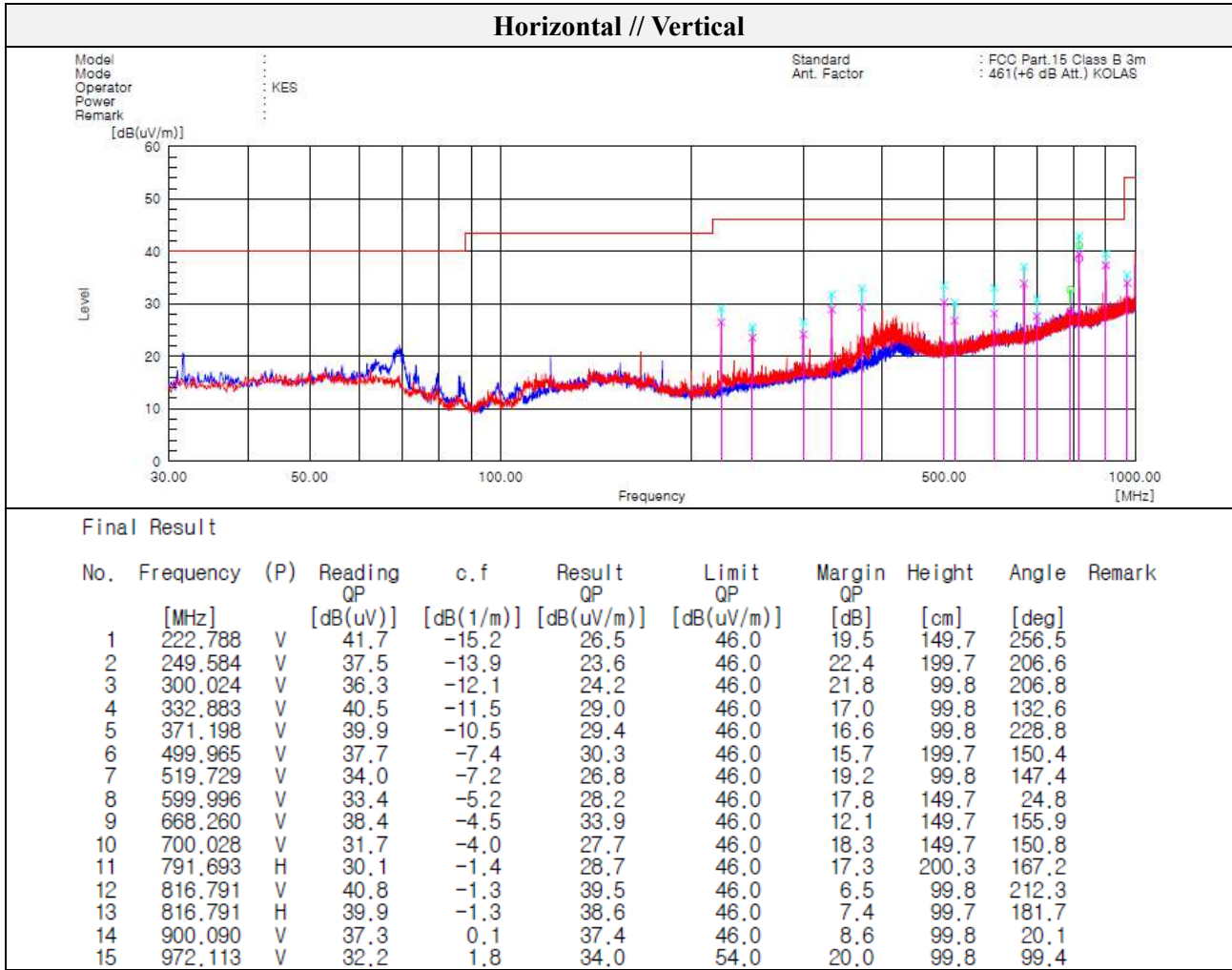


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Test results (Below 1 000 MHz)

Mode: 24 V_BLE (1 Mbps)
 Channel: 40
 Distance of measurement: 3 meter

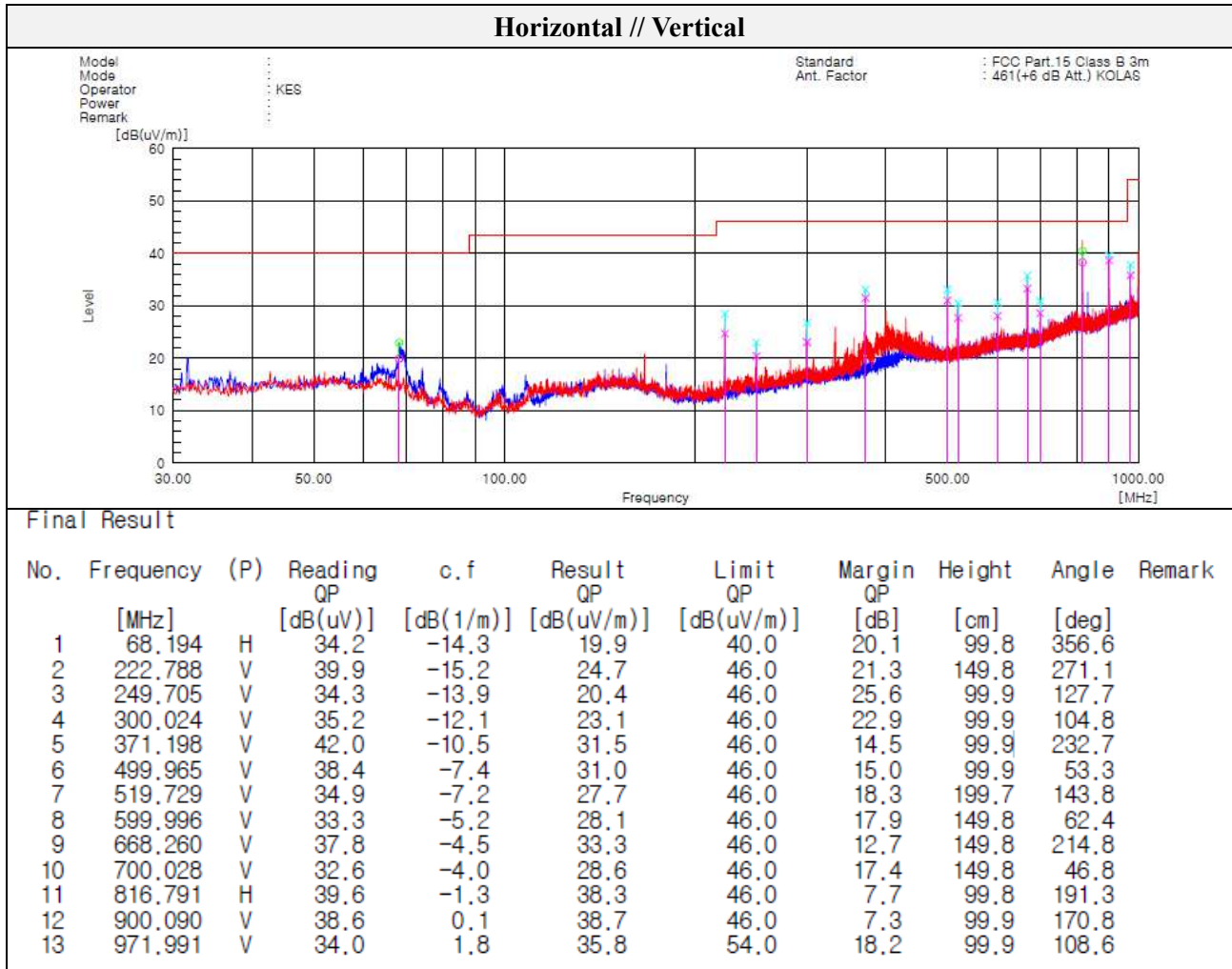


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Test results (Below 1 000 MHz)

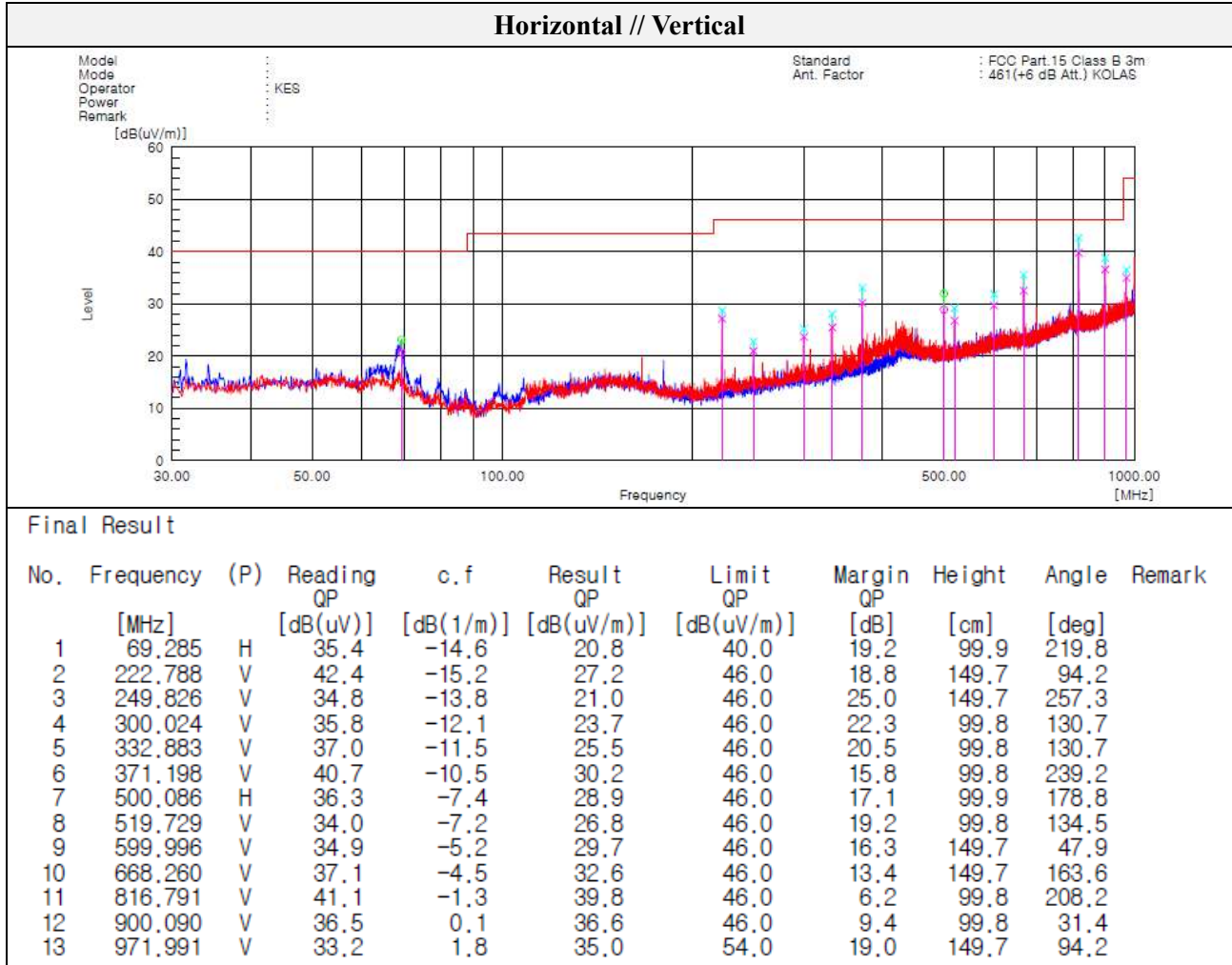
Mode: 12 V_802.11b (1 Mbps)
 Channel: 11
 Distance of measurement: 3 meter



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Mode: 24 V_802.11b (1 Mbps)
 Channel: 11
 Distance of measurement: 3 meter



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Test results (Above 1 000 MHz)

