

TEST REPORT

Part 15 Subpart E 15.407

Equipment under test THINKWARE DASH CAM

Model name U1000

FCC ID 2ADTG-U1000

Applicant THINKWARE CORPORATION

Manufacturer THINKWARE CORPORATION

Date of test(s) 2019.06.14 ~ 2019.06.24

Date of issue 2019.06.25

Issued to

THINKWARE CORPORATION

A, 9FL, Samwhan Hipex, 240, Pangyoyeok-ro, Bundang-gu,
 Seongnam-si, Gyeonggi-do, South Korea

Tel: +82-10-2320-7248

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 :
	
Won-Jun Sim Test engineer	Hyeon-Su, Jang Technical manager

**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

Test report No.:
KES-RF-19T0084
Page (2) of (75)

Revision history

Revision	Date of issue	Test report No.	Description
-	2019.06.25	KES-RF-19T0084	Initial

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



TABLE OF CONTENTS

1.	General information.....	4
1.1.	EUT description.....	4
1.2.	Test configuration.....	4
1.3.	Information about derivative model	오류! 책갈피가 정의되어 있지 않습니다.
1.4.	Accessory information	오류! 책갈피가 정의되어 있지 않습니다.
1.5.	Measurement results explanation example.....	5
1.6.	Measurement Uncertainty	5
1.7.	Frequency/channel operations.....	6
1.8.	Worst case data rate	6
2.	Summary of tests	7
3.	Test results	8
3.1.	Maximum conducted output power.....	8
3.2.	Radiated restricted band and emissions.....	12
Appendix A.	Measurement equipment	74
Appendix B.	Test setup photos	75

1. General information

Applicant: THINKWARE CORPORATION
 Applicant address: A, 9FL, Samwhan Hipex, 240, Pangyoyeok-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
 473-21, Gayeo-ro, Yeosu-si, Gyeonggi-do, Korea
 FCC/IC rule part(s): 15.407 / RSS-247
 FCC ID: 2ADTG-U1000
 Test device serial No.: ☒ Production ☐ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test THINKWARE DASH CAM
 Frequency range 2 412 MHz ~ 2 462 MHz (11b/g/n_HT20)
 UNII-1 5 180 MHz ~ 5 240 MHz (11a/n_HT20, 11ac_VHT20)
 5 190 MHz ~ 5 230 MHz (11n_HT40, 11ac_VHT40)
 Model: U1000
 Modulation technique DSSS, OFDM
 Number of channels 2 412 MHz ~ 2 462 MHz (11b/g/n_HT20) : 11ch
 5 180 MHz ~ 5 240 MHz (11a/n_HT20, 11ac_VHT20) : 4ch
 5 190 MHz ~ 5 230 MHz (11a/n_HT40, 11ac_VHT40) : 2ch
 Antenna specification Antenna type(2.4GHz WIFI) : Chip antenna, Peak gain : 0.80 dBi
 Antenna type(BT, 5GHz WIFI) : Chip antenna, Peak gain : 1.95 dBi
 Power source DC 12 & 24 V
 H/W version V4.0
 S/W version V1.00.00

1.2. Test configuration

The **THINKWARE CORPORATION // U1000 // FCC ID: 2ADTG-U1000** was tested according to the specification of EUT, the EUT must comply with following standards and KDB documents.

FCC Part 15.407
 KDB 789033 D02 v02r01
 ANSI C63.10-2013

1.3. Device modifications

N/A

1.4. Accessory information

N/A

1.5. Measurement results explanation example

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.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)} \\ &= 1.12 + 10 = 11.12 \text{ (dB)}\end{aligned}$$

1.6. Measurement Uncertainty

Test Item		Uncertainty
Uncertainty for Conduction emission test		2.62 dB
Uncertainty for Radiation emission test (include Fundamental emission)	9kHz - 30MHz	4.54 dB
	30MHz - 1GHz	4.36 dB
	Above 1GHz	5.00 dB
Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.		

1.7. Frequency/channel operations

UNII-1 802.11a/n/ac_HT20/VHT20

Ch.	Frequency (MHz)	Mode
36	5 180	802.11a/n/ac_HT20/VHT20
.		.
44	5 220	802.11a/n/ac_HT20/VHT20
.		.
48	5 240	802.11a/n/ac_HT20/VHT20

UNII-1 802.11n/ac_HT40/VHT40

Ch.	Frequency (MHz)	Mode
38	5 190	802.11n/ac_HT40/VHT40
.		.
46	5 230	802.11n/ac_HT40/VHT40

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:
802.11a: **54 Mbps**
802.11n_HT20/HT40: **MCS7**
802.11ac_VHT20: **MCS8**
802.11ac_VHT40: **MCS9**

2. Summary of tests

Section in FCC Part 15	Section in RSS-247 & Gen	Parameter	Test results
15.407(a)	RSS-Gen 6.6	26 dB bandwidth & 99 % bandwidth	N/A ¹⁾
15.407(e)	RSS-247 6.2.4	6 dB bandwidth (UNII-3)	N/A ¹⁾
15.407(a)	RSS-247 6.2	Maximum conducted output power	Pass
15.407(a)	RSS-247 6.2	Power spectral density	N/A ¹⁾
15.407(g)	RSS-Gen 6.11	Frequency stability	N/A ¹⁾
15.205 15.209 15.407(d)	RSS-247 6.2 RSS-Gen 8.9, 8.10	Radiated restricted band and emission	Pass
15.207	RSS-Gen 8.8	AC power line conducted emissions	N/A ¹⁾

Note :

- 1) Please Refer to the approved Module Report (Report No.: TCT171018E032) for these parameters.

3. Test results

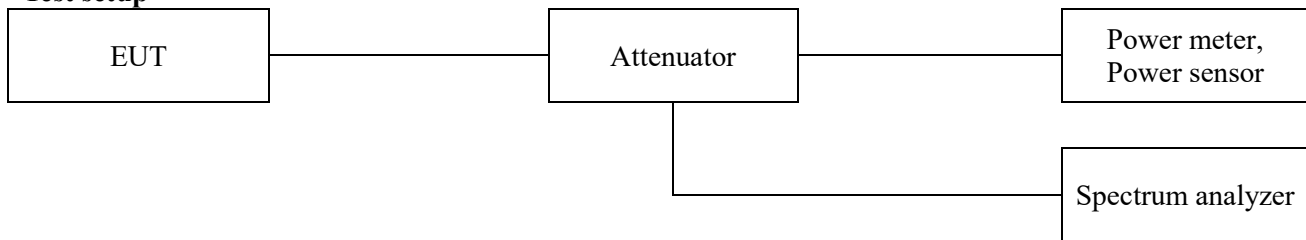
3.1. Maximum conducted output power

Test procedure

KDB 789033 D02 v02r01– Section E.3.a) or b)

Used test method is Section E.3.b)

Test setup



Section E.3.a)

Method PM (Measurement using an RF average power meter):

- i. Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied.
 - The EUT is configured to transmit continuously or to transmit with a constant duty cycle.
 - At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
 - The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
- ii. If the transmitter does not transmit continuously, measure the duty cycle, x , of the transmitter output signal as described in section II.B.
- iii. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
- iv. Adjust the measurement in dBm by adding $10 \log (1/x)$ where x is the duty cycle (e.g., $10 \log (1/0.25)$ if the duty cycle is 25 %).

Section E.3.b)

Method PM-G (Measurement using a gated RF average power meter):

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. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

**Limit
FCC**

Band	EUT Category		Limit
UNII-1		Outdoor access point	1 W (30 dBm)
		Indoor access point	
		Fixed point-to-point access point	
	✓	Mobile and portable client device	250 mW(24 dBm)
UNII-2A	-		250 mW or 11 dBm + 10logB*
UNII-2C	-		250 mW or 11 dBm + 10logB*
UNII-3	-		1 W (30 dBm)

Note.

1. FCC Limit B is the 26 dB emission bandwidth.

Test results
12V

Band	Frequency (MHz)	Mode	Peak Output Power (dBm)	Average Output Power (dBm)	Limit (dBm)
					FCC
UNII-1	5 180	802.11a	17.49	14.69	24.00
	5 220		17.32	14.52	
	5 240		19.76	16.83	

Band	Frequency (MHz)	Mode	Peak Output Power (dBm)	Average Output Power (dBm)	Limit (dBm)
					FCC
UNII-1	5 180	802.11n-HT20	15.19	12.74	24.00
	5 220		15.12	12.29	
	5 240		17.41	14.64	

Band	Frequency (MHz)	Mode	Peak Output Power (dBm)	Average Output Power (dBm)	Limit (dBm)
					FCC
UNII-1	5 180	802.11n-HT40	15.19	12.30	24.00
	5 220		17.22	14.51	

Band	Frequency (MHz)	Mode	Peak Output Power (dBm)	Average Output Power (dBm)	Limit (dBm)
					FCC
UNII-1	5 180	802.11ac_VHT20	15.38	12.53	24.00
	5 220		15.42	12.73	
	5 240		17.22	14.76	

Band	Frequency (MHz)	Mode	Peak Output Power (dBm)	Average Output Power (dBm)	Limit (dBm)
					FCC
UNII-1	5 180	802.11ac_VHT40	15.04	12.55	24.00
	5 220		17.16	14.38	



24V

Band	Frequency (MHz)	Mode	Peak Output Power (dBm)	Average Output Power (dBm)	Limit (dBm)
					FCC
UNII-1	5 180	802.11a	17.47	14.81	24.00
	5 220		17.33	14.79	
	5 240		19.75	16.95	

Band	Frequency (MHz)	Mode	Peak Output Power (dBm)	Average Output Power (dBm)	Limit (dBm)
					FCC
UNII-1	5 180	802.11n-HT20	15.21	12.20	24.00
	5 220		15.15	12.24	
	5 240		17.38	14.87	

Band	Frequency (MHz)	Mode	Peak Output Power (dBm)	Average Output Power (dBm)	Limit (dBm)
					FCC
UNII-1	5 180	802.11n-HT40	15.16	12.47	24.00
	5 220		17.23	14.45	

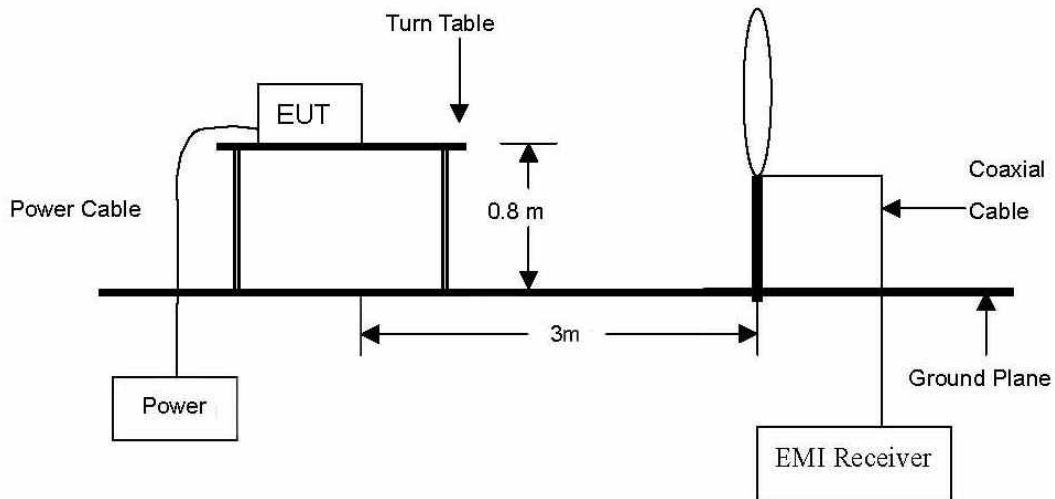
Band	Frequency (MHz)	Mode	Peak Output Power (dBm)	Average Output Power (dBm)	Limit (dBm)
					FCC
UNII-1	5 180	802.11ac-VHT20	15.40	12.43	24.00
	5 220		15.38	12.69	
	5 240		17.23	14.29	

Band	Frequency (MHz)	Mode	Peak Output Power (dBm)	Average Output Power (dBm)	Limit (dBm)
					FCC
UNII-1	5 180	802.11ac-VHT40	15.02	12.30	24.00
	5 220		17.14	14.43	

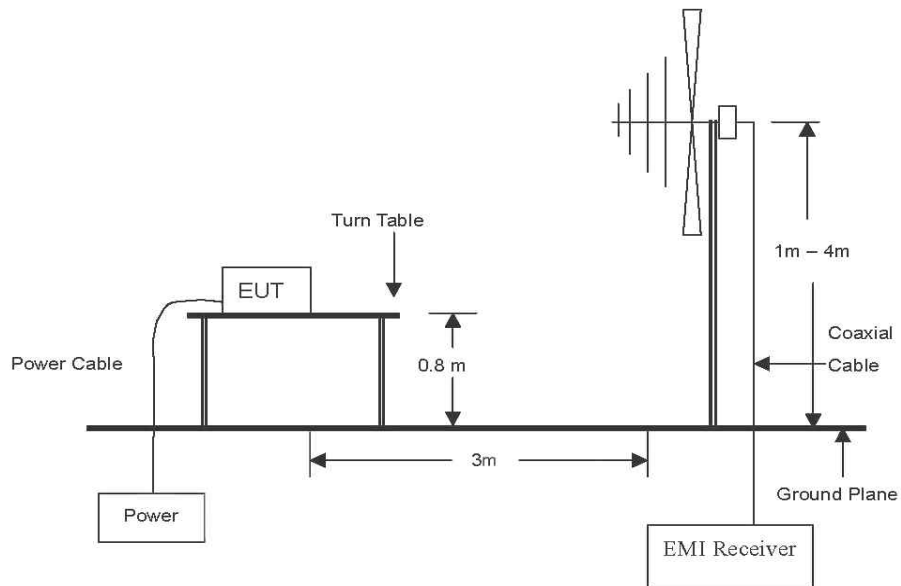
3.2. Radiated restricted band and emissions

Test setup

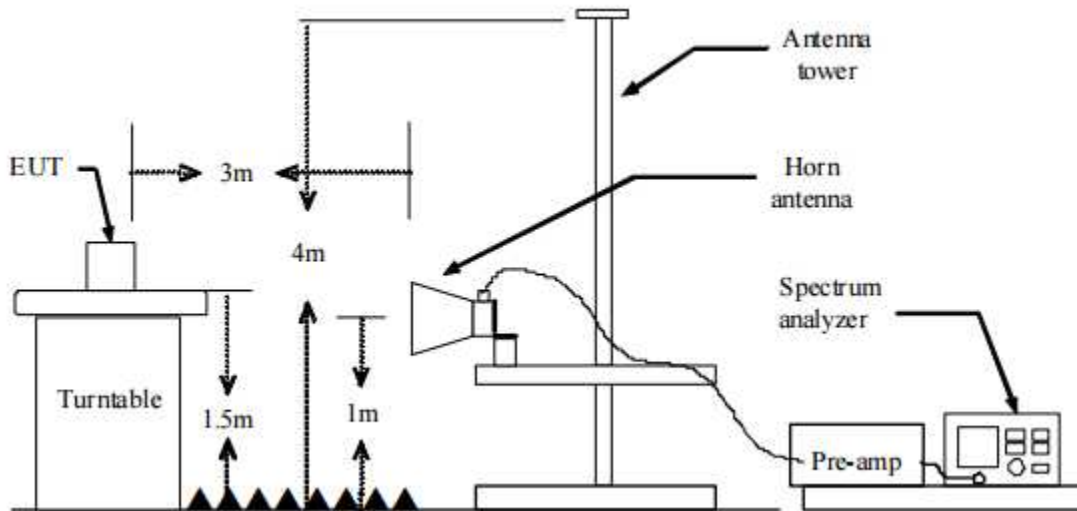
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



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



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 and perpendicular 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 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. it was determined that **Horizontal** was worst-case polarizations
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 (μ 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.

According to 15.407(b), (b) Undesirable emission limits: Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

- (1) For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (4) For transmitters operating in the 5.725-5.85 GHz band:
 - i) All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.
 - ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.
- (5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.
- (6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in § 15.207.
- (7) The provisions of §15.205 apply to intentional radiators operating under this section.
- (8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

Duty cycle

Regarding to KDB 789033 D02 v02r01, B)2)b), the maximum duty cycles of all modes were investigated and set the spectrum analyzer as below.