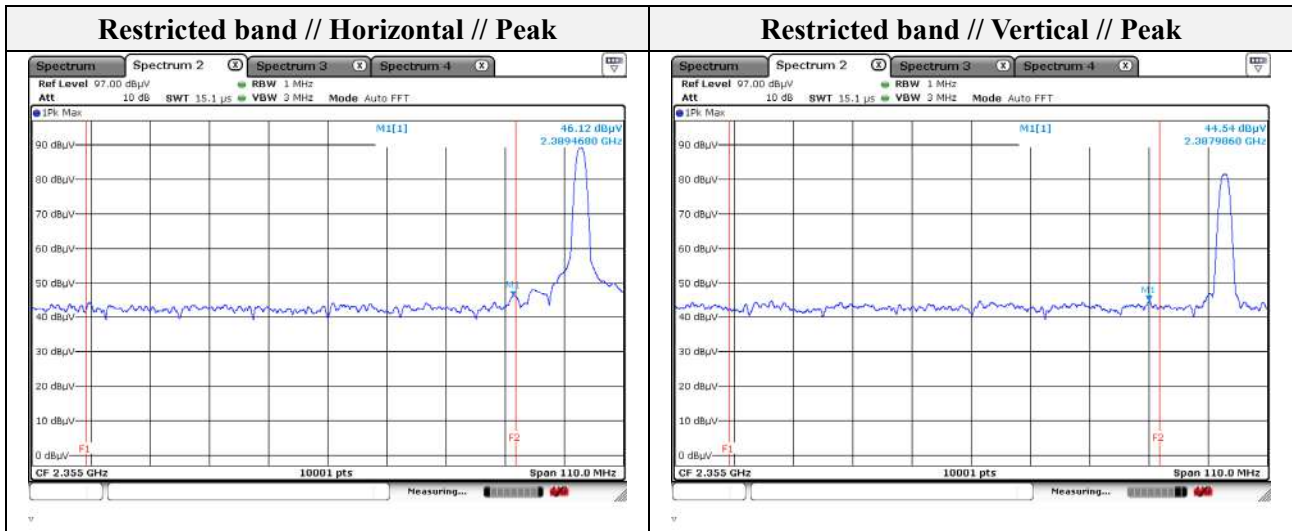
Mode: 12 V_BLE (1 Mbps)
 Channel: 00
 Distance of measurement: 3 meter

- Spurious

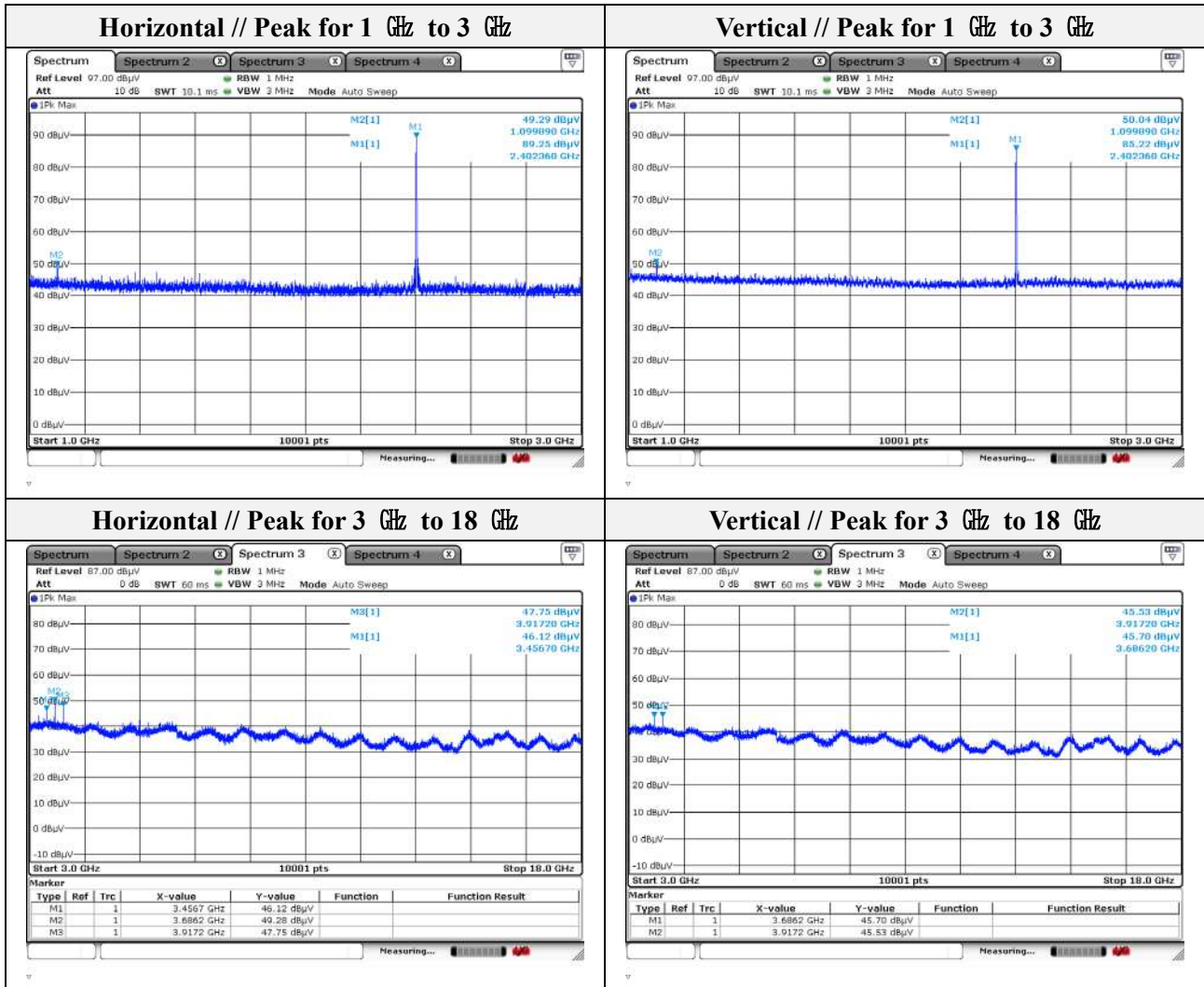
Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1099.89	49.90	Peak	H	-9.81	-	40.09	74.00	33.91
1099.89	50.04	Peak	V	-9.81	-	40.23	74.00	33.77
3456.70	46.12	Peak	H	-0.17	-	45.95	74.00	28.05
3686.20	49.28	Peak	H	0.80	-	50.08	74.00	23.92
3686.20	45.70	Peak	V	0.80	-	46.50	74.00	27.50
3917.20	47.75	Peak	H	1.85	-	49.60	74.00	24.40
3917.20	45.53	Peak	V	1.85	-	47.38	74.00	26.62

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2389.47	46.12	Peak	H	-1.69	-	44.43	74.00	29.57
2387.99	44.54	Peak	V	-1.69	-	42.85	74.00	31.15



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Note.

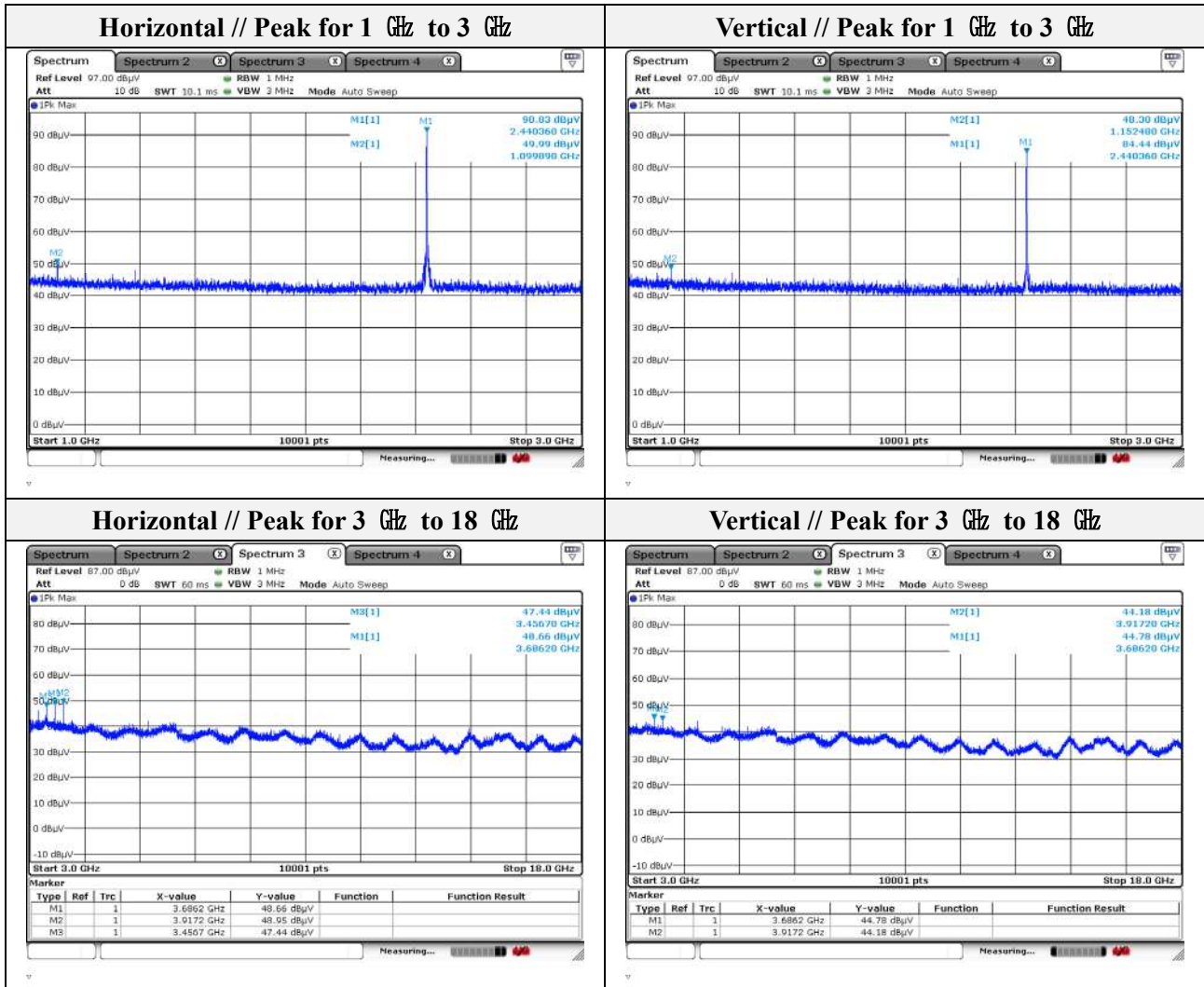
1. Average test would be performed if the peak result were greater than the average limit.



Mode: 12 V_BLE (1 Mbps)
Channel 19
Distance of measurement: 3 meter

- **Spurious**

Frequency (MHz)	Level (dB μ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1099.89	49.99	Peak	H	-9.81		40.18	74.00	33.82
1152.48	48.30	Peak	V	-9.49		38.81	74.00	35.19
3456.70	47.44	Peak	H	-0.17		47.27	74.00	26.73
3686.20	48.66	Peak	H	0.80		49.46	74.00	24.54
3686.20	44.78	Peak	V	0.80		45.58	74.00	28.42
3917.20	48.95	Peak	H	1.85		50.80	74.00	23.20
3917.20	44.18	Peak	V	1.85		46.03	74.00	27.97



Note.