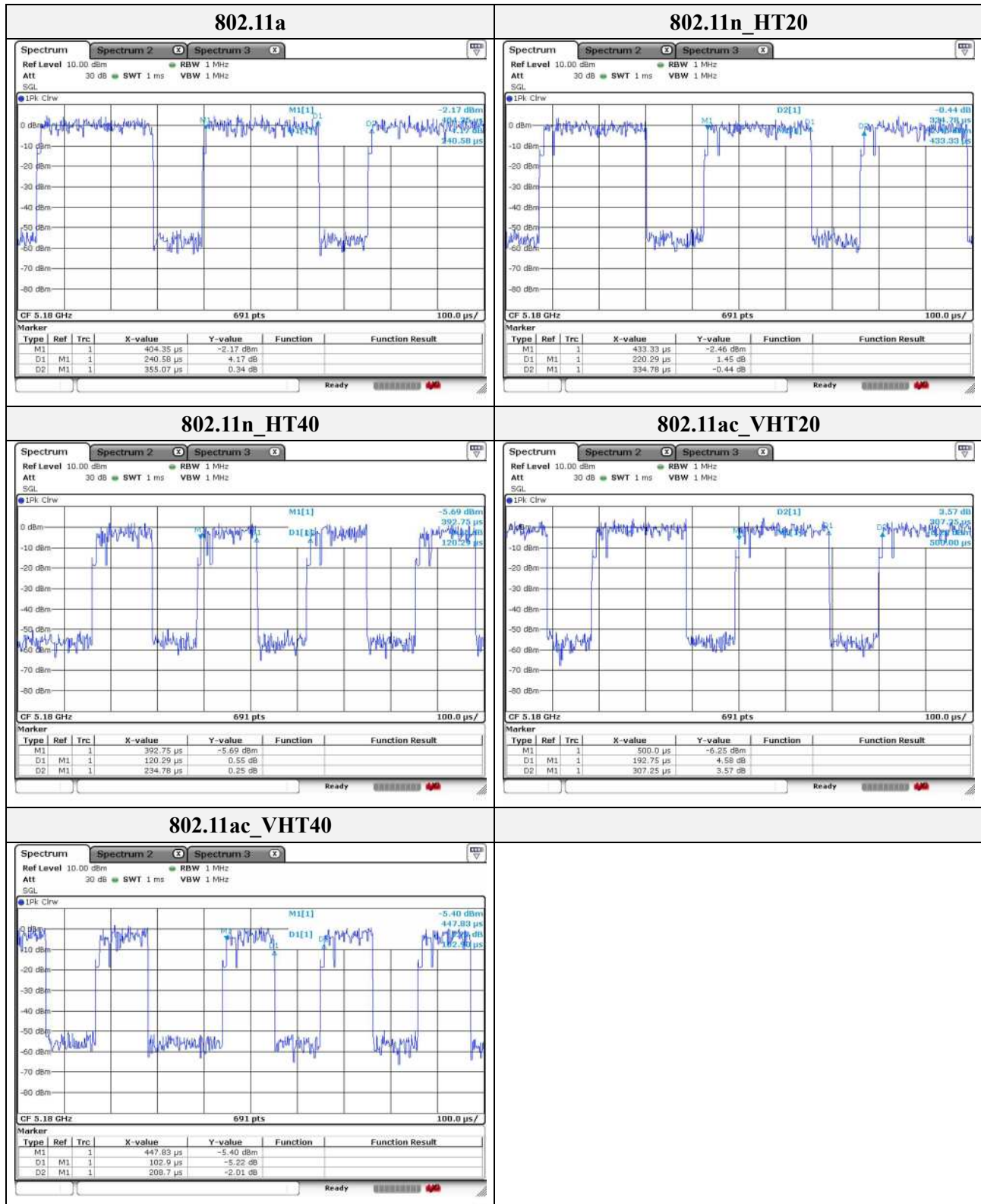
Set $RBW \geq OBW$ if possible; otherwise, set RBW to the largest available value. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are $> 50/T$, where T is defined in II.B.1.a), and the number of sweep points across duration T exceeds 100.

Test mode	T _{on} time (ms)	Period (ms)	Duty cycle (Linear)	Duty cycle (%)	Duty cycle correction factor (dB)
802.11a	0.240 6	0.355 1	0.677 6	67.76	1.69
802.11n_HT20	0.220 3	0.334 8	0. 658 0	65.80	1.82
802.11n_HT40	0.120 3	0.234 8	0.512 4	51.24	2.90
802.11ac_VHT20	0.192 8	0.307 3	0.627 4	62.74	2.02
802.11ac_VHT40	0. 102 9	0.208 7	0.493 1	49.31	3.07

Note:

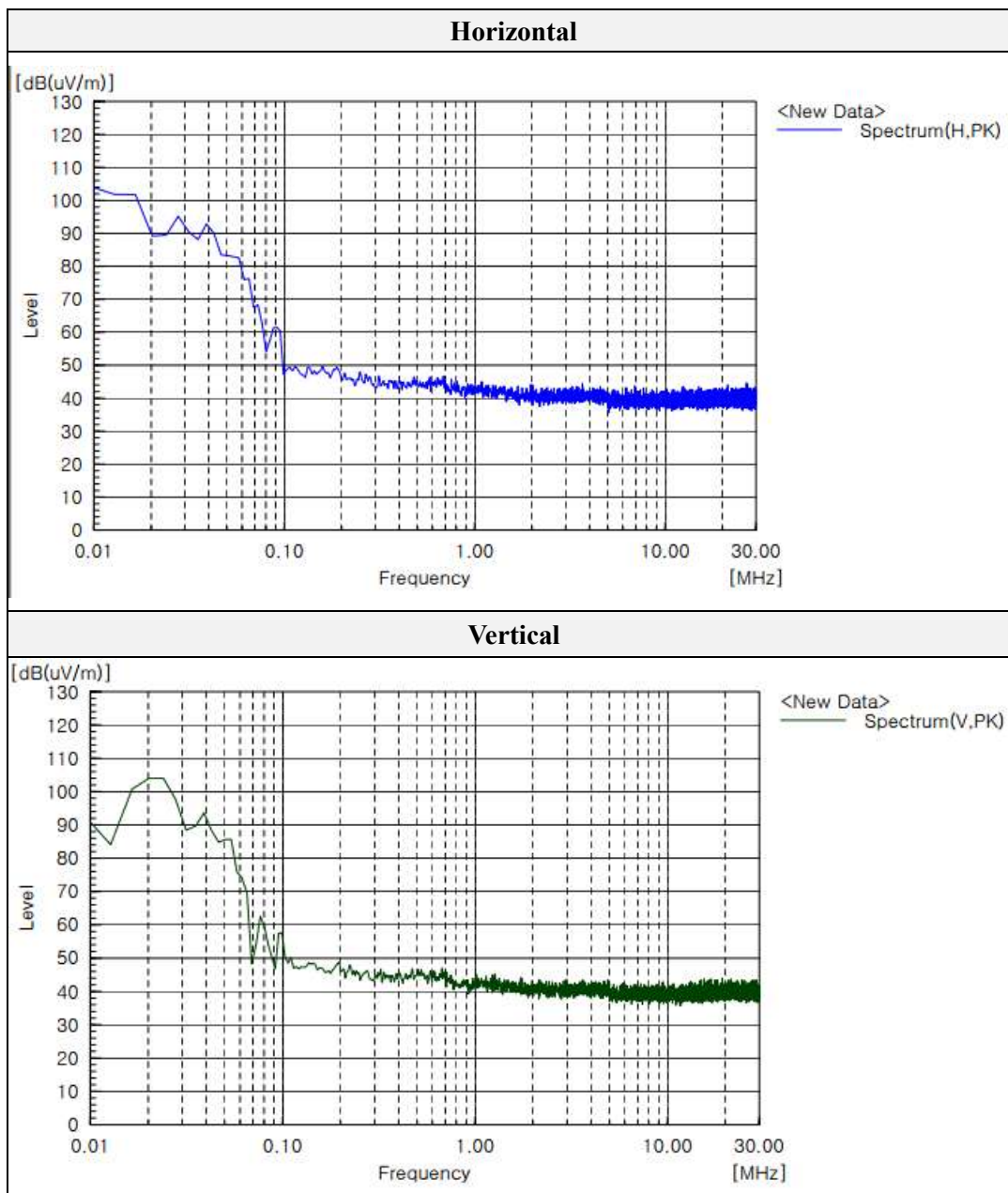
Duty cycle (Linear) = T_{on} time/Period

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



Test results (Below 30 MHz)

Mode: 802.11a
 Distance of measurement: 3 meter
 Channel: 48 (Worst case)



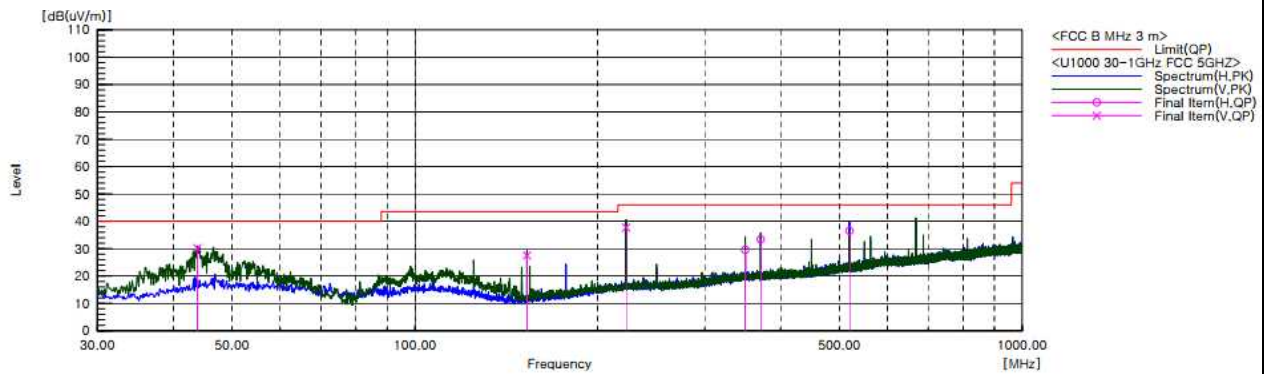
No spurious emission were detected below 30 MHz

Test results (Below 1 000 MHz) – Worst case

Mode: 802.11a

Distance of measurement: 3 meter

Channel: 48 (Worst case)

Horizontal // Vertical


No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	43.823	V	52.8	-22.6	30.2	40.0	9.8	132.0	153.0	
2	152.948	V	54.2	-26.7	27.5	43.5	16.0	110.0	30.0	
3	222.788	V	59.3	-21.6	37.7	46.0	8.3	103.0	141.0	
4	349.979	H	47.2	-17.6	29.6	46.0	16.4	400.0	350.0	
5	371.198	H	50.6	-17.2	33.4	46.0	12.6	356.0	15.0	
6	519.850	H	50.4	-13.9	36.5	46.0	9.5	322.0	274.0	



Test results (Above 1 000 MHz)

12 V

Mode: 802.11a

Distance of measurement: 3 meter

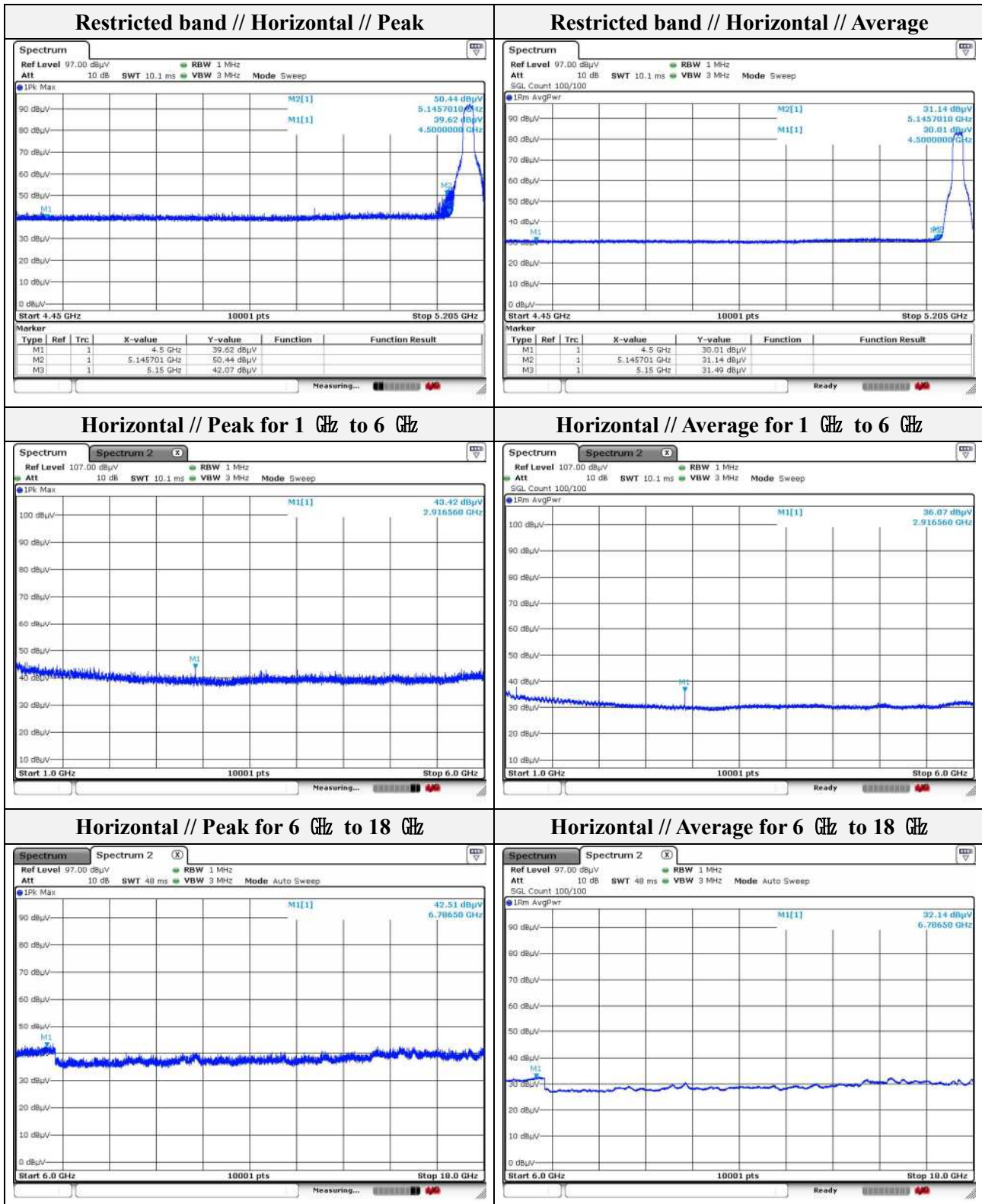
Channel: 36

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 916.56	43.42	Peak	H	29.50	-27.57	-	45.35	74.00	28.65
2 916.56	36.07	Average	H	29.50	-27.57	1.69	39.69	54.00	14.31
6 786.50	42.51	Peak	H	36.10	-21.20	-	57.41	74.00	16.59
6 786.50	32.14	Average	H	36.10	-21.20	1.69	48.73	54.00	5.27

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 500.00	39.62	Peak	H	32.10	-25.14	-	46.58	74.00	27.42
4 500.00	30.01	Average	H	32.10	-25.14	1.69	38.66	54.00	15.34
5 145.70	50.44	Peak	H	34.19	-24.44	-	60.19	74.00	13.81
5 145.70	31.14	Average	H	34.19	-24.44	1.69	42.58	54.00	11.42
5 150.00	42.07	Peak	H	34.20	-24.42	-	51.85	74.00	22.15
5 150.00	31.49	Average	H	34.20	-24.42	1.69	42.96	54.00	11.04



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (23) of (75)

Mode: 802.11a

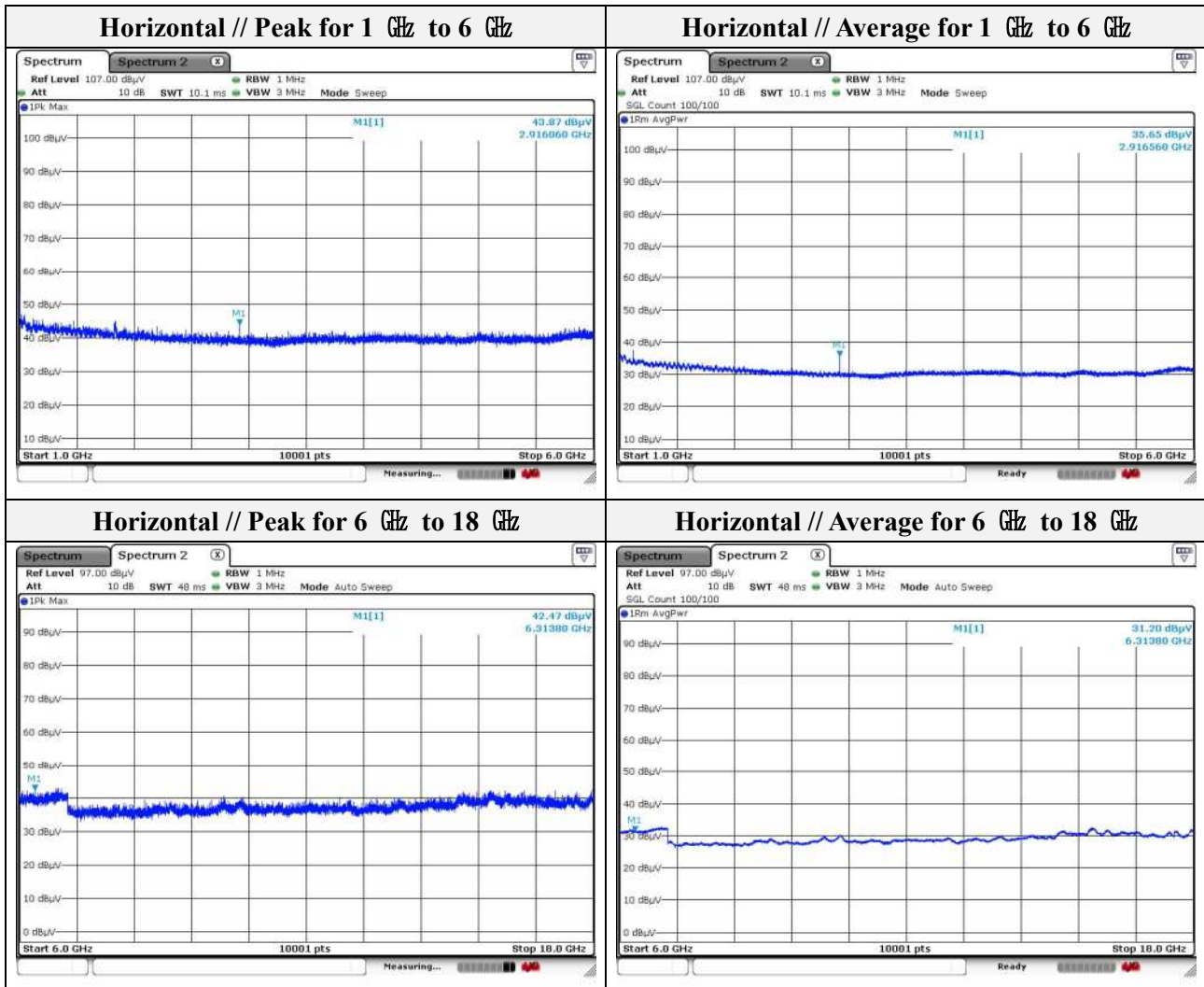
Distance of measurement: 3 meter

Channel: 44

- **Spurious**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 916.56	43.87	Peak	H	29.50	-27.57	-	45.80	74.00	28.20
2 916.56	35.65	Average	H	29.50	-27.57	1.69	39.27	54.00	14.73
6 313.80	42.47	Peak	H	35.03	-22.88	-	54.62	74.00	19.38
6 313.80	31.20	Average	H	35.03	-22.88	1.69	45.04	54.00	8.96

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
 The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
 The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (25) of (75)

Mode: 802.11a

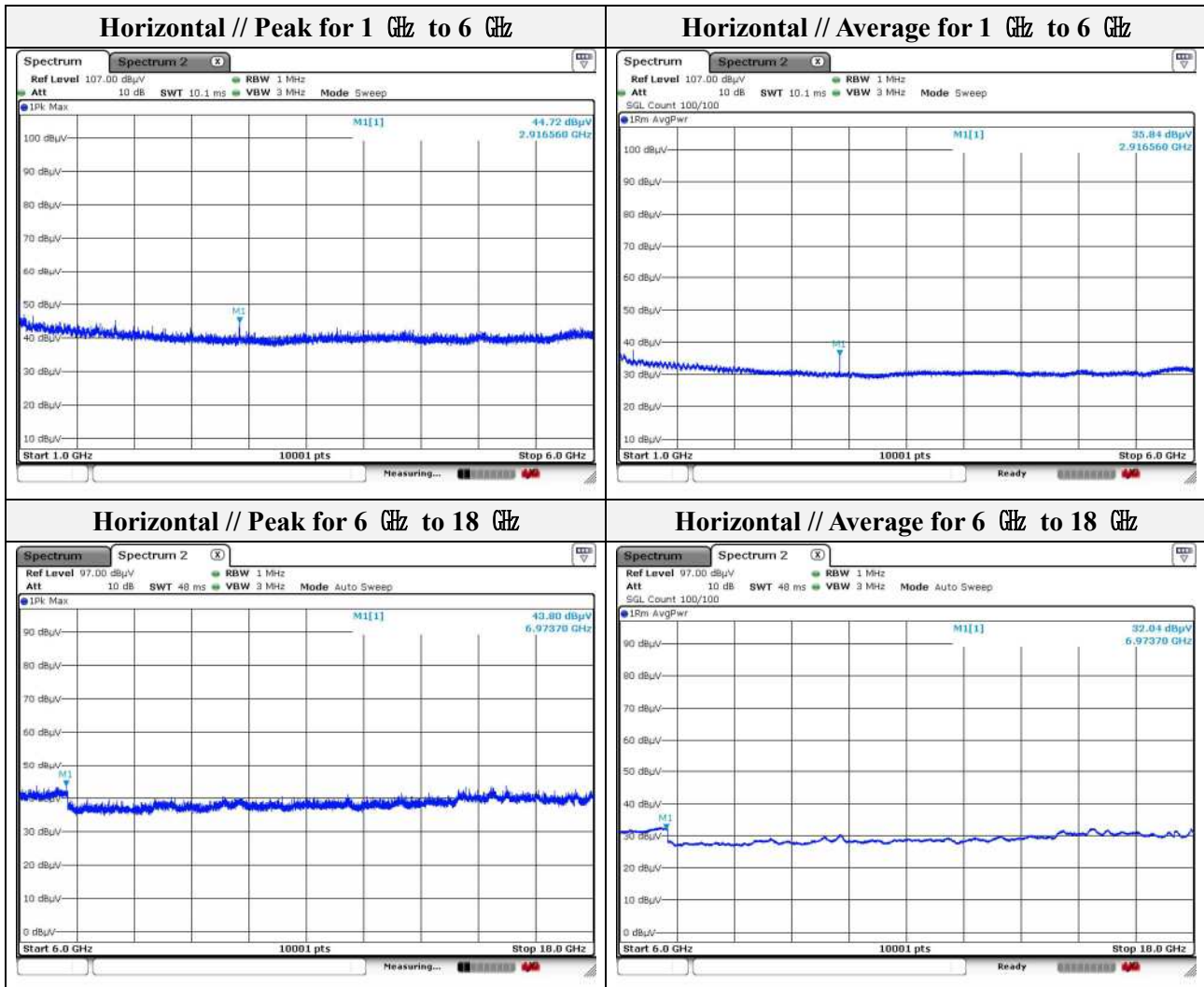
Distance of measurement: 3 meter

Channel: 48

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 916.50	44.72	Peak	H	29.50	-27.57	-	46.65	74.00	27.35
2 916.50	35.84	Average	H	29.50	-27.57	1.69	39.46	54.00	14.54
6 973.70	43.80	Peak	H	36.50	-20.86	-	59.44	74.00	14.56
6 973.70	32.04	Average	H	36.50	-20.86	1.69	49.37	54.00	4.63

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
 The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
 The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (27) of (75)

Mode: 802.11n_HT20
Distance of measurement: 3 meter
Channel: 36

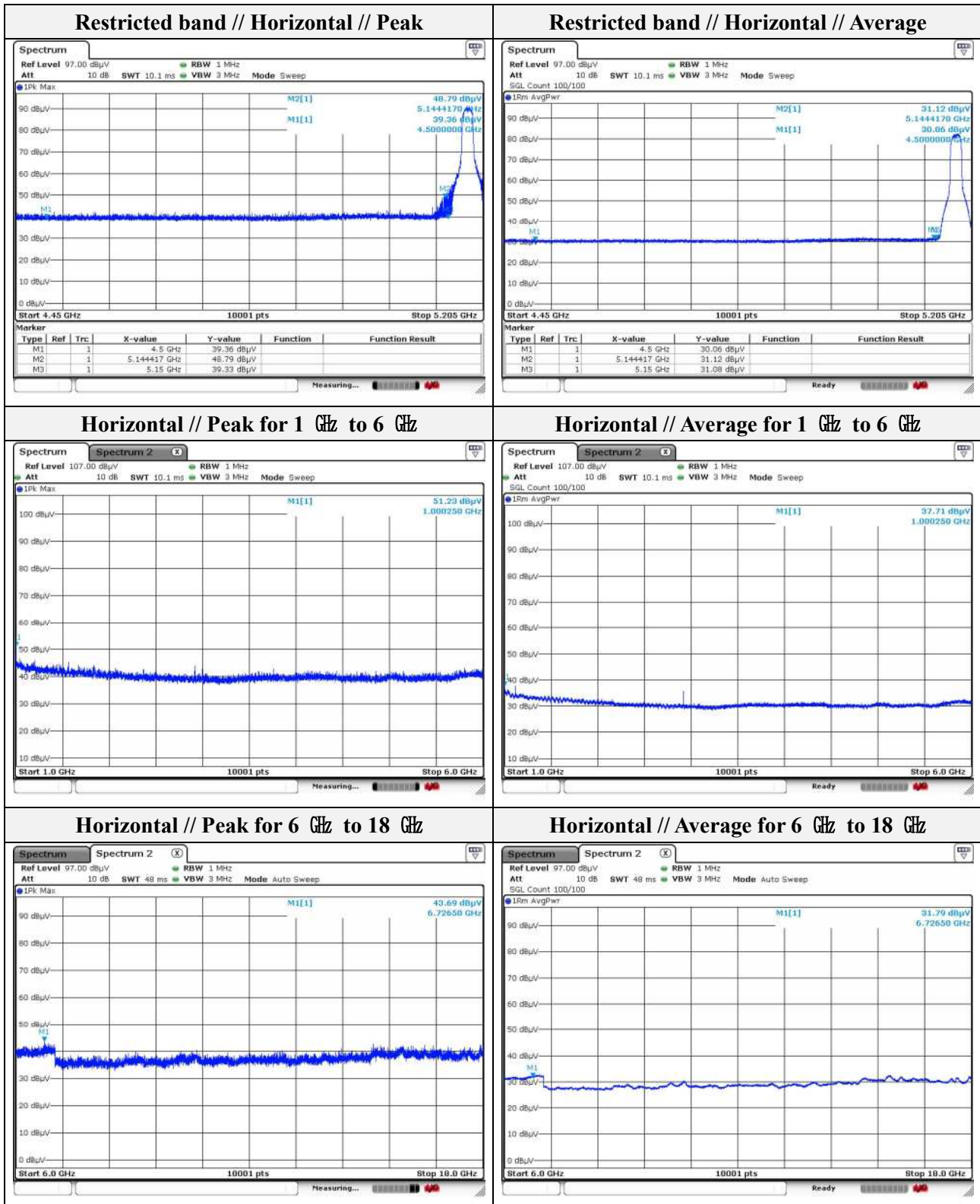
- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.25	51.23	Peak	H	23.90	-32.20	-	42.93	74.00	31.07
1 000.25	37.71	Average	H	23.90	-32.20	1.82	31.23	54.00	22.77
6 726.50	43.69	Peak	H	36.19	-21.35	-	58.53	74.00	15.47
6 726.50	31.79	Average	H	36.19	-21.35	1.82	48.45	54.00	5.55

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 500.00	39.36	Peak	H	32.10	-25.14	-	46.32	74.00	27.68
4 500.00	30.06	Average	H	32.10	-25.14	1.82	38.84	54.00	15.16
5 144.42	48.79	Peak	H	34.19	-24.45	-	58.53	74.00	15.47
5 144.42	31.12	Average	H	34.19	-24.45	1.82	42.68	54.00	11.32
5 150.00	39.33	Peak	H	34.20	-24.42	-	49.11	74.00	24.89
5 150.00	31.08	Average	H	34.20	-24.42	1.82	42.68	54.00	11.32

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



**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

Test report No.:
KES-RF-19T0084
Page (29) of (75)

Mode: 802.11n_HT20

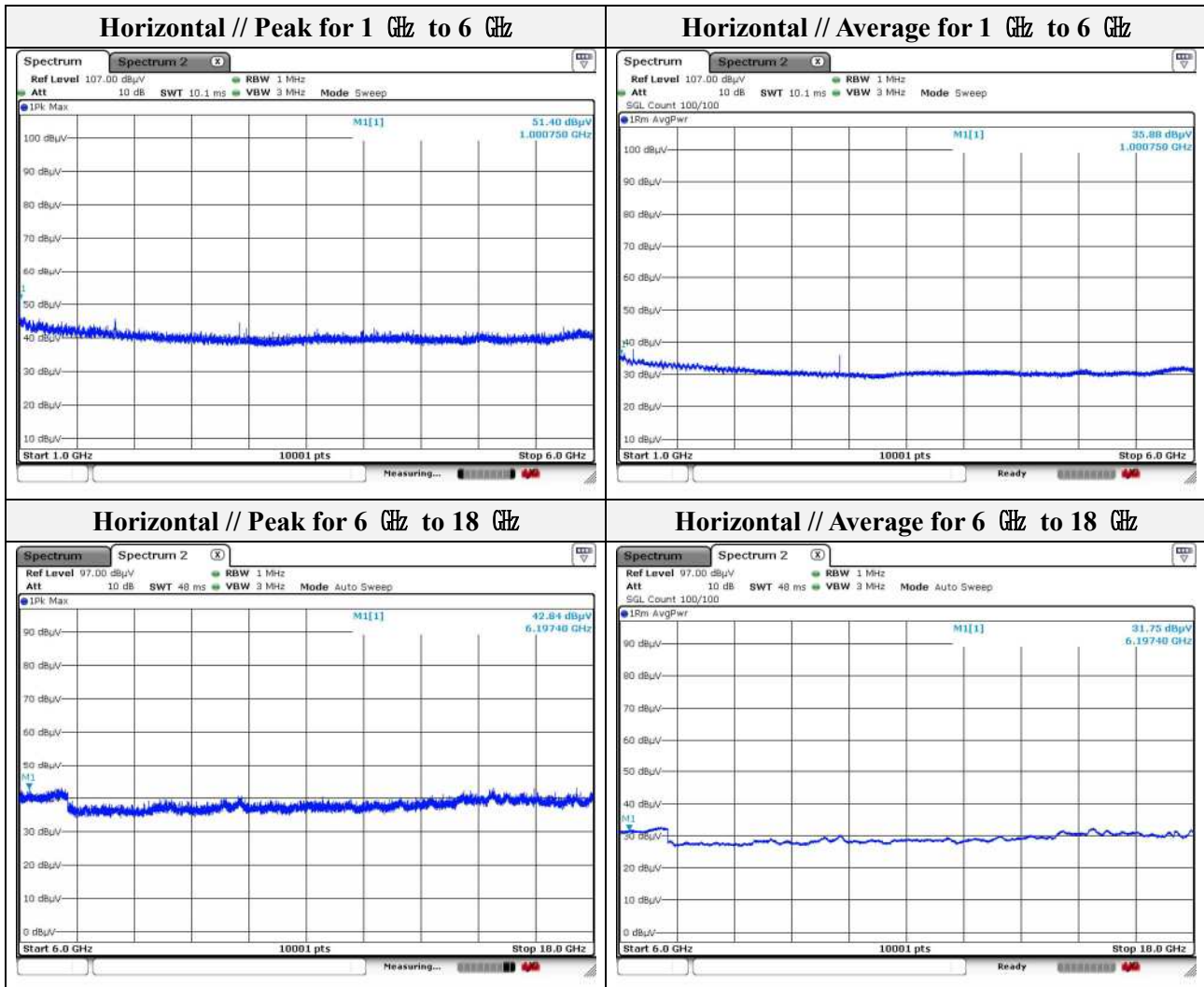
Distance of measurement: 3 meter

Channel: 44

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.75	51.40	Peak	H	23.90	-32.20	-	43.10	74.00	30.90
1 000.75	35.88	Average	H	23.90	-32.20	1.82	29.40	54.00	24.60
6 197.40	42.84	Peak	H	34.91	-23.50	-	54.25	74.00	19.75
6 197.40	31.75	Average	H	34.91	-23.50	1.82	44.98	54.00	9.02

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
 The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
 The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (31) of (75)