1. Average test would be performed if the peak result were greater than the average limit.



Mode: 12 V_BLE (1 Mbps)
Channel: 39
Distance of measurement: 3 meter

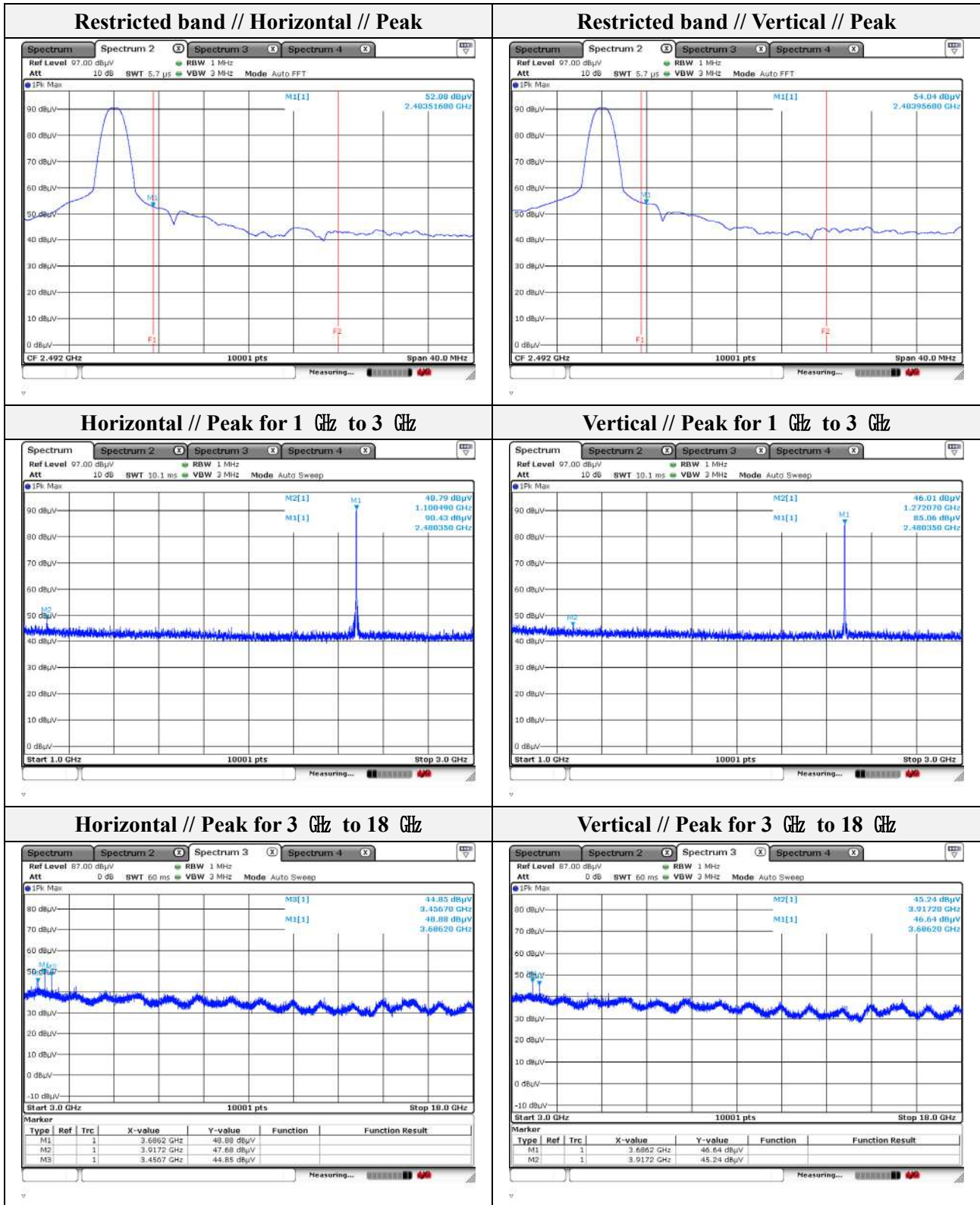
- **Spurious**

Frequency (MHz)	Level (dB μ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1100.49	48.79	Peak	H	-9.81	-	33.57	74.00	40.43
1272.07	46.01	Peak	V	-8.75	-	34.04	74.00	39.96
3456.70	44.85	Peak	H	-0.17	-	34.61	74.00	39.39
3686.20	48.88	Peak	H	0.80	-	40.43	74.00	33.57
3686.20	46.64	Peak	V	0.80	-	54.51	74.00	19.49
3917.20	47.68	Peak	H	1.85	-	51.08	54.00	2.92
3917.20	45.24	Peak	V	1.85	-	55.23	74.00	18.77

- **Band edge**

Frequency (MHz)	Level (dB μ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2483.52	52.88	Peak	H	-1.67	-	51.21	74.00	22.79
2483.96	54.04	Peak	V	-1.67	-	52.37	74.00	21.63

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Note.

1. Average test would be performed if the peak result were greater than the average limit.

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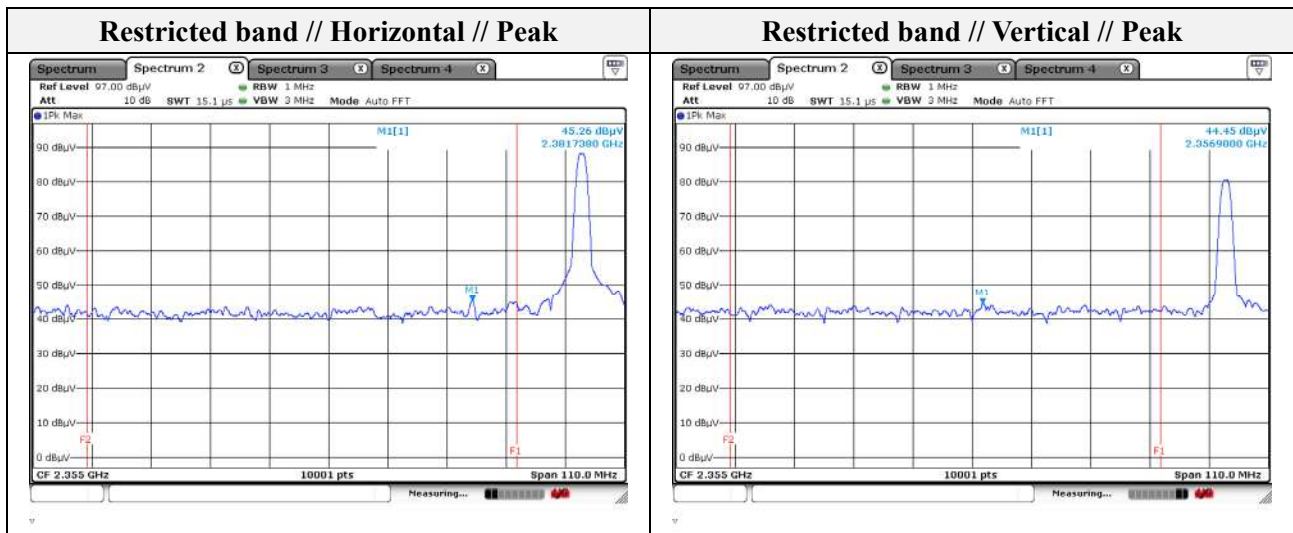
Mode: 24 V_BLE (1 Mbps)
 Channel: 00
 Distance of measurement: 3 meter

- Spurious

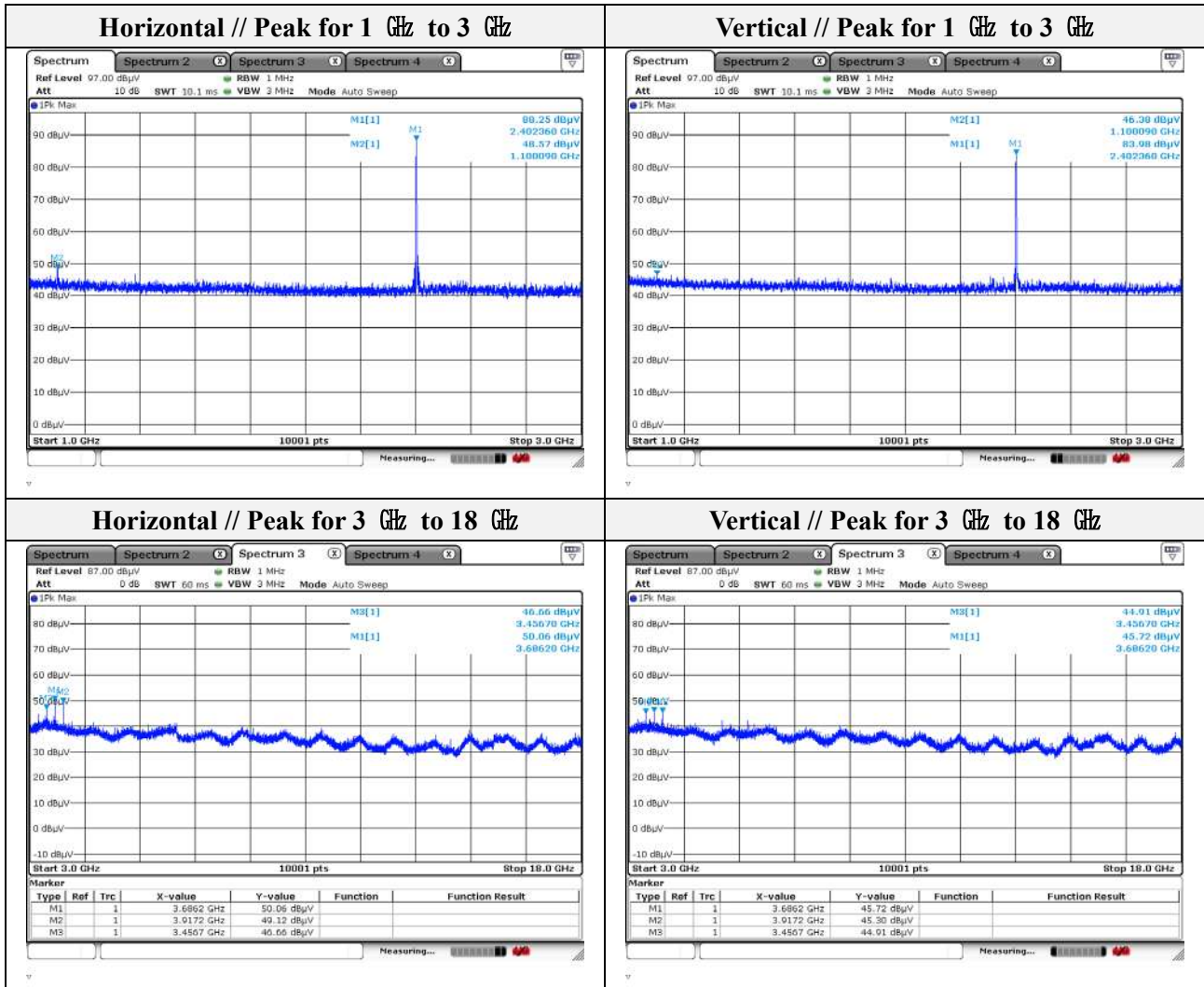
Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1100.09	48.57	Peak	H	-9.81	-	38.76	74.00	35.24
1100.09	46.38	Peak	V	-9.81	-	36.57	74.00	37.43
3456.70	46.66	Peak	H	-0.17	-	46.49	74.00	27.51
3456.70	44.91	Peak	V	-0.17	-	44.74	74.00	29.26
3686.20	50.06	Peak	H	0.80	-	50.86	74.00	23.14
3686.20	45.72	Peak	V	0.80	-	46.52	74.00	27.48
3917.20	49.12	Peak	H	1.85	-	50.97	74.00	23.03
3917.20	45.30	Peak	V	1.85	-	47.15	74.00	26.85

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2381.74	45.26	Peak	H	-1.70	-	43.56	74.00	30.44
2356.98	44.45	Peak	V	-1.73	-	42.72	74.00	31.28



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Note.