Mode: 802.11n_HT20

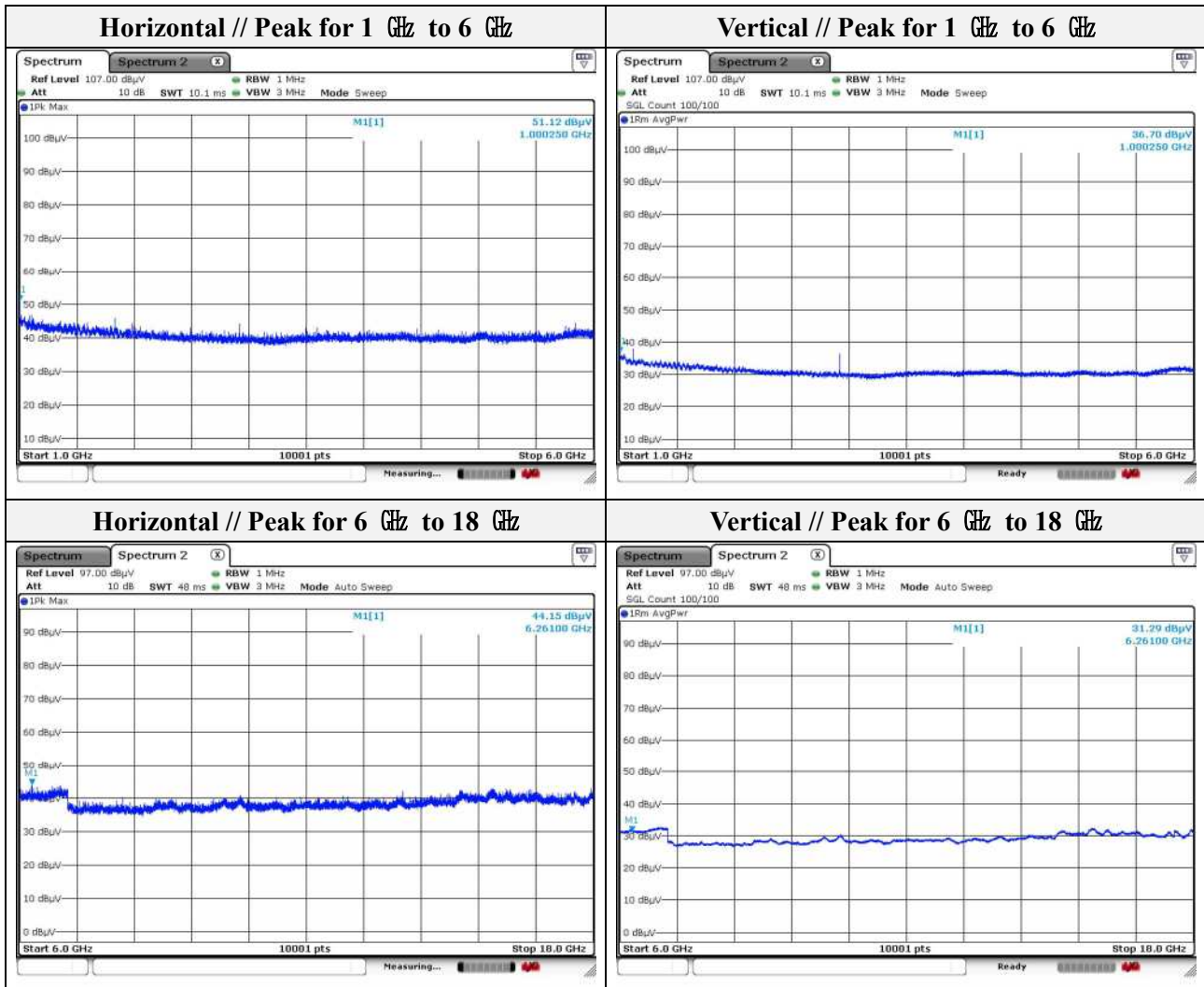
Distance of measurement: 3 meter

Channel: 48

- **Spurious**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.25	51.12	Peak	H	23.90	-32.20	-	42.82	74.00	31.18
1 000.25	36.70	Average	H	23.90	-32.20	1.82	30.22	54.00	23.78
6 261.00	44.15	Peak	H	35.00	-23.16	-	55.99	74.00	18.01
6 261.00	31.29	Average	H	35.00	-23.16	1.82	44.95	54.00	9.05

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (33) of (75)

Mode: 802.11n_HT40
Distance of measurement: 3 meter
Channel: 38

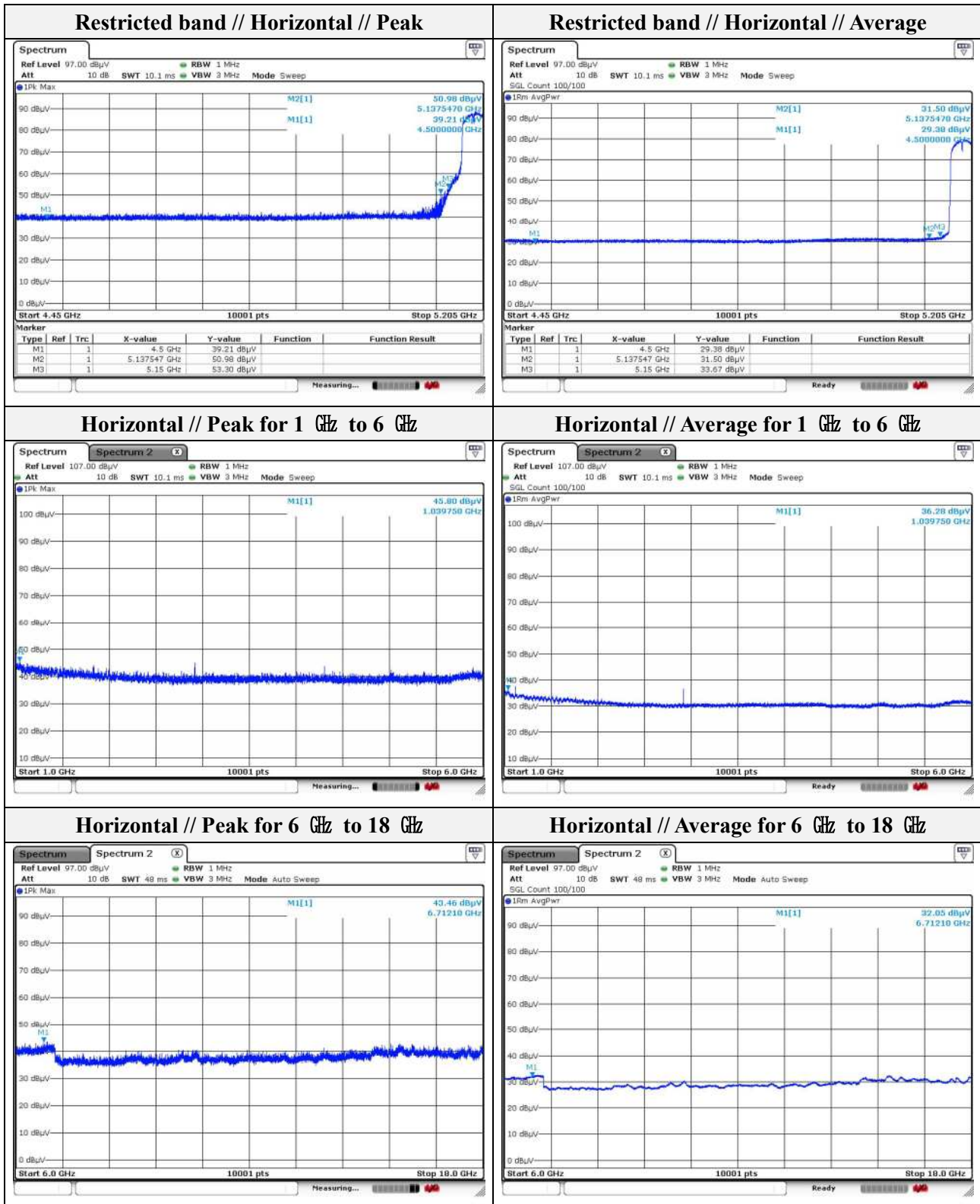
- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 039.75	45.80	Peak	H	23.90	-32.03	-	37.67	74.00	36.33
1 039.75	36.28	Average	H	23.90	-32.03	2.90	31.05	54.00	22.95
6 712.10	43.46	Peak	H	36.25	-21.38	-	58.33	74.00	15.67
6 712.10	32.05	Average	H	36.25	-21.38	2.90	49.82	54.00	4.18

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 500.00	39.21	Peak	H	32.10	-25.14	-	46.17	74.00	27.83
4 500.00	29.38	Average	H	32.10	-25.14	2.90	39.24	54.00	14.76
5 137.55	50.98	Peak	H	34.18	-24.48	-	60.68	74.00	13.32
5 137.55	31.50	Average	H	34.18	-24.48	2.90	44.10	54.00	9.90
5 150.00	53.30	Peak	H	34.20	-24.42	-	63.08	74.00	10.92
5 150.00	33.67	Average	H	34.20	-24.42	2.90	46.35	54.00	7.65

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



**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

Test report No.:
KES-RF-19T0084
Page (35) of (75)

Mode: 802.11n_HT40

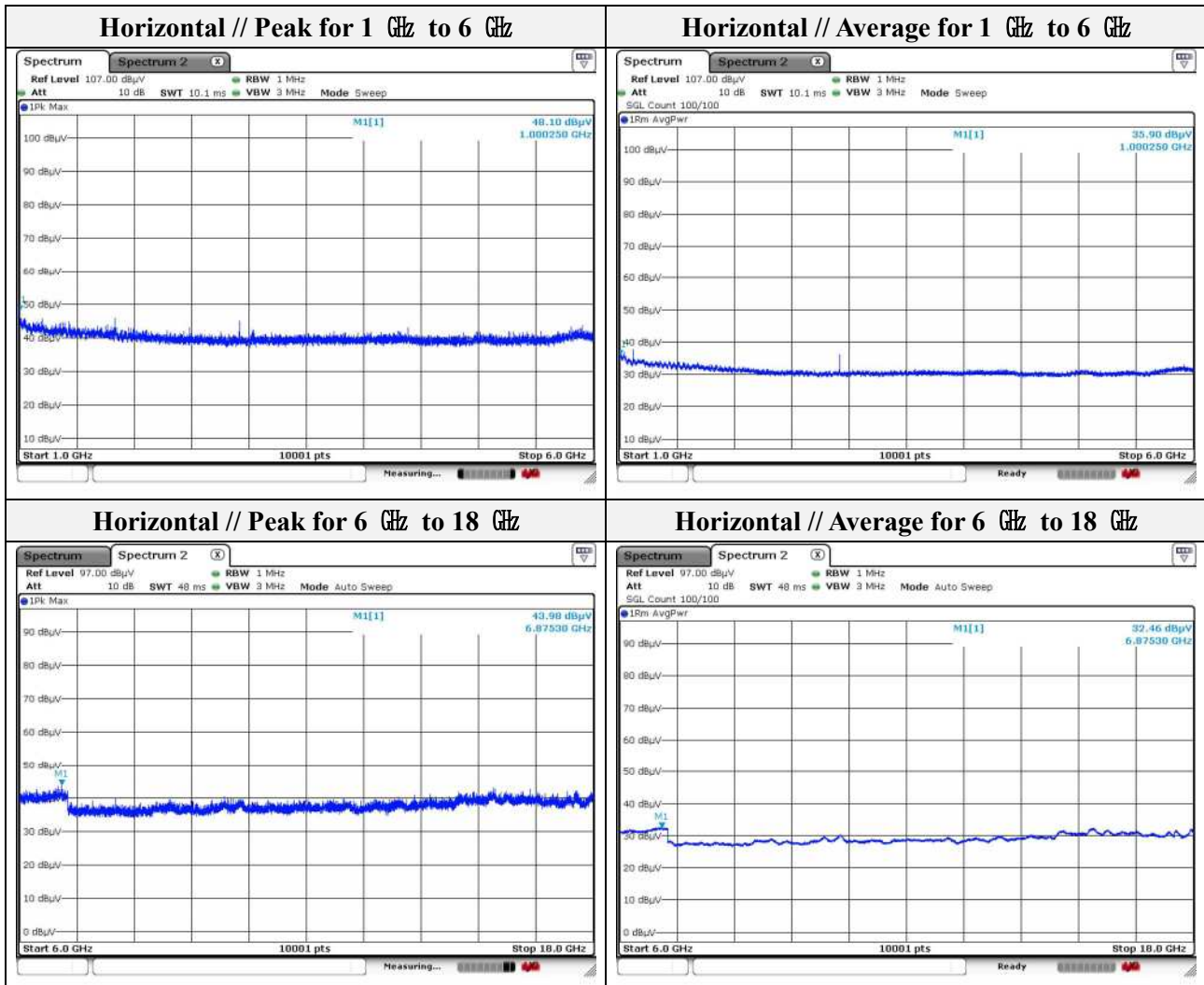
Distance of measurement: 3 meter

Channel: 46

- **Spurious**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.25	48.10	Peak	H	23.90	-32.20	-	39.80	74.00	34.20
1 000.25	35.90	Average	H	23.90	-32.20	2.90	30.50	54.00	23.50
6 875.30	43.98	Peak	H	36.45	-21.03	-	59.40	74.00	14.60
6 875.30	32.46	Average	H	36.45	-21.03	2.90	50.78	54.00	3.22

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (37) of (75)

Mode: 802.11ac_VHT20

Distance of measurement: 3 meter

Channel: 36

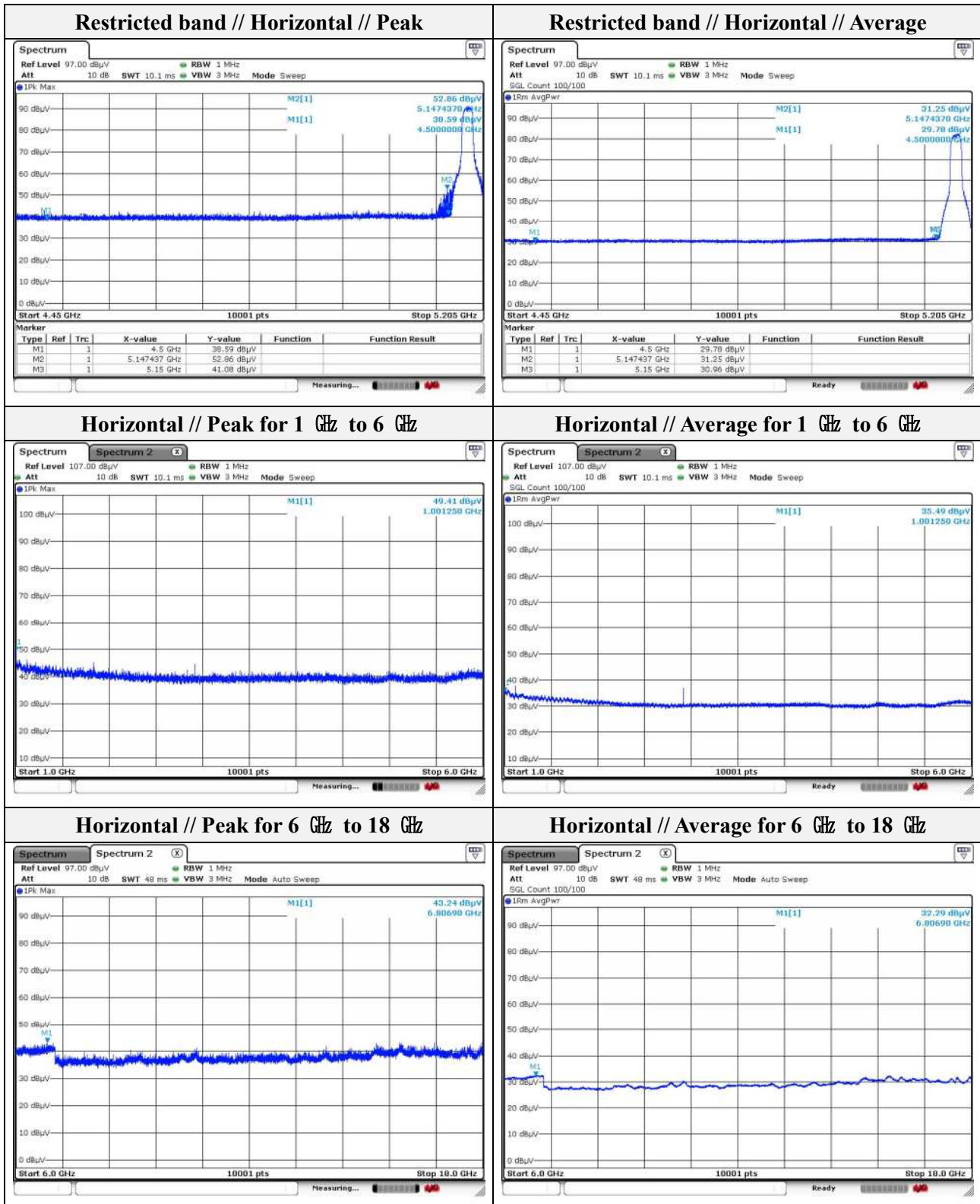
- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 001.25	49.41	Peak	H	23.90	-32.20	-	41.11	74.00	32.89
1 001.25	35.49	Average	H	23.90	-32.20	2.02	29.21	54.00	24.79
6 806.90	43.24	Peak	H	36.13	-21.16	-	58.21	74.00	15.79
6 806.90	32.29	Average	H	36.13	-21.16	2.02	49.28	54.00	4.72

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 500.00	38.59	Peak	H	32.10	-25.14	-	45.55	74.00	28.45
4 500.00	29.78	Average	H	32.10	-25.14	2.02	38.76	54.00	15.24
5 147.44	52.86	Peak	H	34.19	-24.43	-	62.62	74.00	11.38
5 147.44	31.25	Average	H	34.19	-24.43	2.02	43.03	54.00	10.97
5 150.00	41.08	Peak	H	34.20	-24.42	-	50.86	74.00	23.14
5 150.00	30.96	Average	H	34.20	-24.42	2.02	42.76	54.00	11.24

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



**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

Test report No.:
KES-RF-19T0084
Page (39) of (75)

Mode: 802.11ac_VHT20

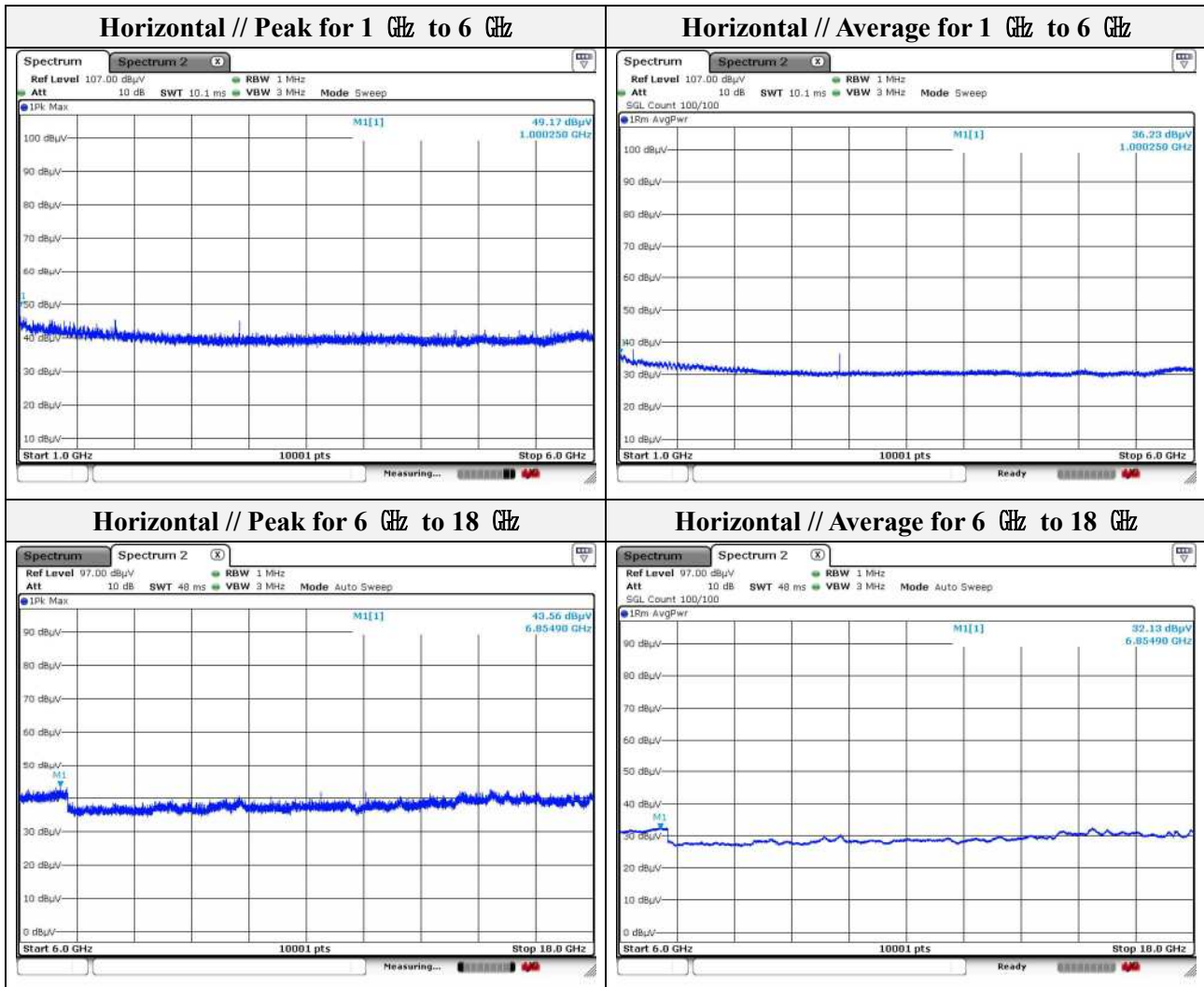
Distance of measurement: 3 meter

Channel: 44

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.25	49.17	Peak	H	23.90	-32.20	-	40.87	74.00	33.13
1 000.25	36.23	Average	H	23.90	-32.20	2.02	29.95	54.00	24.05
6 854.90	43.56	Peak	H	36.33	-21.06	-	58.83	74.00	15.17
6 854.90	32.13	Average	H	36.33	-21.06	2.02	49.42	54.00	4.58

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
 The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
 The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (41) of (75)

Mode: 802.11ac_VHT20

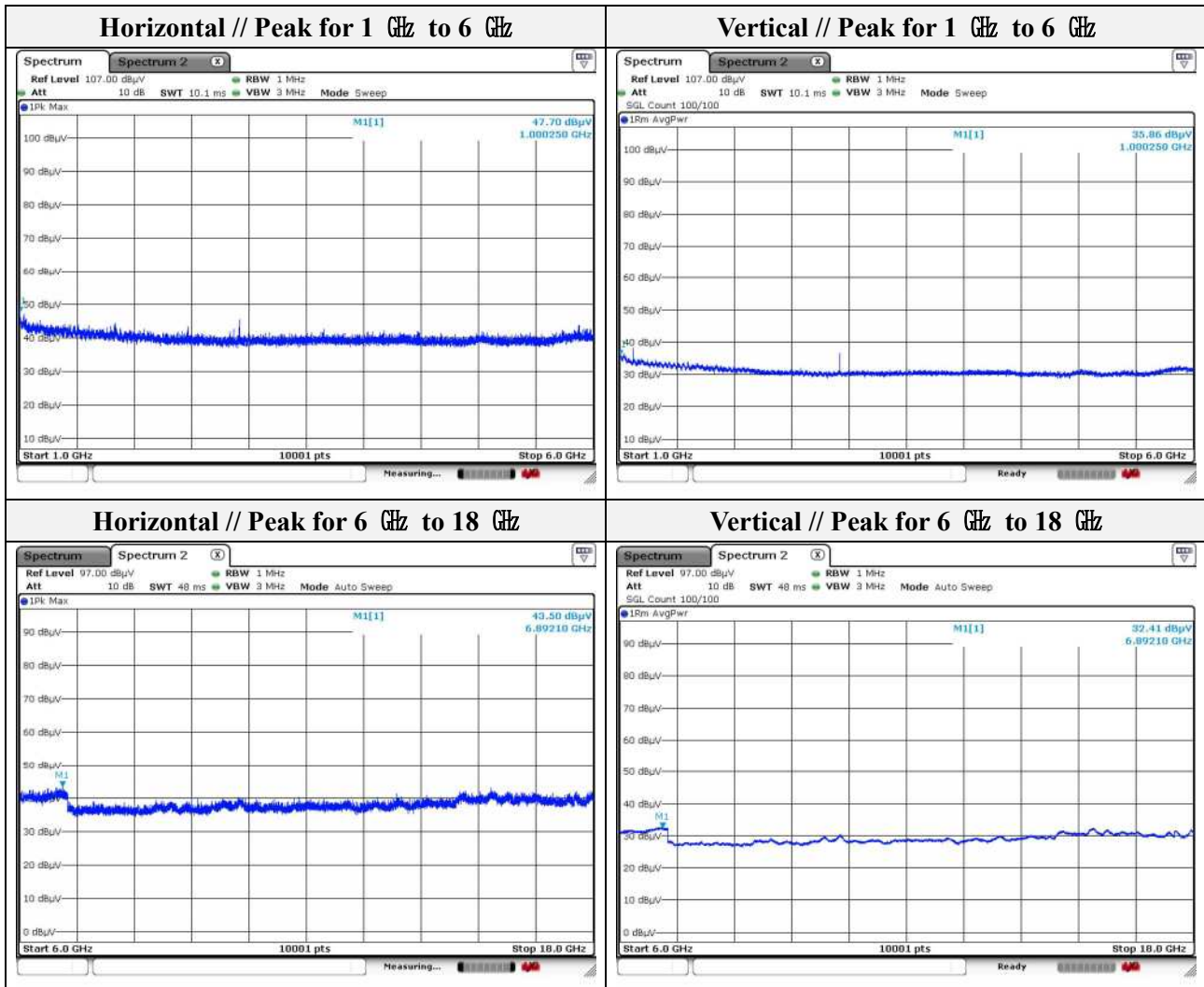
Distance of measurement: 3 meter

Channel: 48

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.25	47.70	Peak	H	23.90	-32.20	-	39.40	74.00	34.60
1 000.25	35.86	Average	H	23.90	-32.20	2.02	29.58	54.00	24.42
6 892.10	43.50	Peak	H	36.55	-21.01	-	59.04	74.00	14.96
6 892.10	32.41	Average	H	36.55	-21.01	2.02	49.97	54.00	4.03

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
 The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
 The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (43) of (75)

Mode: 802.11ac_VHT40

Distance of measurement: 3 meter

Channel: 38

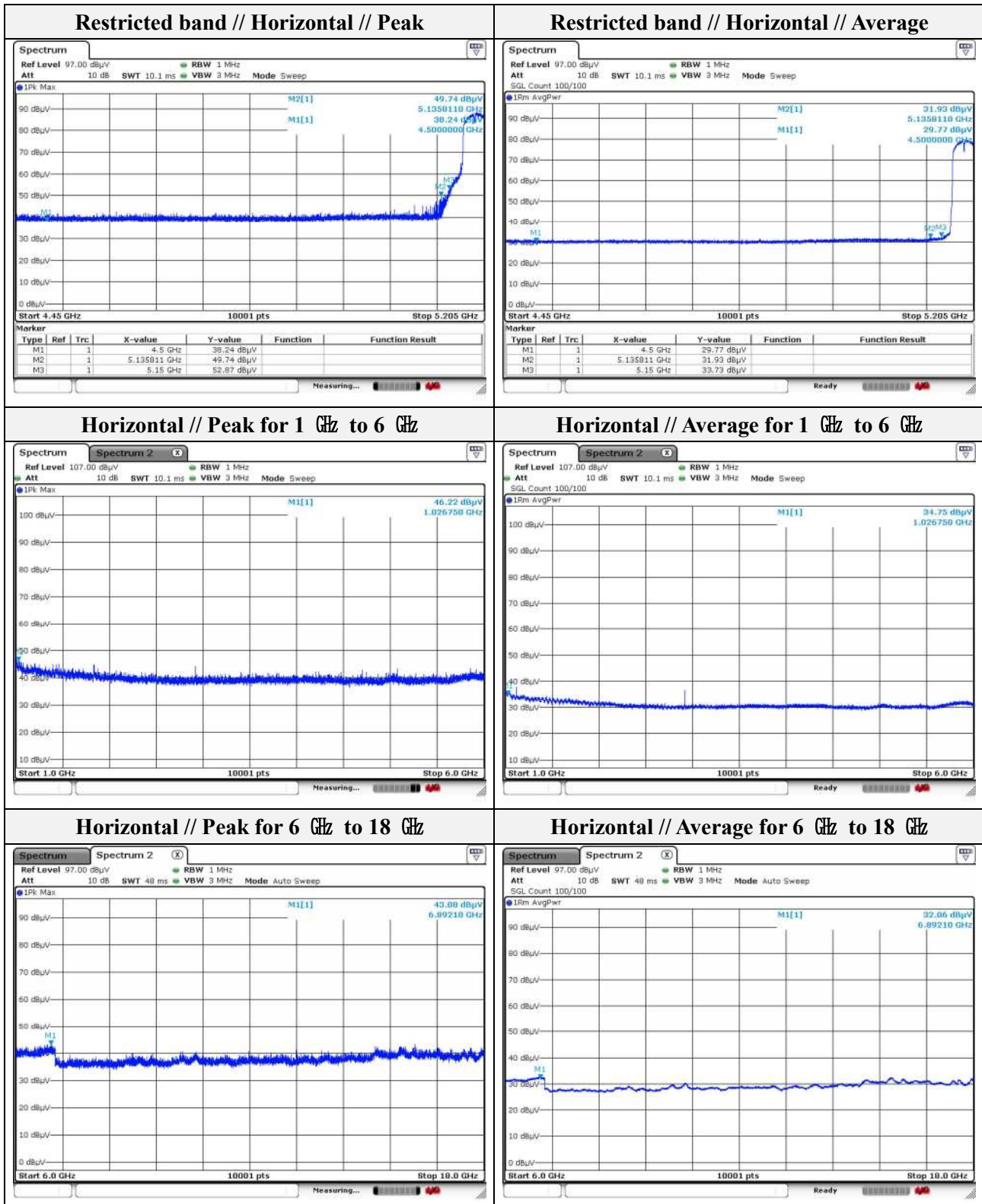
- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 026.75	46.22	Peak	H	23.90	-32.09	-	38.03	74.00	35.97
1 026.75	34.75	Average	H	23.90	-32.09	3.07	29.63	54.00	24.37
6 892.10	43.08	Peak	H	36.55	-21.01	-	58.62	74.00	15.38
6 892.10	32.06	Average	H	36.55	-21.01	3.07	50.67	54.00	3.33

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 500.00	38.24	Peak	H	32.10	-25.14	-	45.20	74.00	28.80
4 500.00	29.77	Average	H	32.10	-25.14	3.07	39.80	54.00	14.20
5 135.81	49.74	Peak	H	34.17	-24.48	-	59.43	74.00	14.57
5 135.81	31.93	Average	H	34.17	-24.48	3.07	44.69	54.00	9.31
5 150.00	52.87	Peak	H	34.20	-24.42	-	62.65	74.00	11.35
5 150.00	33.73	Average	H	34.20	-24.42	3.07	46.58	54.00	7.42

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (45) of (75)

Mode: 802.11ac_VHT40

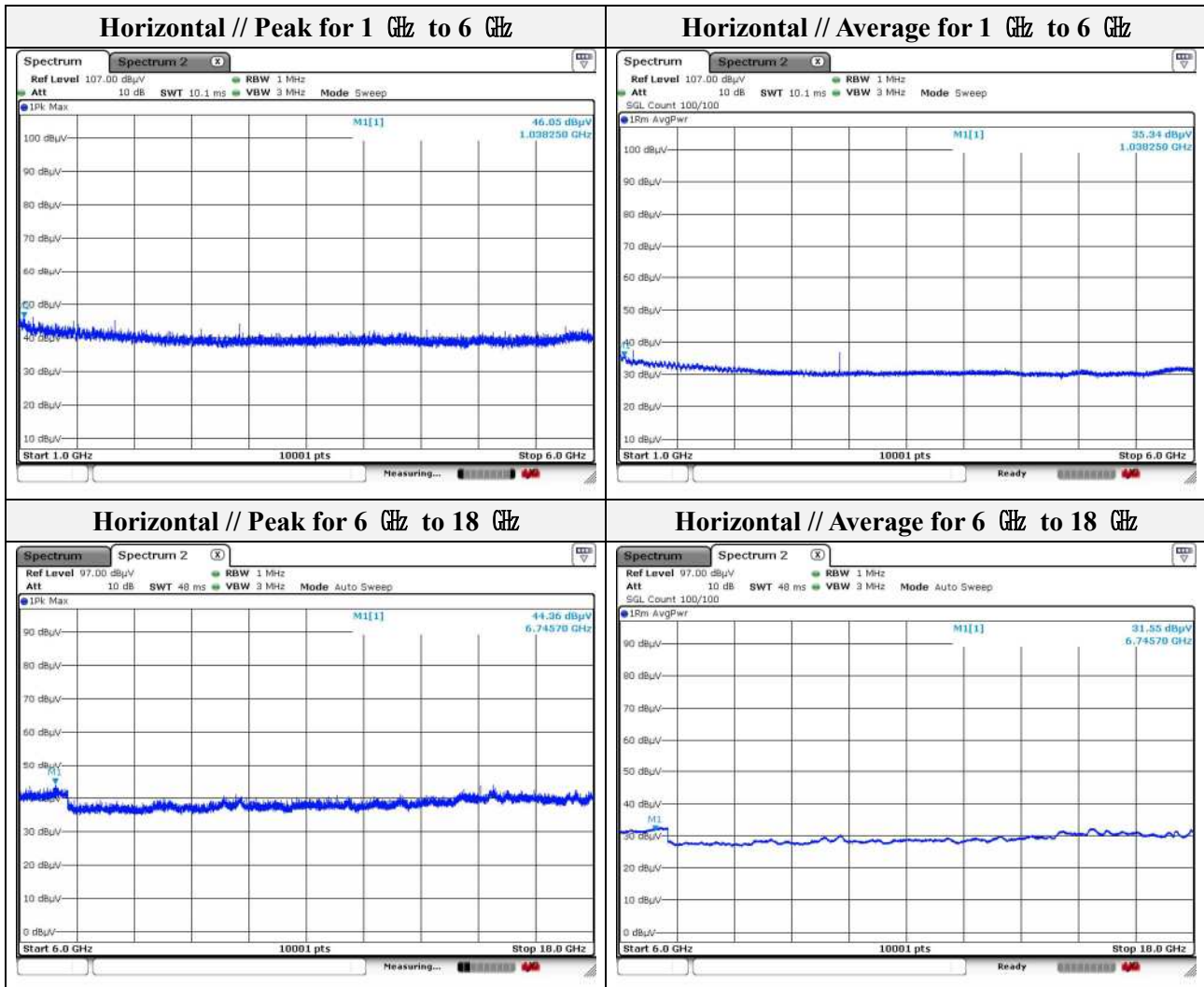
Distance of measurement: 3 meter

Channel: 46

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 038.25	46.05	Peak	H	23.90	-32.05	-	37.90	74.00	36.10
1 038.25	35.34	Average	H	23.90	-32.05	3.07	30.26	54.00	23.74
6 745.70	44.36	Peak	H	36.12	-21.30	-	59.18	74.00	14.82
6 745.70	31.55	Average	H	36.12	-21.30	3.07	49.44	54.00	4.56