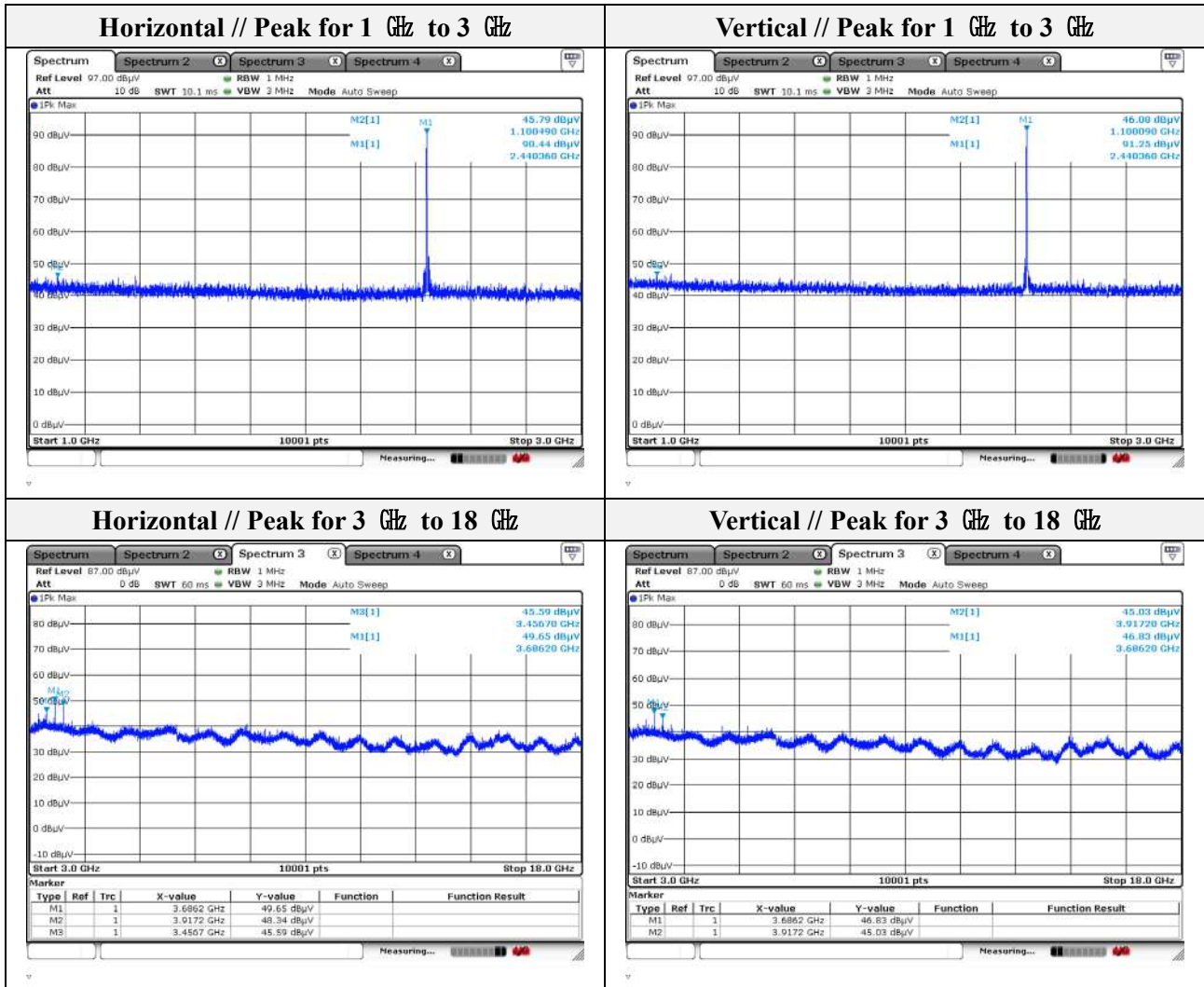
1. Average test would be performed if the peak result were greater than the average limit.



Mode: 24 V_BLE (1 Mbps)
Channel 19
Distance of measurement: 3 meter

- **Spurious**

Frequency (MHz)	Level (dB μ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1100.49	45.79	Peak	H	-9.81	-	35.98	74.00	38.02
1100.09	46.08	Peak	V	-9.81	-	36.27	74.00	37.73
3456.70	45.59	Peak	H	-0.17	-	45.42	74.00	28.58
3686.20	49.65	Peak	H	0.80	-	50.45	74.00	23.55
3686.20	46.83	Peak	V	0.80	-	47.63	74.00	26.37
3917.20	48.34	Peak	H	1.85	-	50.19	74.00	23.81
3917.20	45.03	Peak	V	1.85		46.88	74.00	27.12



Note.

1. Average test would be performed if the peak result were greater than the average limit.

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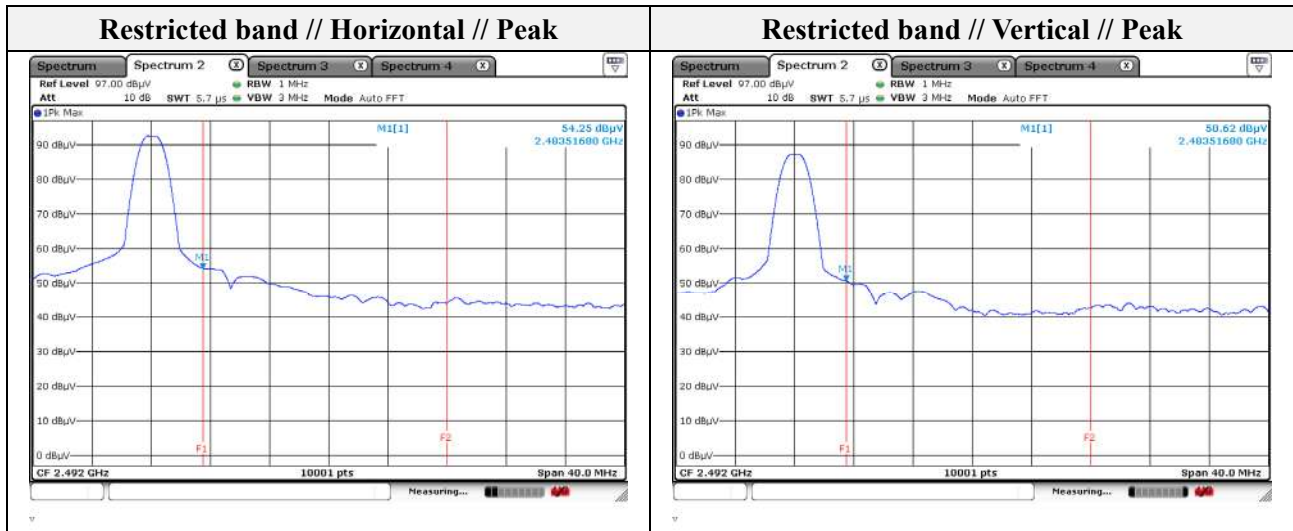
Mode: 24 V_BLE (1 Mbps)
 Channel: 39
 Distance of measurement: 3 meter

- Spurious

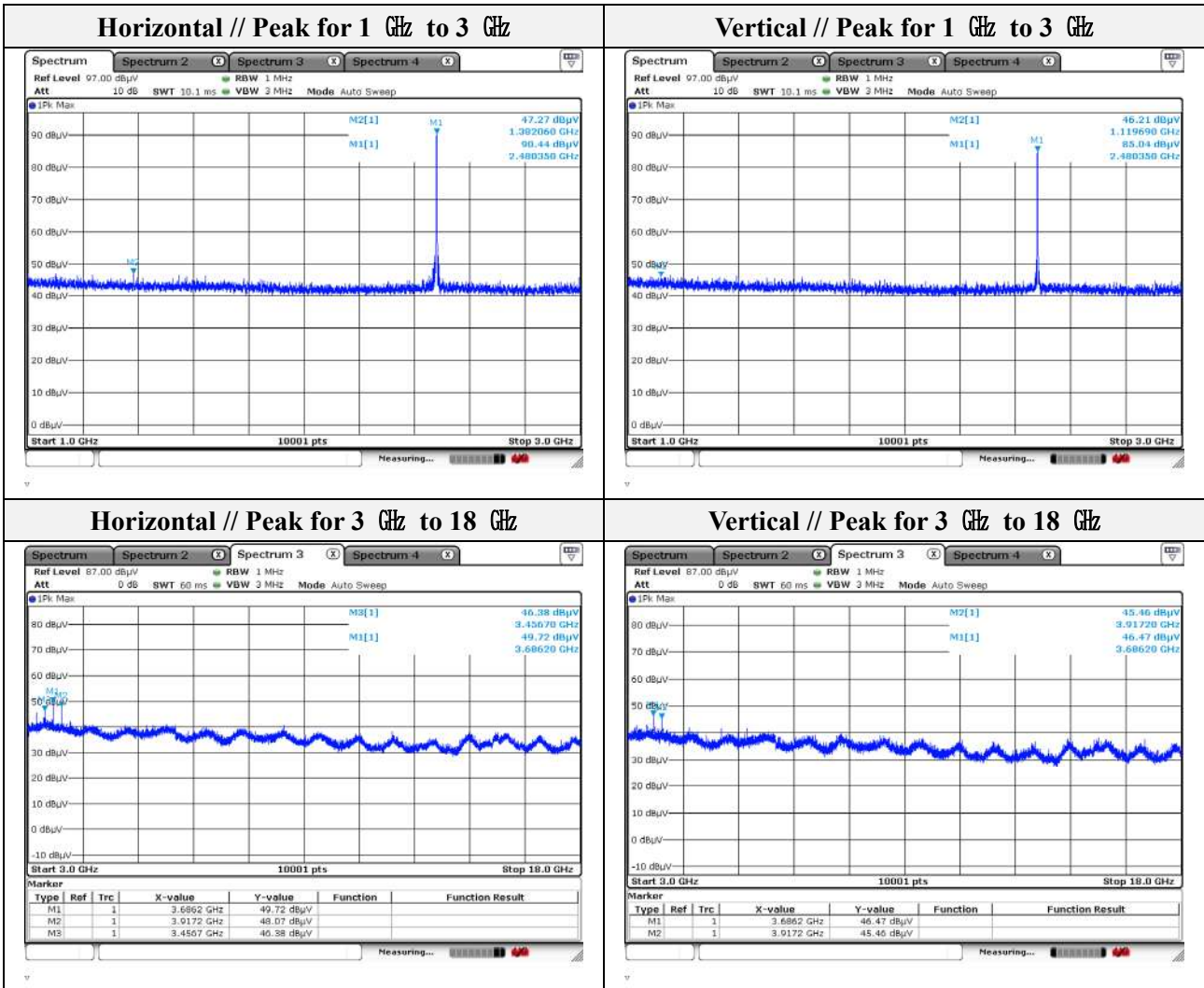
Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1382.06	47.27	Peak	H	-8.08	-	39.19	74.00	34.81
1119.69	46.21	Peak	V	-9.69	-	36.52	74.00	37.48
3456.70	46.38	Peak	H	-0.17	-	46.21	74.00	27.79
3686.20	49.72	Peak	H	0.80	-	50.52	74.00	23.48
3686.20	46.47	Peak	V	0.80	-	47.27	74.00	26.73
3917.20	48.07	Peak	H	1.85	-	49.92	74.00	24.08
3917.20	45.46	Peak	V	1.85	-	47.31	74.00	26.69

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2483.52	54.25	Peak	H	-1.67	-	52.58	74.00	21.42
2483.52	50.62	Peak	V	-1.67	-	48.95	74.00	25.05



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Note.