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
 The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
 The authenticity of the test report, contact shchoi@kes.co.kr

24 V

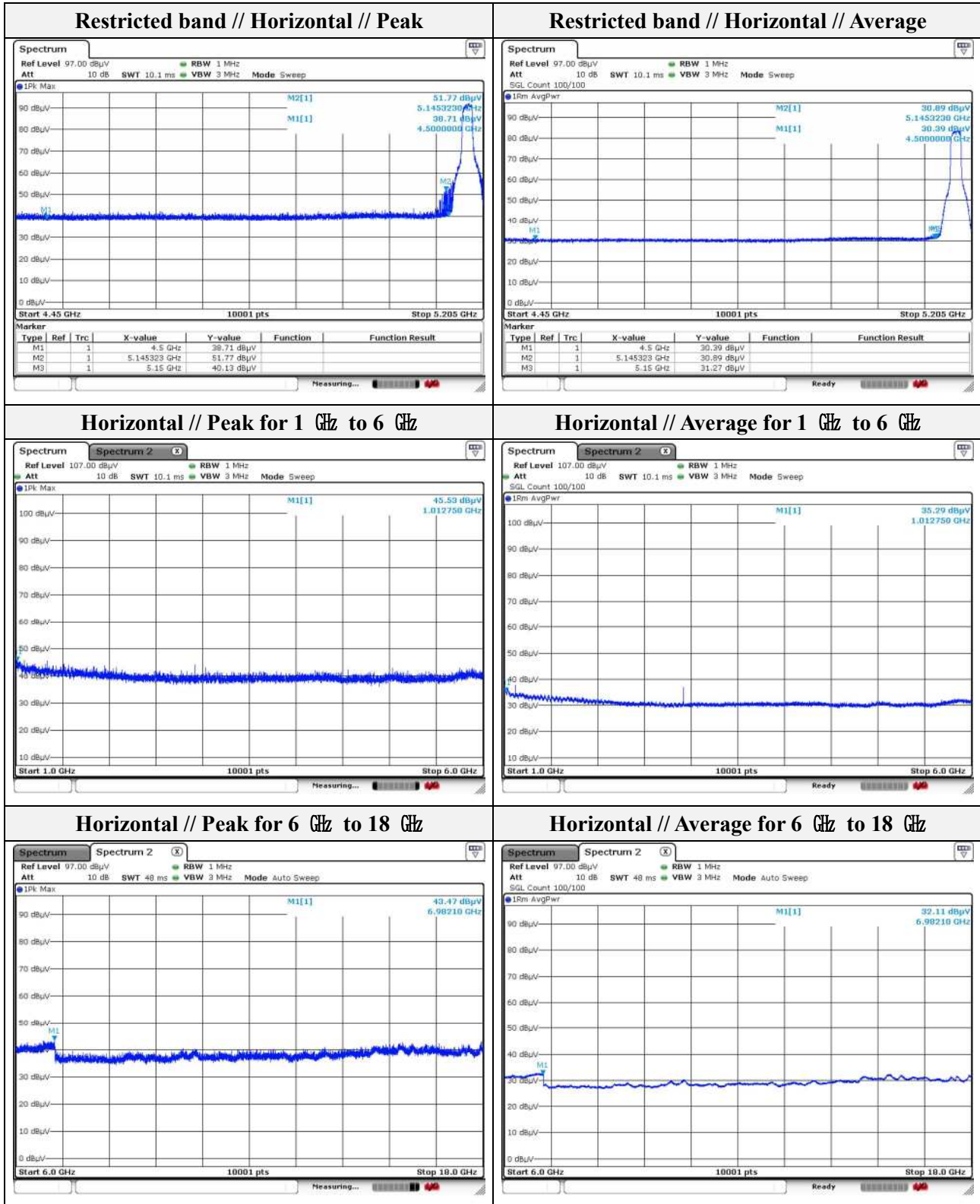
Mode: 802.11a
Distance of measurement: 3 meter
Channel: 36

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 012.75	45.53	Peak	H	23.90	-32.15	-	37.28	74.00	36.72
1 012.75	35.29	Average	H	23.90	-32.15	1.69	28.73	54.00	25.27
6 982.10	43.47	Peak	H	36.50	-20.84	-	59.13	74.00	14.87
6 982.10	32.11	Average	H	36.50	-20.84	1.69	49.46	54.00	4.54

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 500.00	38.71	Peak	H	32.10	-25.14	-	45.67	74.00	28.33
4 500.00	30.39	Average	H	32.10	-25.14	1.69	39.04	54.00	14.96
5 145.32	51.77	Peak	H	34.19	-24.44	-	61.52	74.00	12.48
5 145.32	30.89	Average	H	34.19	-24.44	1.69	42.33	54.00	11.67
5 150.00	40.13	Peak	H	34.20	-24.42	-	49.91	74.00	24.09
5 150.00	31.27	Average	H	34.20	-24.42	1.69	42.74	54.00	11.26



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (49) of (75)

Mode: 802.11a

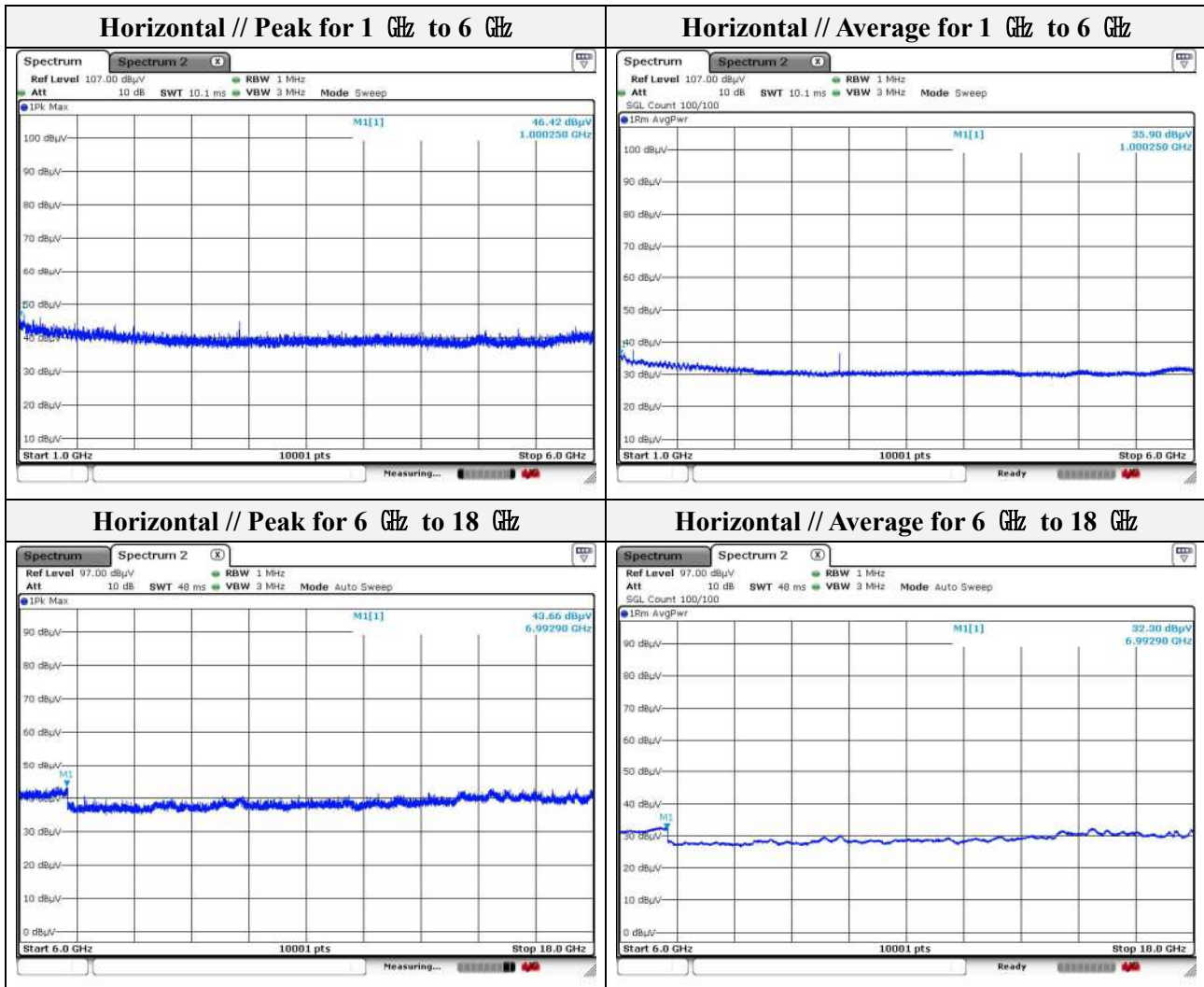
Distance of measurement: 3 meter

Channel: 44

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.25	46.42	Peak	H	23.90	-32.20	-	38.12	74.00	35.88
1 000.25	35.90	Average	H	23.90	-32.20	1.69	29.29	54.00	24.71
6 992.90	43.66	Peak	H	36.50	-20.82	-	59.34	74.00	14.66
6 992.90	32.30	Average	H	36.50	-20.82	1.69	49.67	54.00	4.33

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



**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

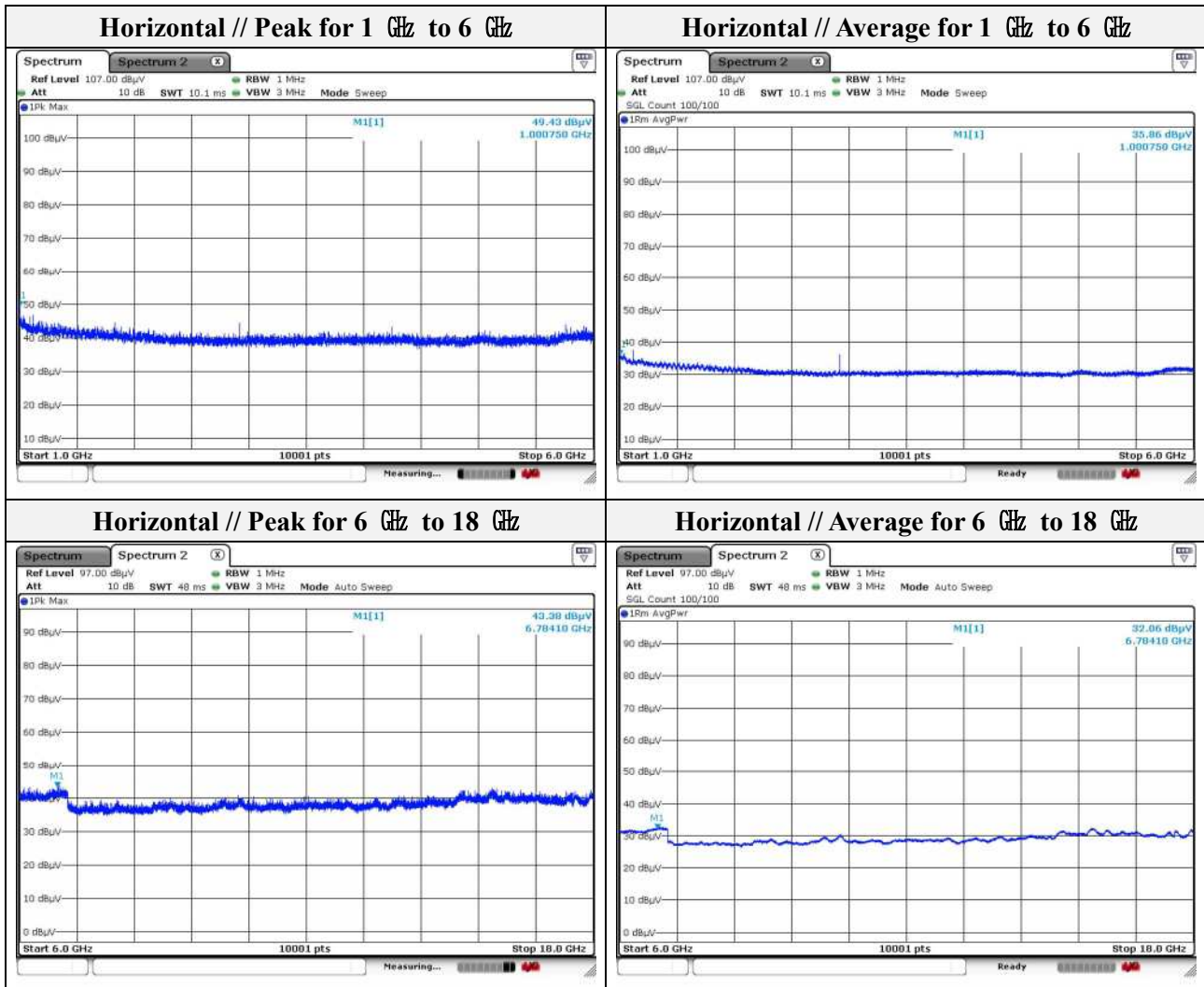
Test report No.:
KES-RF-19T0084
Page (51) of (75)

Mode: 802.11a
Distance of measurement: 3 meter
Channel: 48

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.75	49.43	Peak	H	23.90	-32.20	-	41.13	74.00	32.87
1 000.75	35.86	Average	H	23.90	-32.20	1.69	29.25	54.00	24.75
6 784.10	43.38	Peak	H	36.10	-21.20	-	58.28	74.00	15.72
6 784.10	32.06	Average	H	36.10	-21.20	1.69	48.65	54.00	5.35

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



**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

Test report No.:
KES-RF-19T0084
Page (53) of (75)

Mode: 802.11n_HT20
Distance of measurement: 3 meter
Channel: 36

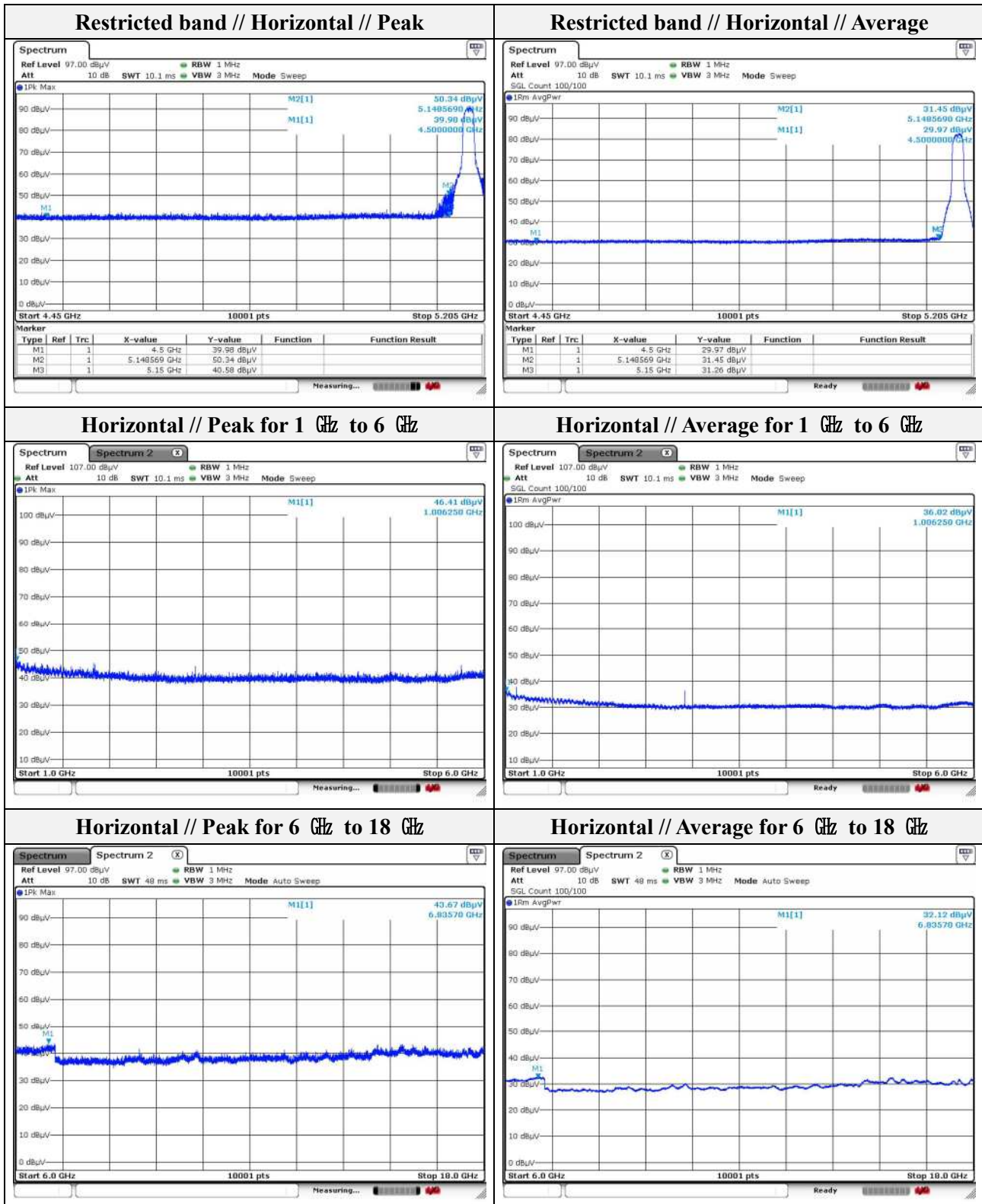
- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 006.25	46.41	Peak	H	23.90	-32.17	-	38.14	74.00	35.86
1 006.25	36.02	Average	H	23.90	-32.17	1.82	29.57	54.00	24.43
6 835.70	43.67	Peak	H	36.24	-21.10	-	58.81	74.00	15.19
6 835.70	32.12	Average	H	36.24	-21.10	1.82	49.08	54.00	4.92