1. Average test would be performed if the peak result were greater than the average limit.



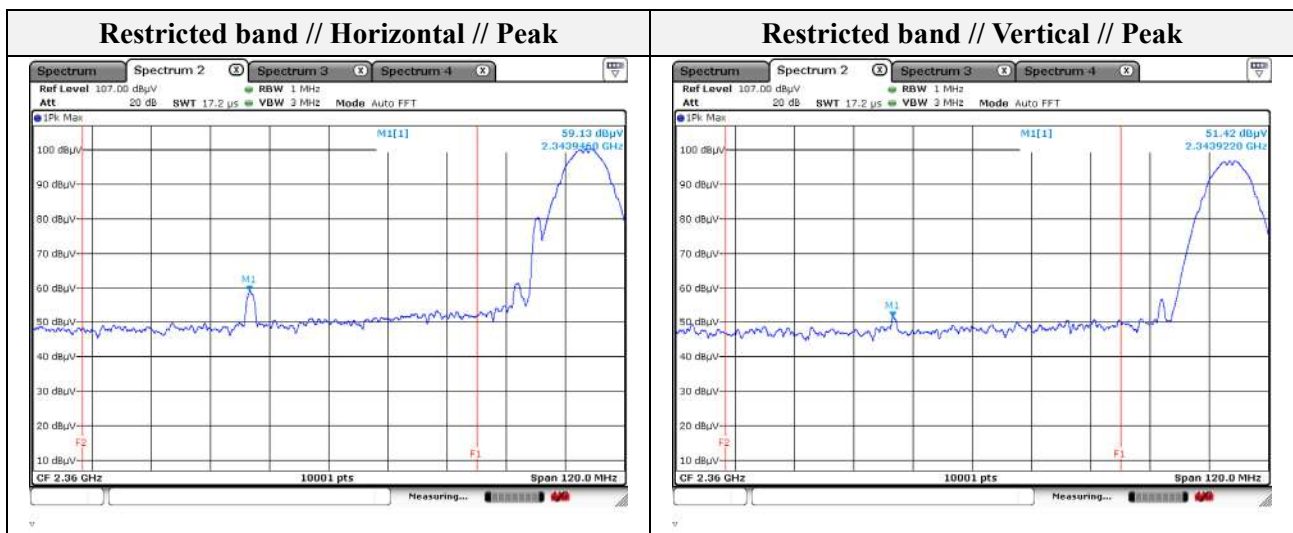
Mode: 12 V_802.11b (1 Mbps)
 Channel: 01
 Distance of measurement: 3 meter

- Spurious

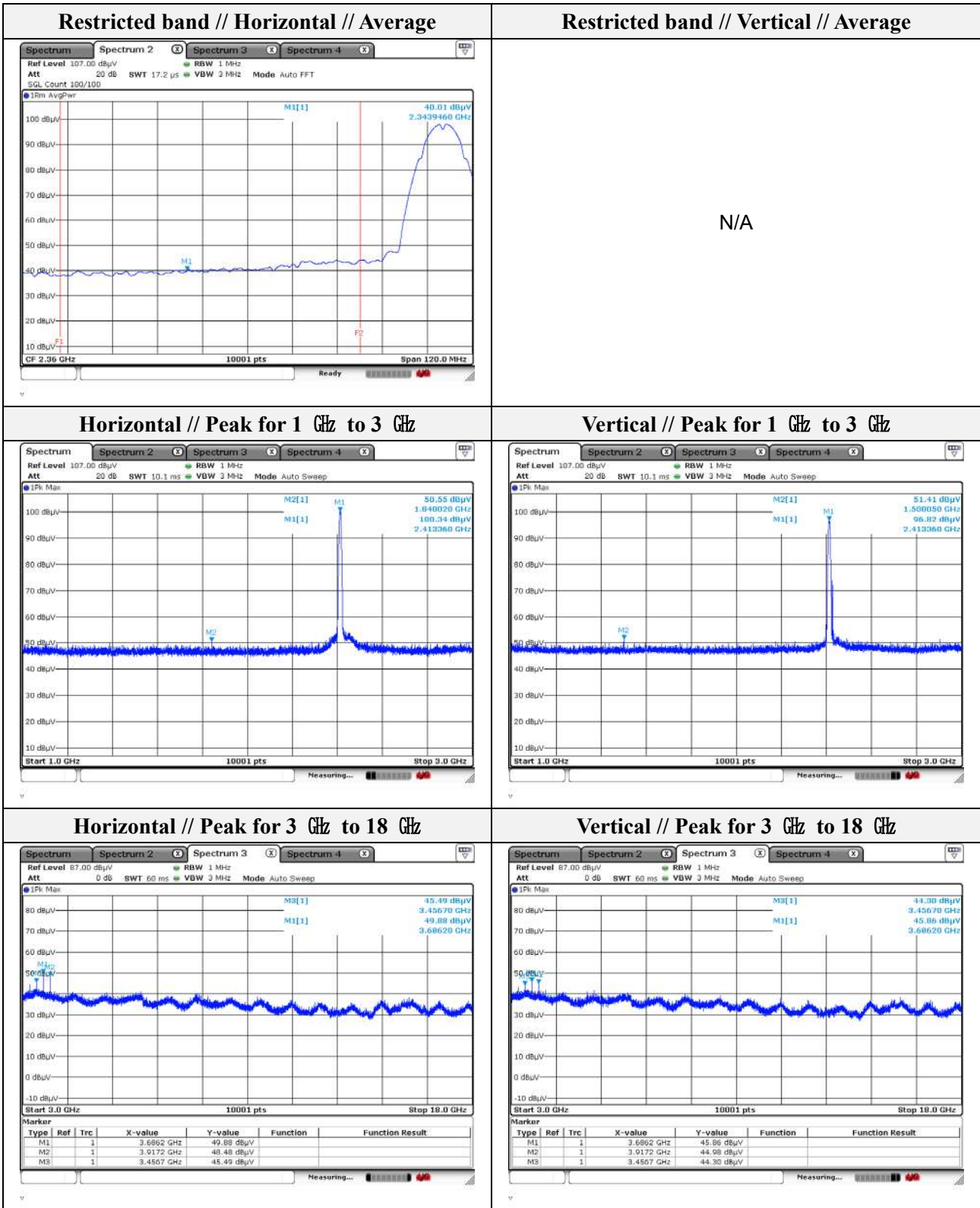
Frequency (MHz)	Level (dB μ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1840.02	50.55	Peak	H	-3.69	-	46.86	74.00	27.14
1500.05	51.41	Peak	V	-7.44	-	43.97	74.00	30.03
3456.70	45.49	Peak	H	-0.17	-	45.32	74.00	28.68
3456.70	44.30	Peak	V	-0.17	-	44.13	74.00	29.87
3686.20	49.88	Peak	H	0.80	-	50.68	74.00	23.32
3686.20	45.86	Peak	V	0.80	-	46.66	74.00	27.34
3917.20	48.48	Peak	H	1.85	-	50.33	74.00	23.67
3917.20	44.98	Peak	V	1.85	-	46.83	74.00	27.17

- Band edge

Frequency (MHz)	Level (dB μ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2343.95	59.13	Peak	H	-1.75	-	57.38	74.00	16.62
2343.95	40.01	Average	V	-1.75	-	38.26	54.00	15.74
2343.92	51.42	Peak	H	-1.75	-	49.67	74.00	24.33



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Note.

1. Average test would be performed if the peak result were greater than the average limit.

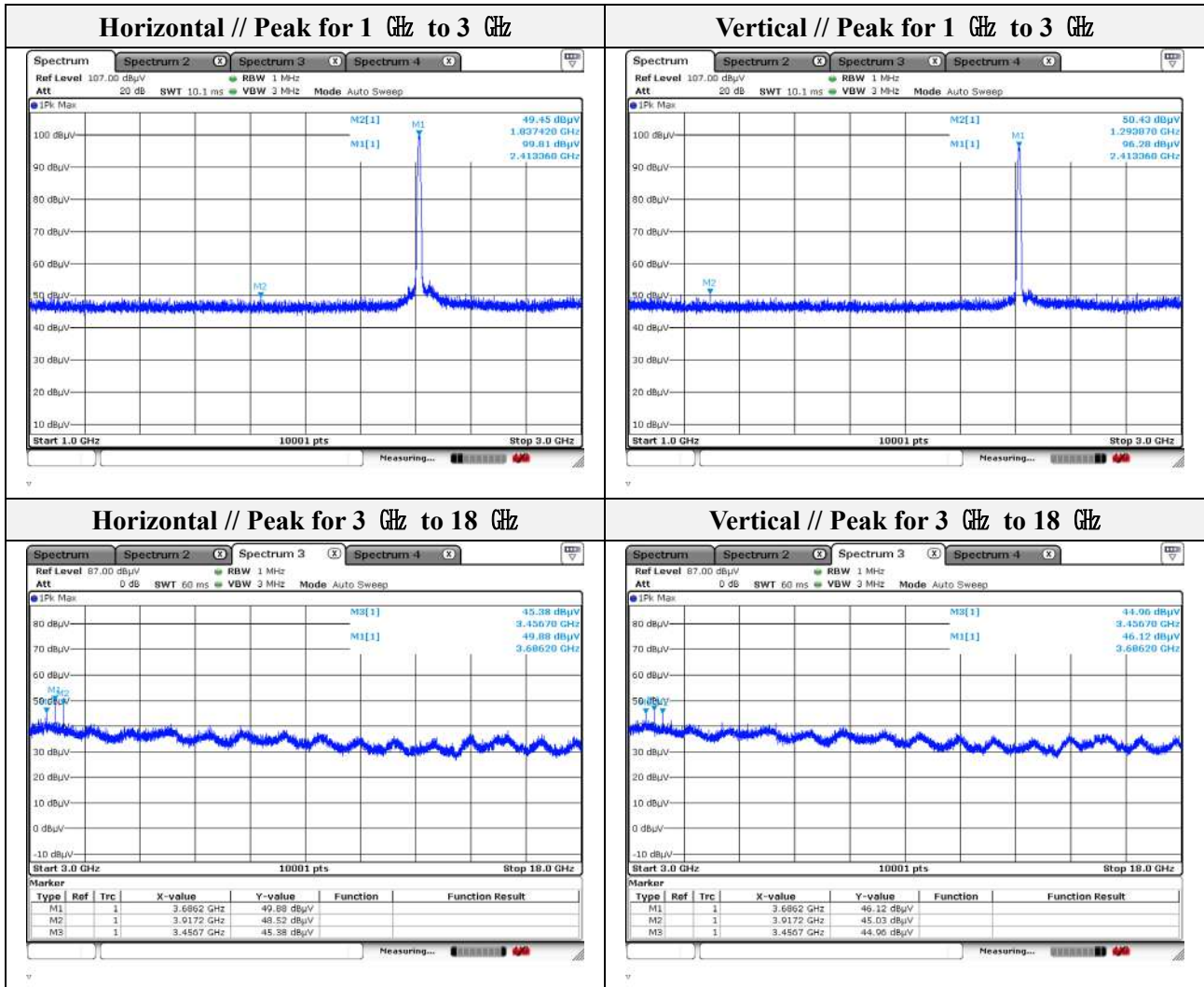
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Mode: 12 V_802.11b (1 Mbps)
Channel 06
Distance of measurement: 3 meter

- **Spurious**

Frequency (MHz)	Level (dB μ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1837.42	49.45	Peak	H	-3.72		45.73	74.00	28.27
1293.87	50.43	Peak	V	-8.62		41.81	74.00	32.19
3456.70	45.38	Peak	H	-0.17		45.21	74.00	28.79
3456.70	44.96	Peak	V	-0.17		44.79	74.00	29.21
3686.20	49.88	Peak	H	0.80		50.68	74.00	23.32
3686.20	46.12	Peak	V	0.80		46.92	74.00	27.08
3917.20	48.51	Peak	H	1.85		50.36	74.00	23.64
3917.20	46.12	Peak	V	1.85		47.97	74.00	26.03



Note.