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 500.00	39.98	Peak	H	32.10	-25.14	-	46.94	74.00	27.06
4 500.00	29.97	Average	H	32.10	-25.14	1.82	38.75	54.00	15.25
5 148.57	50.34	Peak	H	34.20	-24.42	-	60.12	74.00	13.88
5 148.57	31.45	Average	H	34.20	-24.42	1.82	43.05	54.00	10.95
5 150.00	40.58	Peak	H	34.20	-24.42	-	50.36	74.00	23.64
5 150.00	31.26	Average	H	34.20	-24.42	1.82	42.86	54.00	11.14

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
 The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
 The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (55) of (75)

Mode: 802.11n_HT20

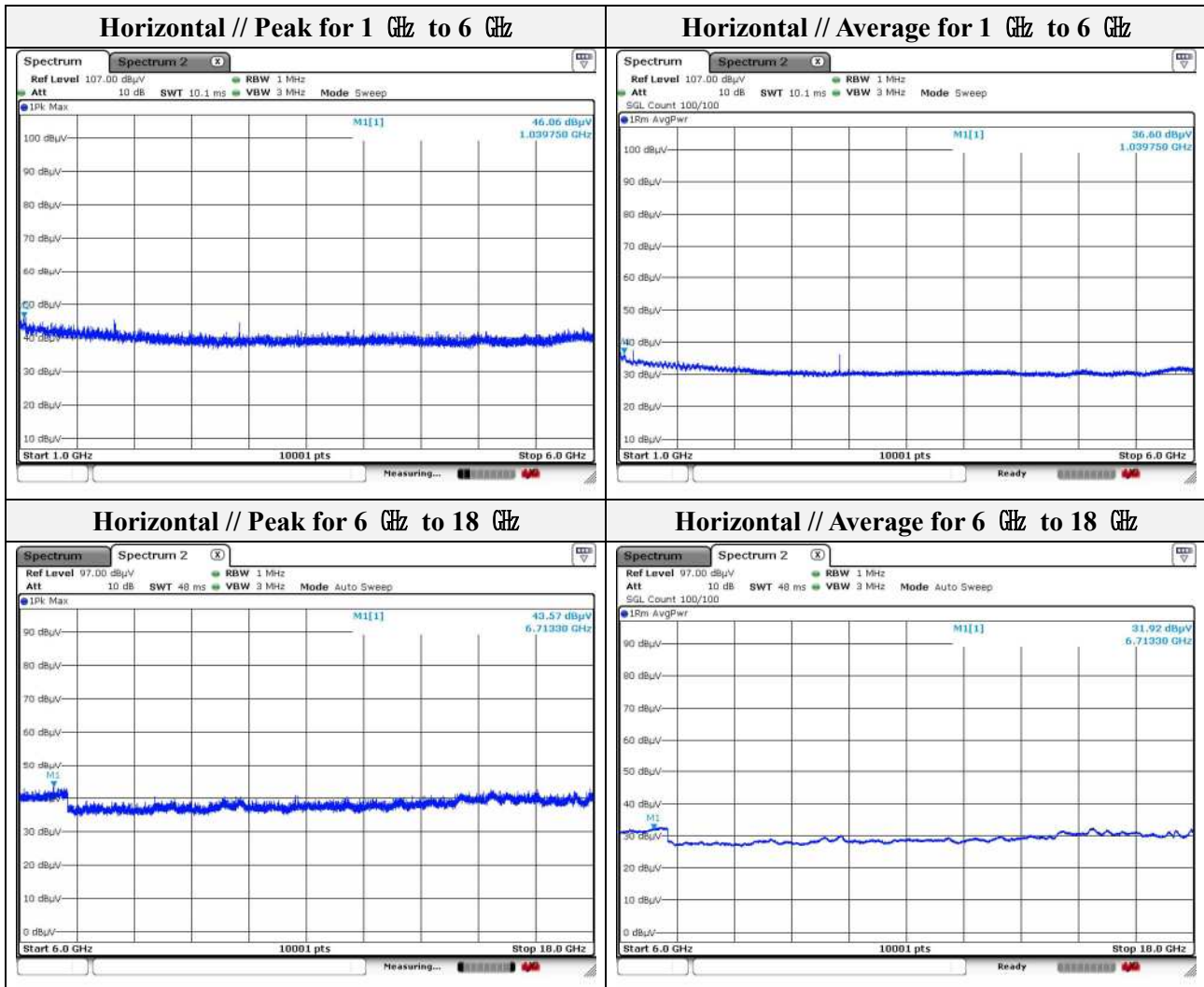
Distance of measurement: 3 meter

Channel: 44

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 039.75	46.06	Peak	H	23.90	-32.03	-	37.93	74.00	36.07
1 039.75	36.60	Average	H	23.90	-32.03	1.82	30.29	54.00	23.71
6 713.30	43.57	Peak	H	36.25	-21.38	-	58.44	74.00	15.56
6 713.30	31.92	Average	H	36.25	-21.38	1.82	48.61	54.00	5.39

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



**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

Test report No.:
KES-RF-19T0084
Page (57) of (75)

Mode: 802.11n_HT20

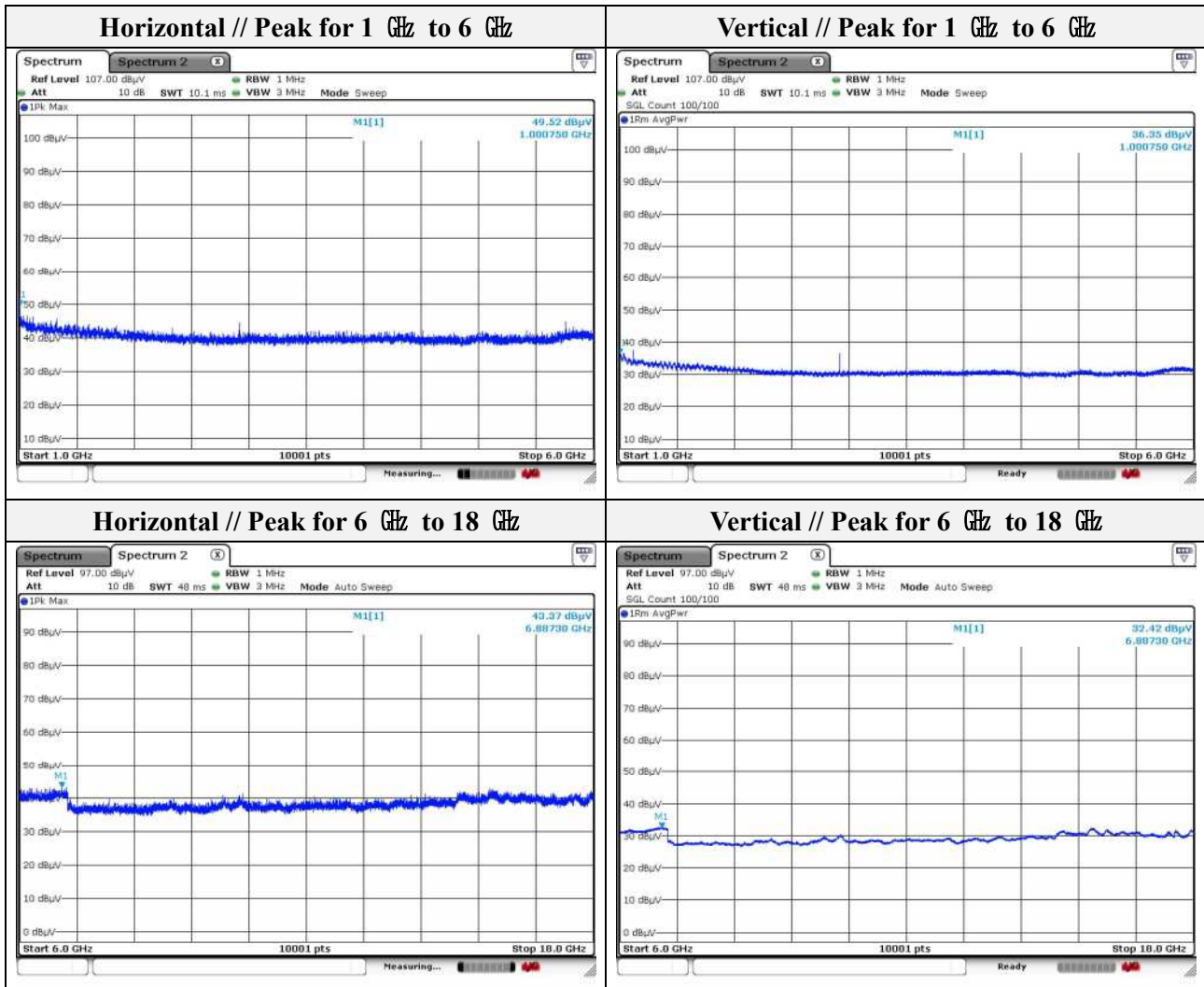
Distance of measurement: 3 meter

Channel: 48

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.75	49.52	Peak	H	23.90	-32.20	-	41.22	74.00	32.78
1 000.75	36.35	Average	H	23.90	-32.20	1.82	29.87	54.00	24.13
6 887.30	43.37	Peak	H	36.52	-21.01	-	58.88	74.00	15.12
6 887.30	32.42	Average	H	36.52	-21.01	1.82	49.75	54.00	4.25

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
 The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
 The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (59) of (75)

Mode: 802.11n_HT40
Distance of measurement: 3 meter
Channel: 38

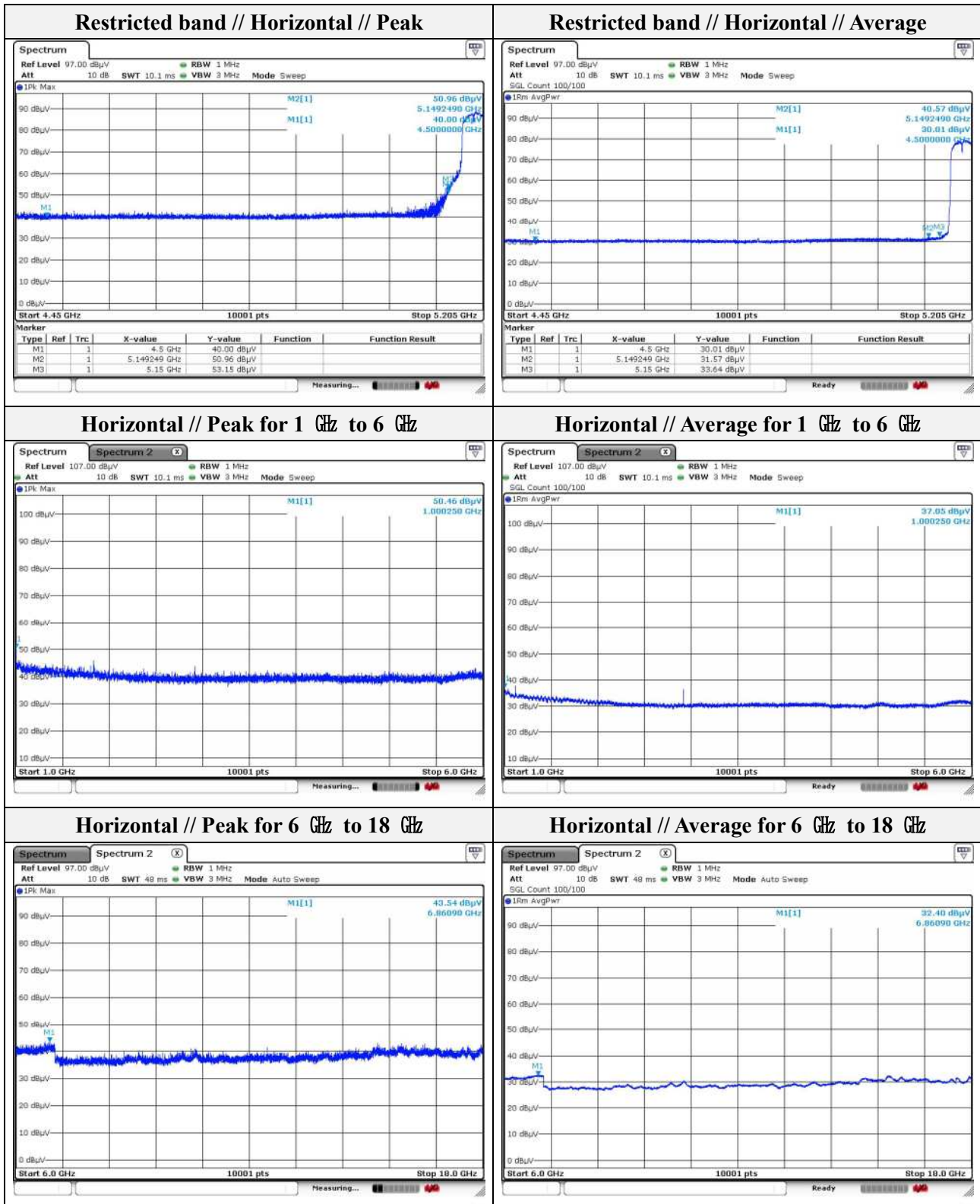
- Spurious

Frequency (MHz)	Level (dB μ V)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1 000.25	50.46	Peak	H	23.90	-32.20	-	42.16	74.00	31.84
1 000.25	37.05	Average	H	23.90	-32.20	2.90	31.65	54.00	22.35
6 860.90	43.54	Peak	H	36.37	-21.06	-	58.85	74.00	15.15
6 860.90	32.40	Average	H	36.37	-21.06	2.90	50.61	54.00	3.39

- Band edge

Frequency (MHz)	Level (dB μ V)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
4 500.00	40.00	Peak	H	32.10	-25.14	-	46.96	74.00	27.04
4 500.00	30.01	Average	H	32.10	-25.14	2.90	39.87	54.00	14.13
5 149.25	50.96	Peak	H	34.20	-24.42	-	60.74	74.00	13.26
5 149.25	31.57	Average	H	34.20	-24.42	2.90	44.25	54.00	9.75
5 150.00	53.15	Peak	H	34.20	-24.42	-	62.93	74.00	11.07
5 150.00	33.64	Average	H	34.20	-24.42	2.90	46.32	54.00	7.68

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (61) of (75)