1. Average test would be performed if the peak result were greater than the average limit.

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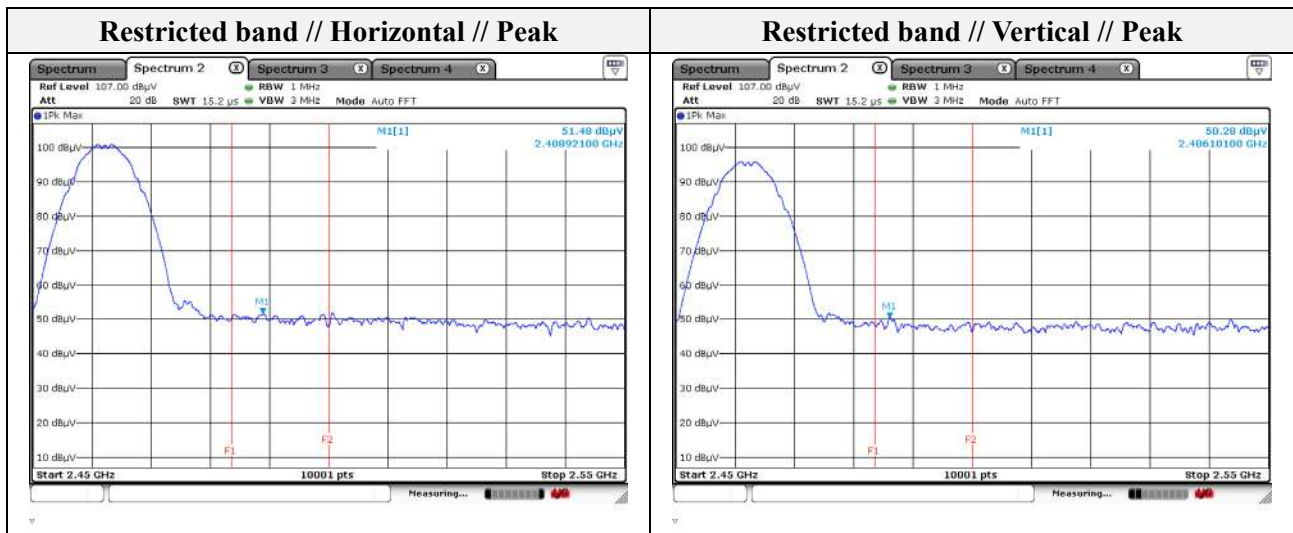
Mode: 12 V_802.11b (1 Mbps)
 Channel: 11
 Distance of measurement: 3 meter

- Spurious

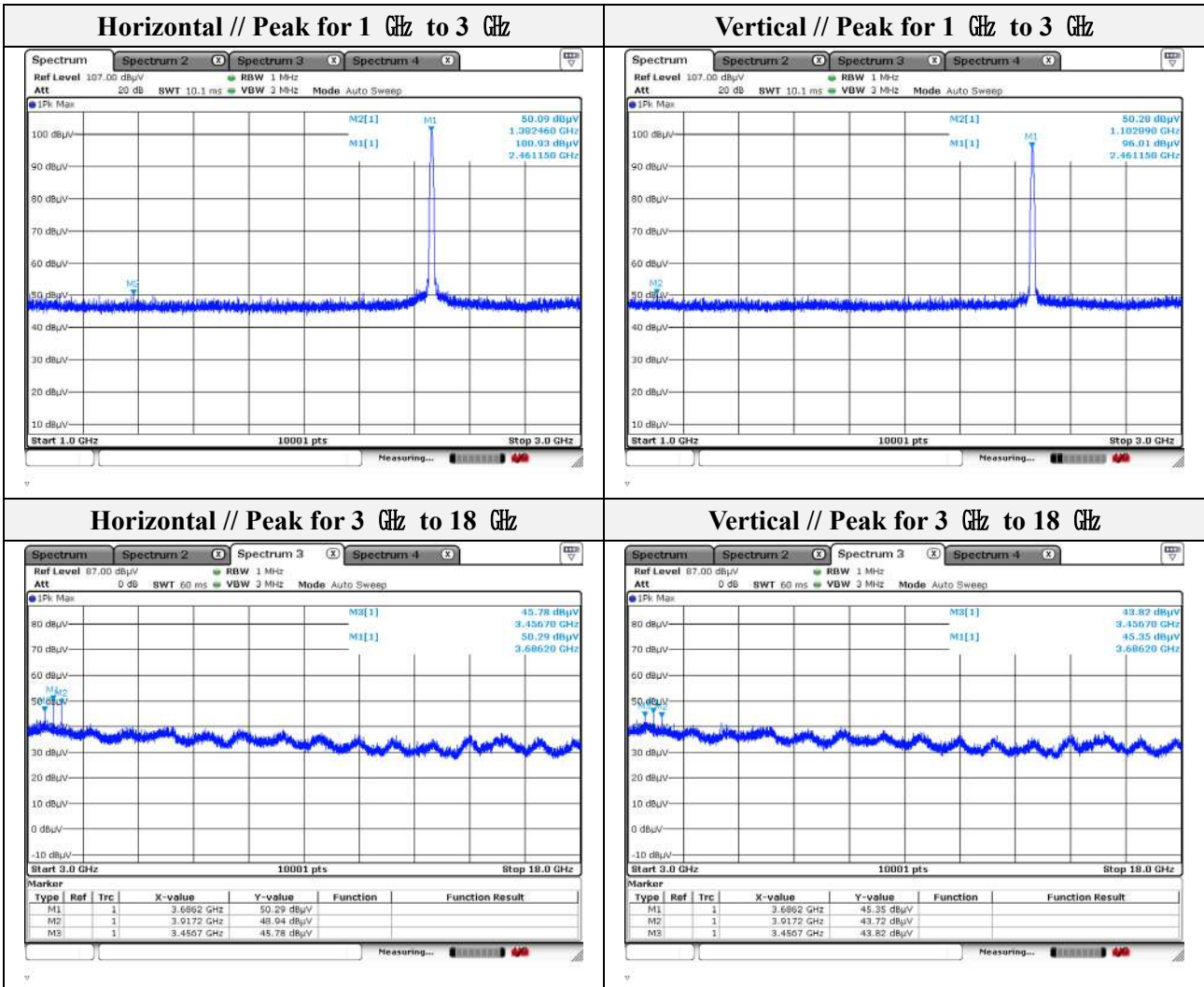
Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1382.46	50.09	Peak	H	-8.07	-	42.02	74.00	31.98
1102.89	50.28	Peak	V	-9.79	-	40.49	74.00	33.51
3456.70	45.78	Peak	H	-0.17	-	45.61	74.00	28.39
3456.70	43.82	Peak	V	-0.17	-	43.65	74.00	30.35
3686.20	50.29	Peak	H	0.80	-	51.09	74.00	22.91
3686.20	45.35	Peak	V	0.80	-	46.15	74.00	27.85
3917.20	48.94	Peak	H	1.85	-	50.79	74.00	23.21
3917.20	43.72	Peak	V	1.85	-	45.57	74.00	28.43

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2488.92	51.48	Peak	H	-1.67	-	49.81	74.00	24.19
2486.10	50.28	Peak	V	-1.67	-	48.61	74.00	25.39



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Note.

1. Average test would be performed if the peak result were greater than the average limit.



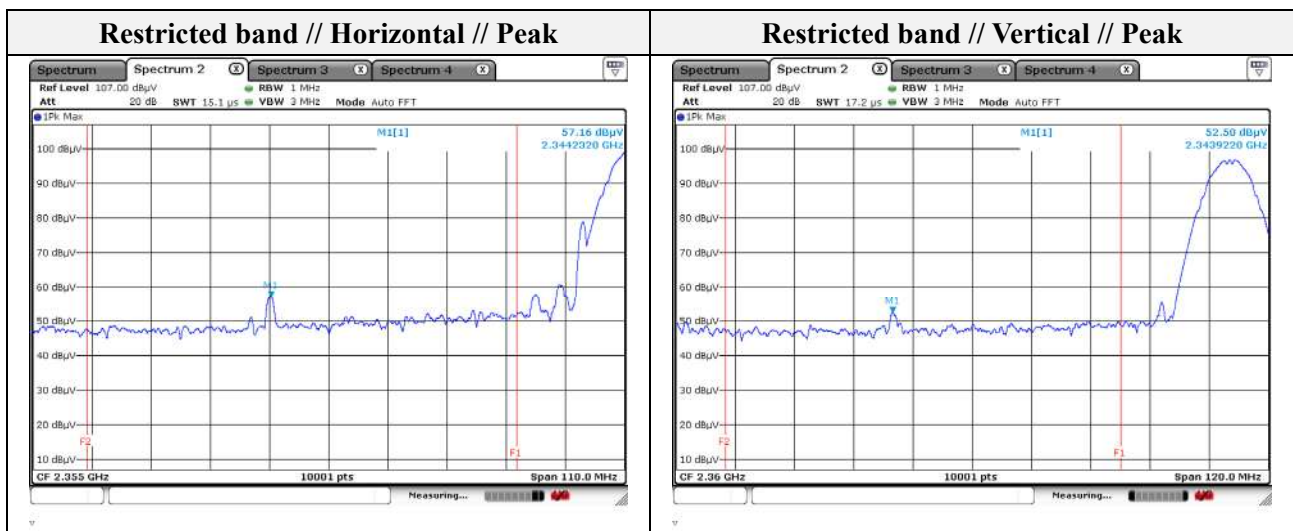
Mode: 24 V_802.11b (1 Mbps)
 Channel: 01
 Distance of measurement: 3 meter

- Spurious

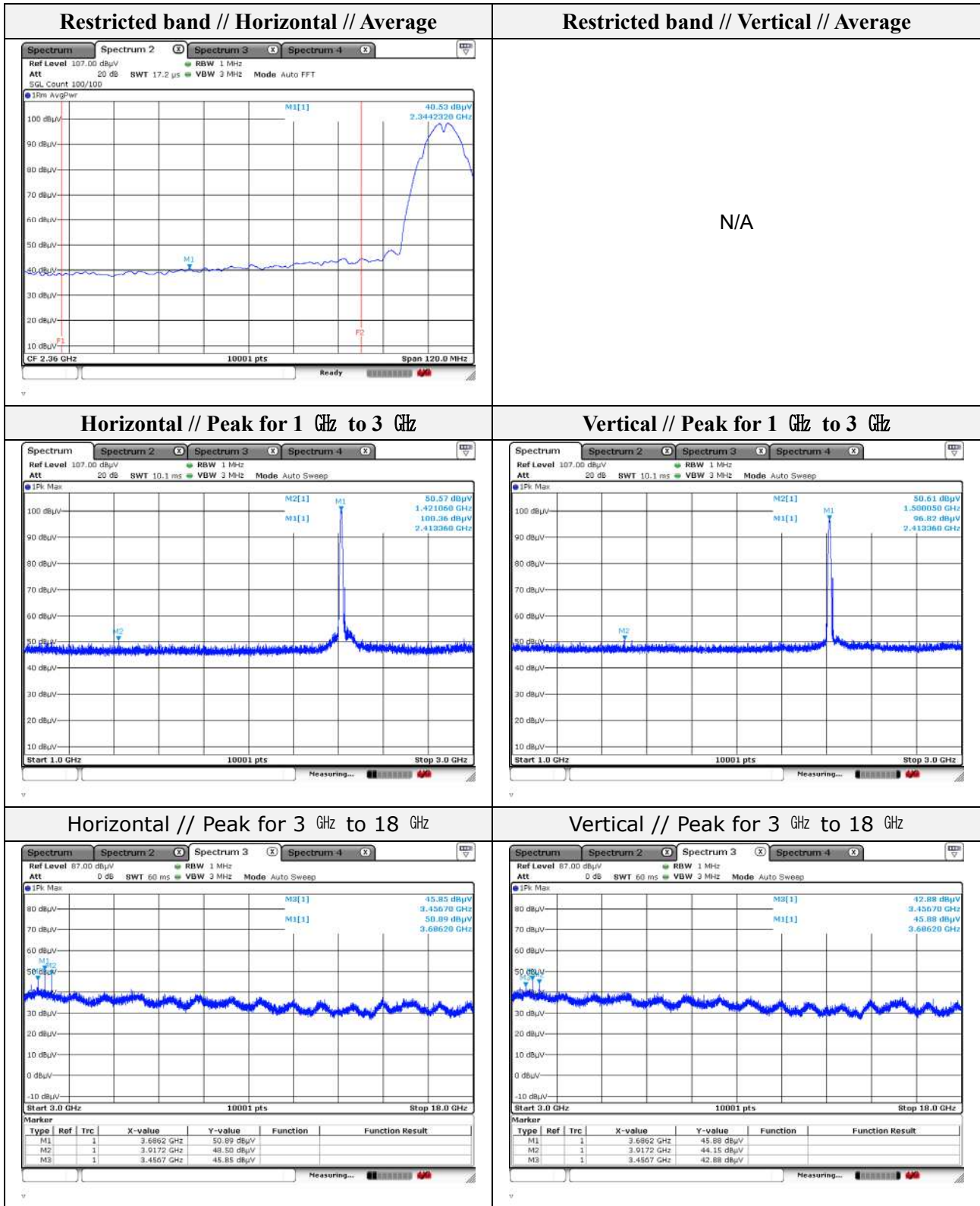
Frequency (MHz)	Level (dB μ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1421.06	50.57	Peak	H	-7.86	-	42.71	74.00	31.29
1500.05	50.61	Peak	V	-7.44	-	43.17	74.00	30.83
3456.70	45.85	Peak	H	-0.17	-	45.68	74.00	28.32
3456.70	42.88	Peak	V	-0.17	-	42.71	74.00	31.29
3686.20	50.89	Peak	H	0.80	-	51.69	74.00	22.31
3686.20	45.88	Peak	V	0.80	-	46.68	74.00	27.32
3917.20	48.50	Peak	H	1.85	-	50.35	74.00	23.65
3917.20	44.15	Peak	V	1.85	-	46.00	74.00	28.00

- Band edge

Frequency (MHz)	Level (dB μ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2344.23	57.16	Peak	H	-1.75	-	55.41	74.00	18.59
2344.23	40.53	Average	H	-1.75	-	38.78	54.00	15.22
2343.92	52.50	Peak	V	-1.75	-	50.75	74.00	23.25



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Note.

1. Average test would be performed if the peak result were greater than the average limit.

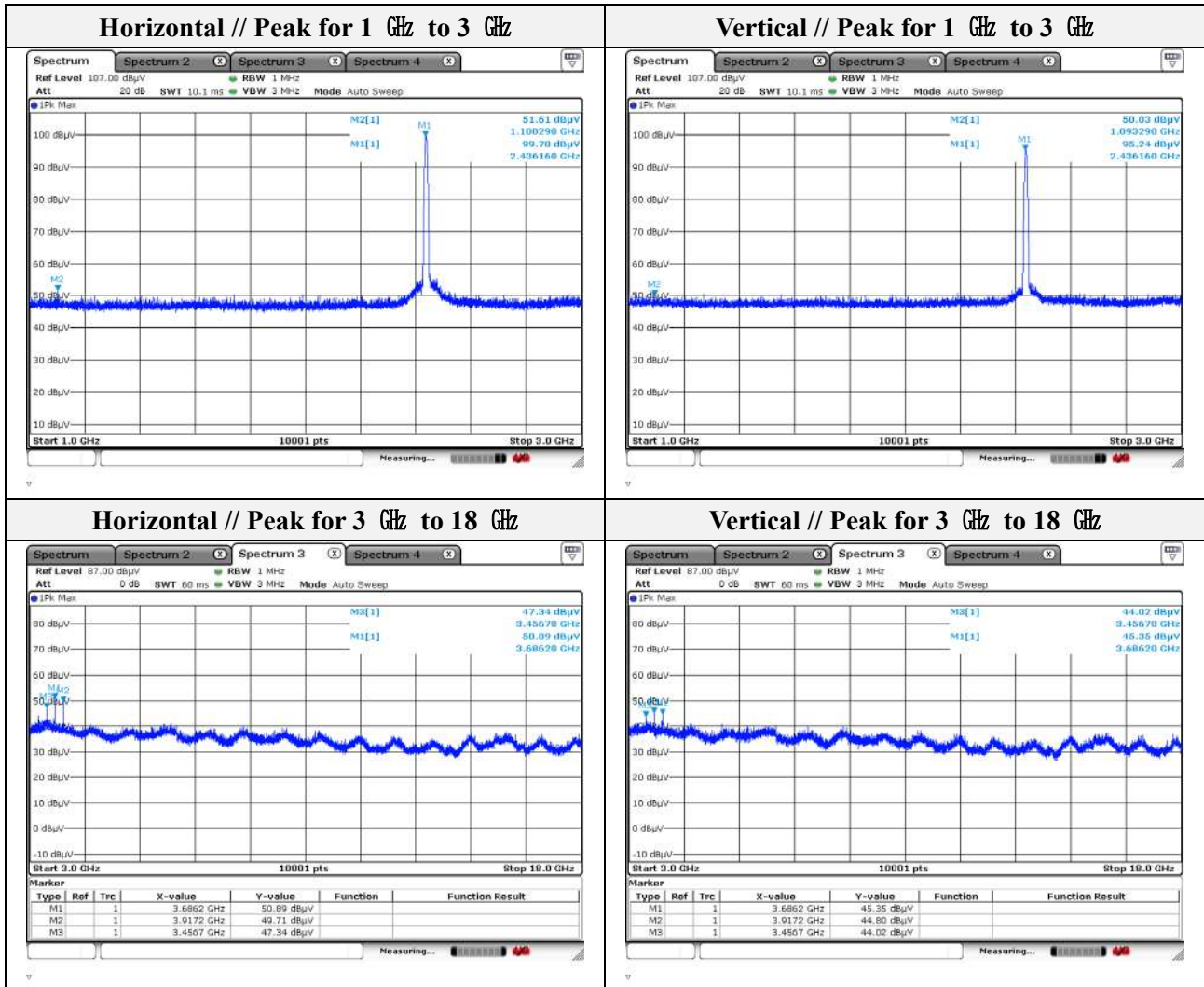
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Mode: 24 V_802.11b (1 Mbps)
Channel 06
Distance of measurement: 3 meter

- **Spurious**

Frequency (MHz)	Level (dB μ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1093.29	50.03	Peak	V	-9.85	-	40.18	74.00	33.82
1100.29	51.61	Peak	H	-9.81	-	41.80	74.00	32.20
3456.70	47.34	Peak	H	-0.17	-	47.17	74.00	26.83
3456.70	44.02	Peak	V	-0.17	-	43.85	74.00	30.15
3686.20	50.89	Peak	H	0.80	-	51.69	74.00	22.31
3686.20	45.35	Peak	V	0.80	-	46.15	74.00	27.85
3917.20	49.71	Peak	H	1.85	-	51.56	74.00	22.44
3917.20	44.80	Peak	V	1.85	-	46.65	74.00	27.35



Note.

1. Average test would be performed if the peak result were greater than the average limit.



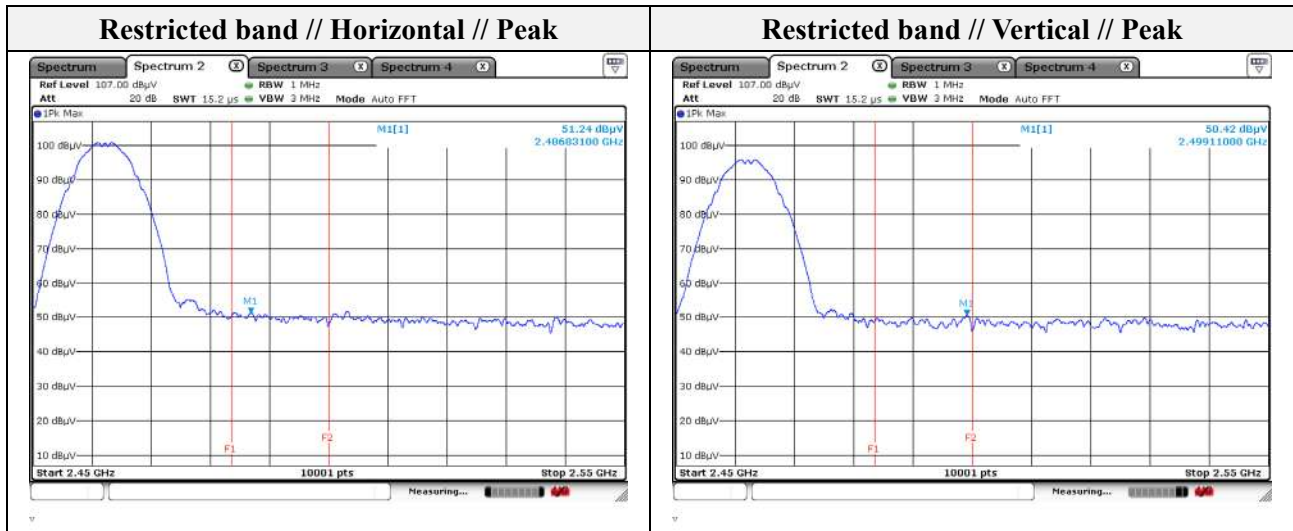
Mode: 24 V_802.11b (1 Mbps)
 Channel: 11
 Distance of measurement: 3 meter

- Spurious

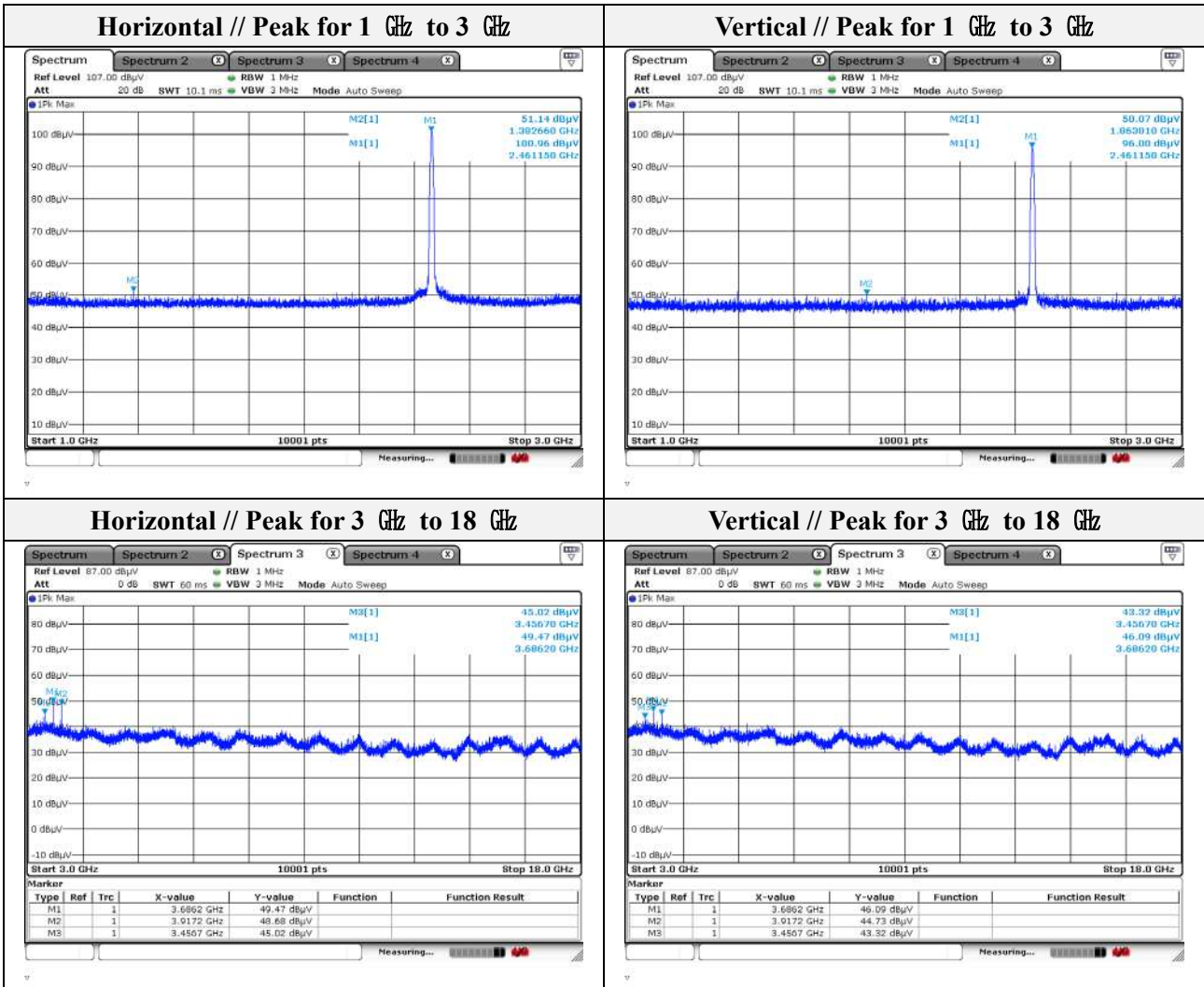
Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1382.66	51.14	Peak	H	-8.07	-	43.07	74.00	30.93
1863.81	50.07	Peak	V	-3.45	-	46.62	74.00	27.38
3456.70	45.02	Peak	H	-0.17	-	44.85	74.00	29.15
3456.70	43.32	Peak	V	-0.17	-	43.15	74.00	30.85
3686.20	49.47	Peak	H	0.80	-	50.27	74.00	23.73
3686.20	46.09	Peak	V	0.80	-	46.89	74.00	27.11
3917.20	48.68	Peak	H	1.85	-	50.53	74.00	23.47
3917.20	44.73	Peak	V	1.85	-	46.58	74.00	27.42

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2486.83	51.24	Peak	H	-1.67	-	50.24	74.00	23.76
2499.11	50.42	Peak	V	-1.66	-	48.76	74.00	25.24



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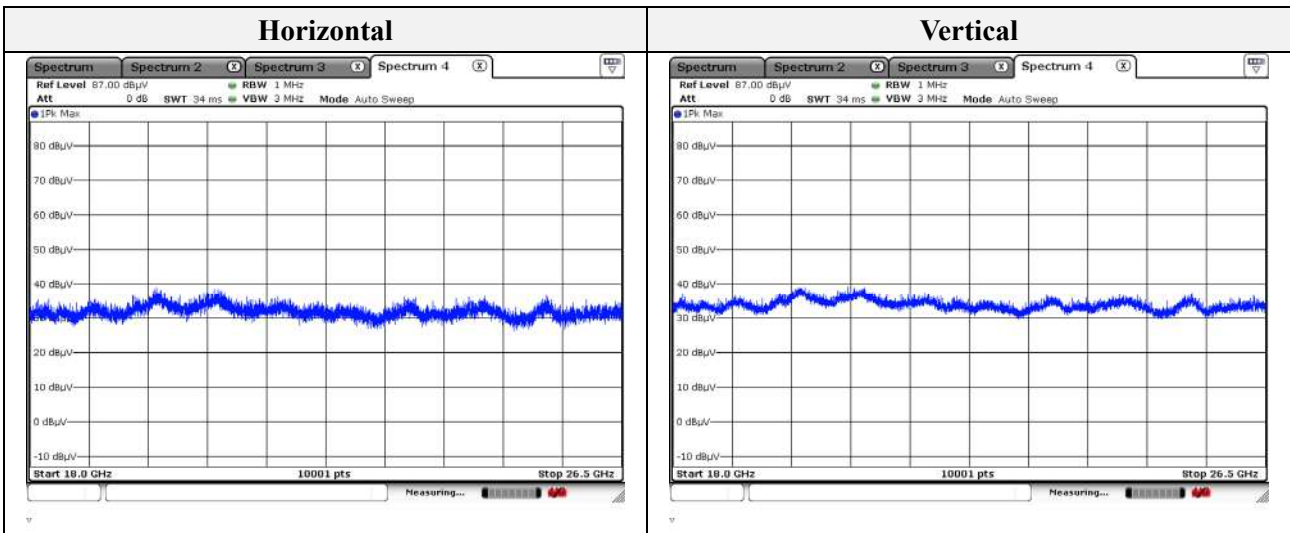


Note.

1. Average test would be performed if the peak result were greater than the average limit.

Test results (18 GHz to 30 GHz)

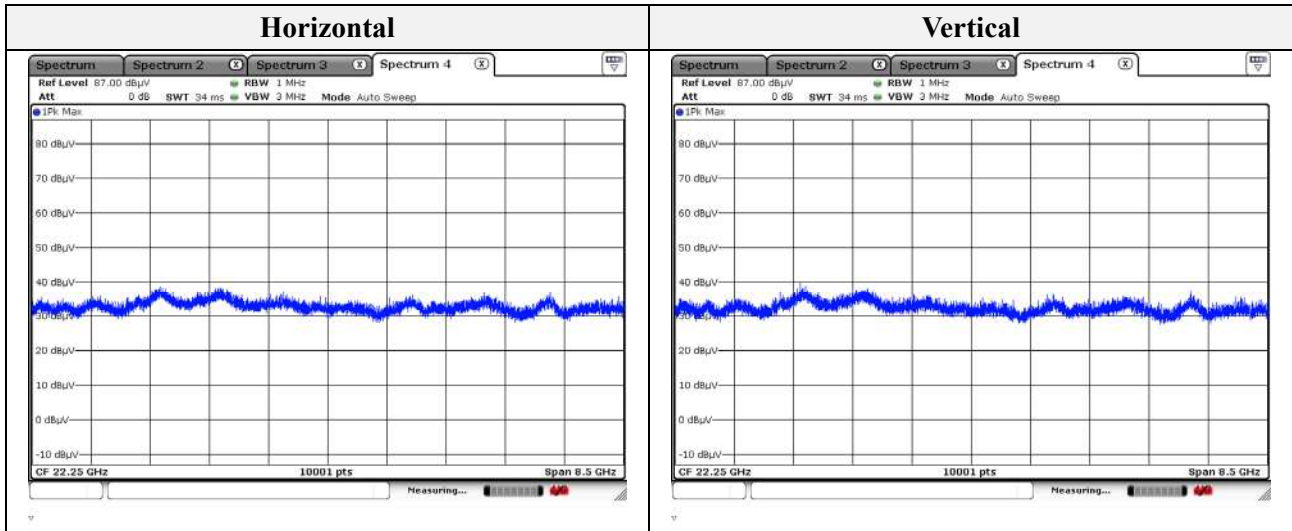
Mode: 12 V_BLE (1 Mbps)
 Channel 40
 Distance of measurement: 3 meter



Note.

1. No spurious emission were detected above 18 GHz.

Mode: 24 V_BLE (1 Mbps)
 Channel: 40
 Distance of measurement: 3 meter



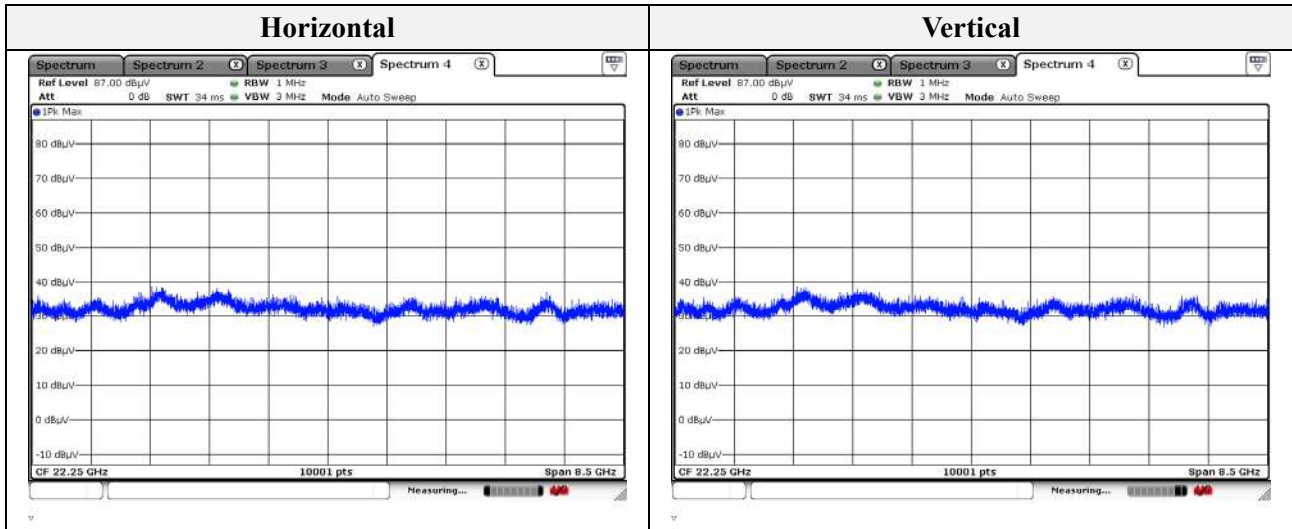
Note.

1. No spurious emission were detected above 18 GHz.

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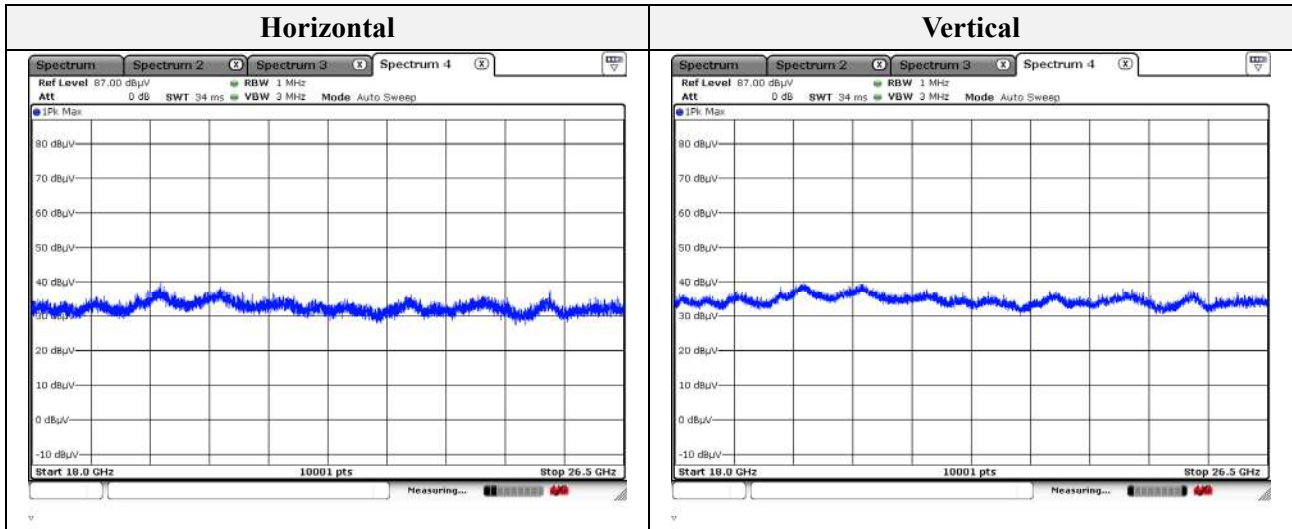
Mode: 12 V_802.11b (1 Mbps)
Channel: 11
Distance of measurement: 3 meter



Note.

1. No spurious emission were detected above 18 GHz.

Mode: 24 V_802.11b (1 Mbps)
 Channel 11
 Distance of measurement: 3 meter



Note.

1. No spurious emission were detected above 18 GHz.

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Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV40	101002	1 year	2023.06.17
SIGNAL GENERATOR	KEYSIGHT	N5182B	MY59100115	1 year	2023.04.27
SIGNAL GENERATOR	Anritsu	68369B	002118	1 year	2023.05.13
BAND REJECT FILTER	MICRO-TRONICS	BRM50702	G272	1 year	2023.01.14
Attenuator	HUBER+SUHNER	6806.17.A	-	1 year	2022.11.19
Attenuator	KEYSIGHT	8493C	82506	1 year	2023.01.14
Power Meter	Anritsu	ML2495A	1438001	1 year	2023.01.13
Pulse Power Sensor	Anritsu	MA2411B	1339205	1 year	2023.01.13
Loop Antenna	Schwarzbeck	FMZB1513	225	2 years	2023.03.18
Horn Antenna	A.H	SAS-571	414	1 year	2023.01.18
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA 9170550	1 year	2023.01.20
TRILOG- BROADBAND ANTENNA	VULB9163	Schwarzbeck	714	2 years	2024.04.19
Amplifier	SONOMA INSTRUMENT	310N	401123	1 year	2023.06.02
PREAMPLIFIER	HP	8449B	3008A00538	1 year	2023.06.02
BROADBAND AMPLIFIER	SCHWARZBECK	BBV9721	PS9721-003	1 year	2023.01.17
DC POWER SUPPLY	SORENSEN	DCS40-75E	1408A02745	1 year	2023.01.14
EMI Test Receiver	R&S	ESU26	100552	1 year	2023.03.31

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook computer	LG Electronics Inc.,	LG15N54	504NZJV027828
Jig board	-	-	-

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