Mode: 802.11n_HT40

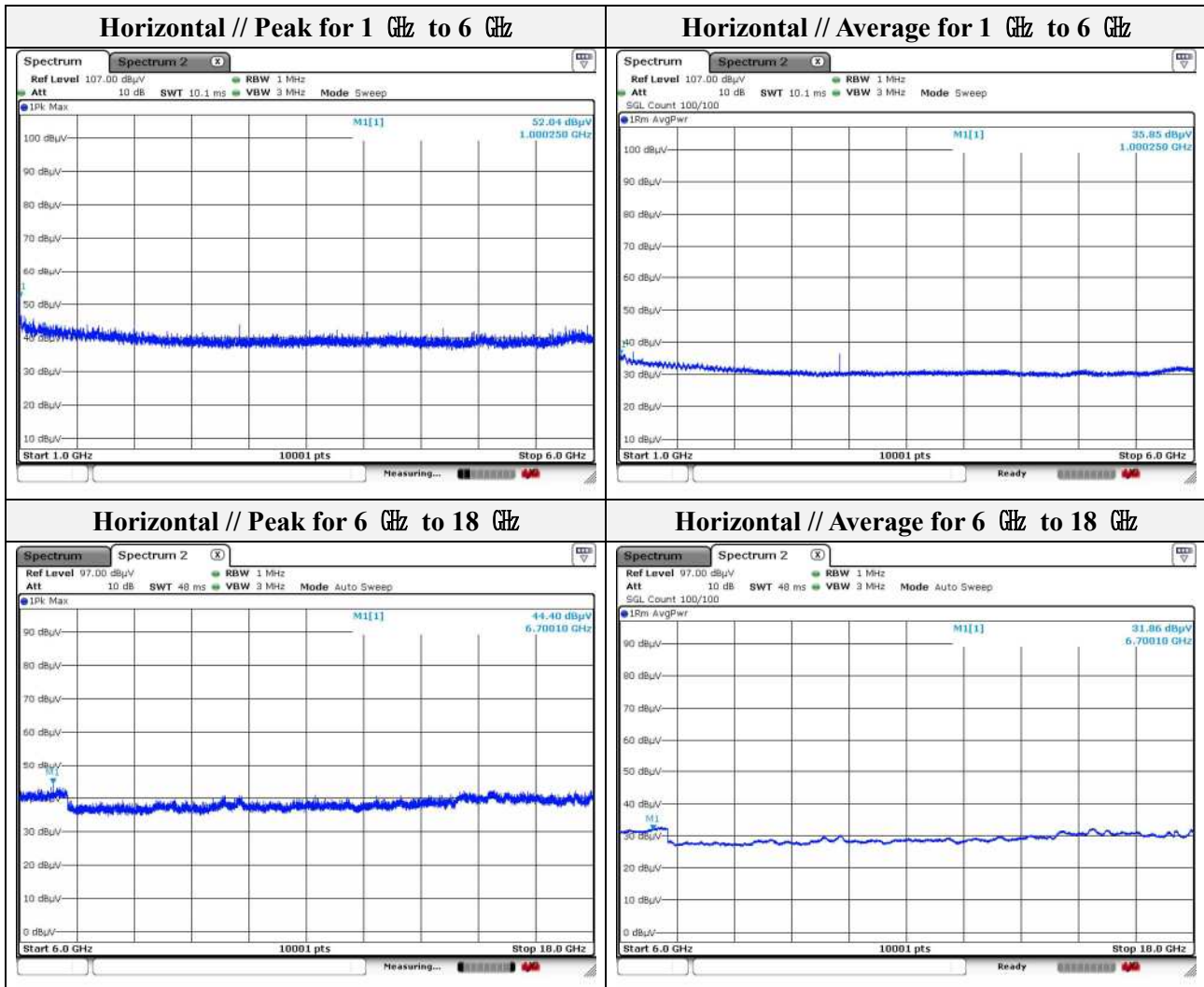
Distance of measurement: 3 meter

Channel: 46

- **Spurious**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.25	52.04	Peak	H	23.90	-32.20	-	43.74	74.00	30.26
1 000.25	35.85	Average	H	23.90	-32.20	2.90	30.45	54.00	23.55
6 700.10	44.40	Peak	H	36.30	-21.41	-	59.29	74.00	14.71
6 700.10	31.86	Average	H	36.30	-21.41	2.90	49.65	54.00	4.35

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



**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

Test report No.:
KES-RF-19T0084
Page (63) of (75)

Mode: 802.11ac_VHT20

Distance of measurement: 3 meter

Channel: 36

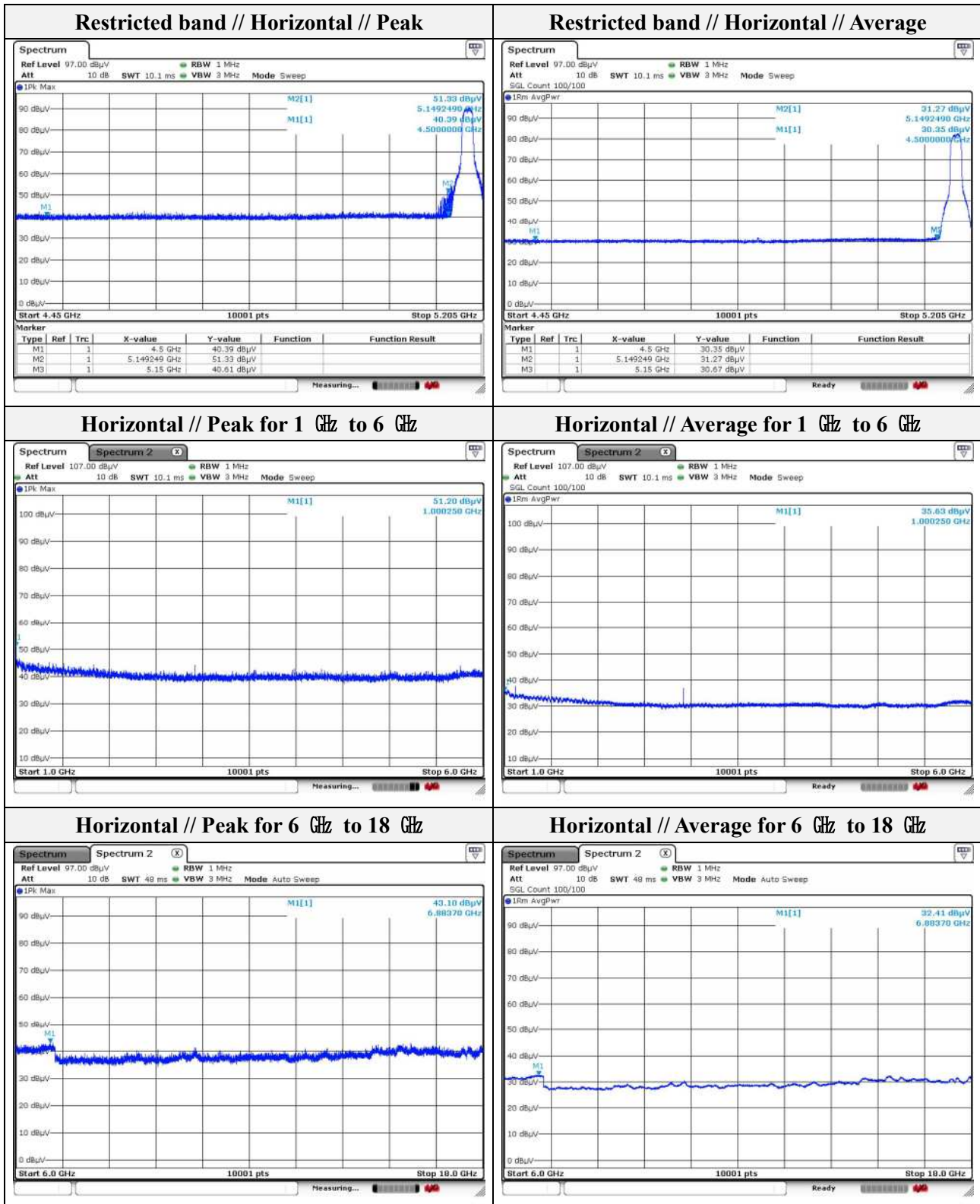
- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.25	51.20	Peak	H	23.90	-32.20	-	42.90	74.00	31.10
1 000.25	35.63	Average	H	23.90	-32.20	2.02	29.35	54.00	24.65
6 883.70	43.10	Peak	H	36.50	-21.02	-	58.58	74.00	15.42
6 883.70	32.41	Average	H	36.50	-21.02	2.02	49.91	54.00	4.09

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 500.00	40.39	Peak	H	32.10	-25.14	-	47.35	74.00	26.65
4 500.00	30.35	Average	H	32.10	-25.14	2.02	39.33	54.00	14.67
5 149.25	51.33	Peak	H	34.20	-24.42	-	61.11	74.00	12.89
5 149.25	31.27	Average	H	34.20	-24.42	2.02	43.07	54.00	10.93
5 150.00	40.61	Peak	H	34.20	-24.42	-	50.39	74.00	23.61
5 150.00	30.67	Average	H	34.20	-24.42	2.02	42.47	54.00	11.53

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



**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

Test report No.:
KES-RF-19T0084
Page (65) of (75)

Mode: 802.11ac_VHT20

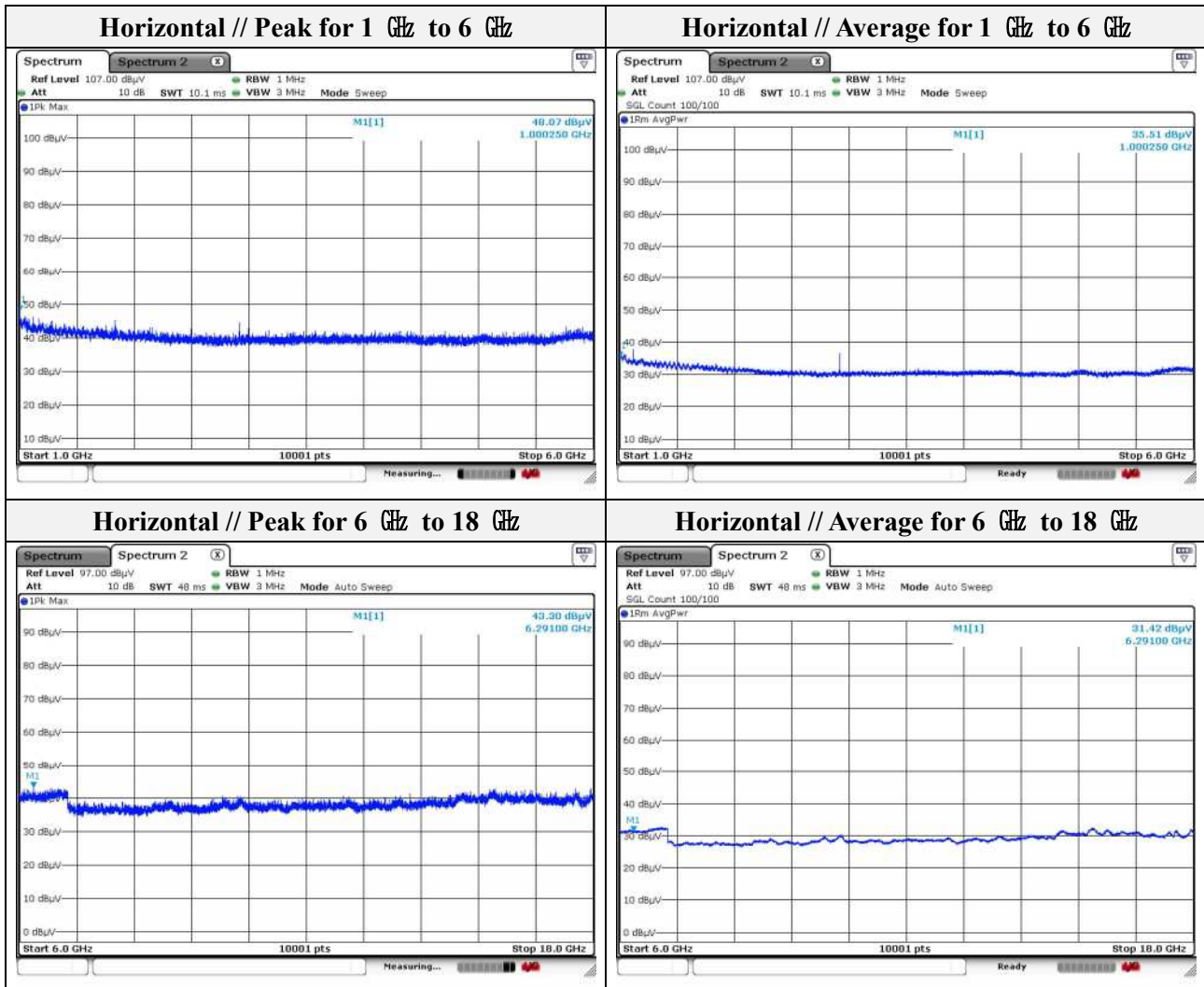
Distance of measurement: 3 meter

Channel: 44

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.25	48.07	Peak	H	23.90	-32.20	-	39.77	74.00	34.23
1 000.25	35.51	Average	H	23.90	-32.20	2.02	29.23	54.00	24.77
6 291.00	43.30	Peak	H	35.00	-23.01	-	55.29	74.00	18.71
6 291.00	31.42	Average	H	35.00	-23.01	2.02	45.43	54.00	8.57

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



**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

Test report No.:
KES-RF-19T0084
Page (67) of (75)

Mode: 802.11ac_VHT20

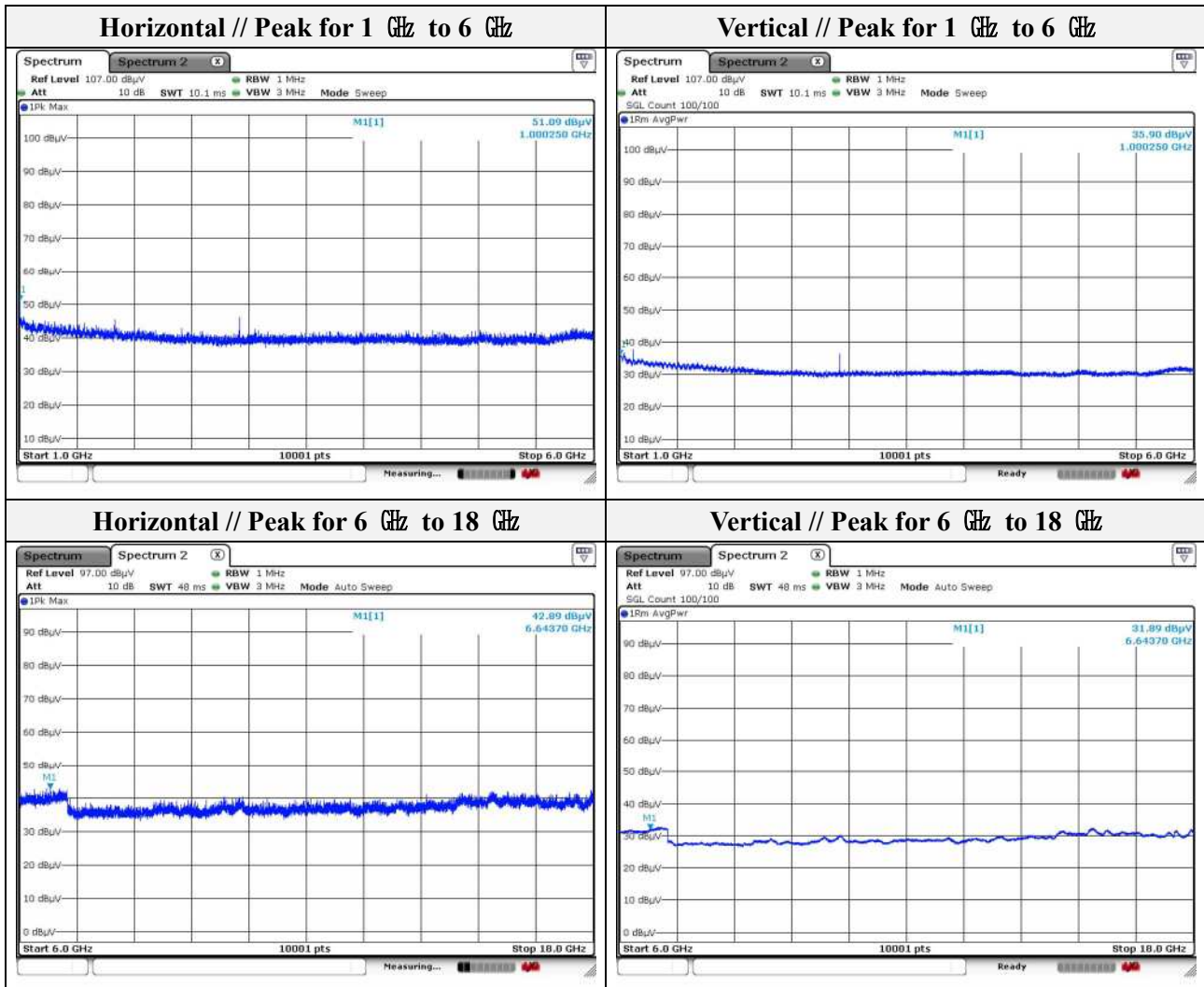
Distance of measurement: 3 meter

Channel: 48

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.25	51.09	Peak	H	23.90	-32.20	-	42.79	74.00	31.21
1 000.25	35.90	Average	H	23.90	-32.20	2.02	29.62	54.00	24.38
6 643.70	42.89	Peak	H	36.30	-21.55	-	57.64	74.00	16.36
6 643.70	31.89	Average	H	36.30	-21.55	2.02	48.66	54.00	5.34

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
 The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
 The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (69) of (75)

Mode: 802.11ac_VHT40

Distance of measurement: 3 meter

Channel: 38

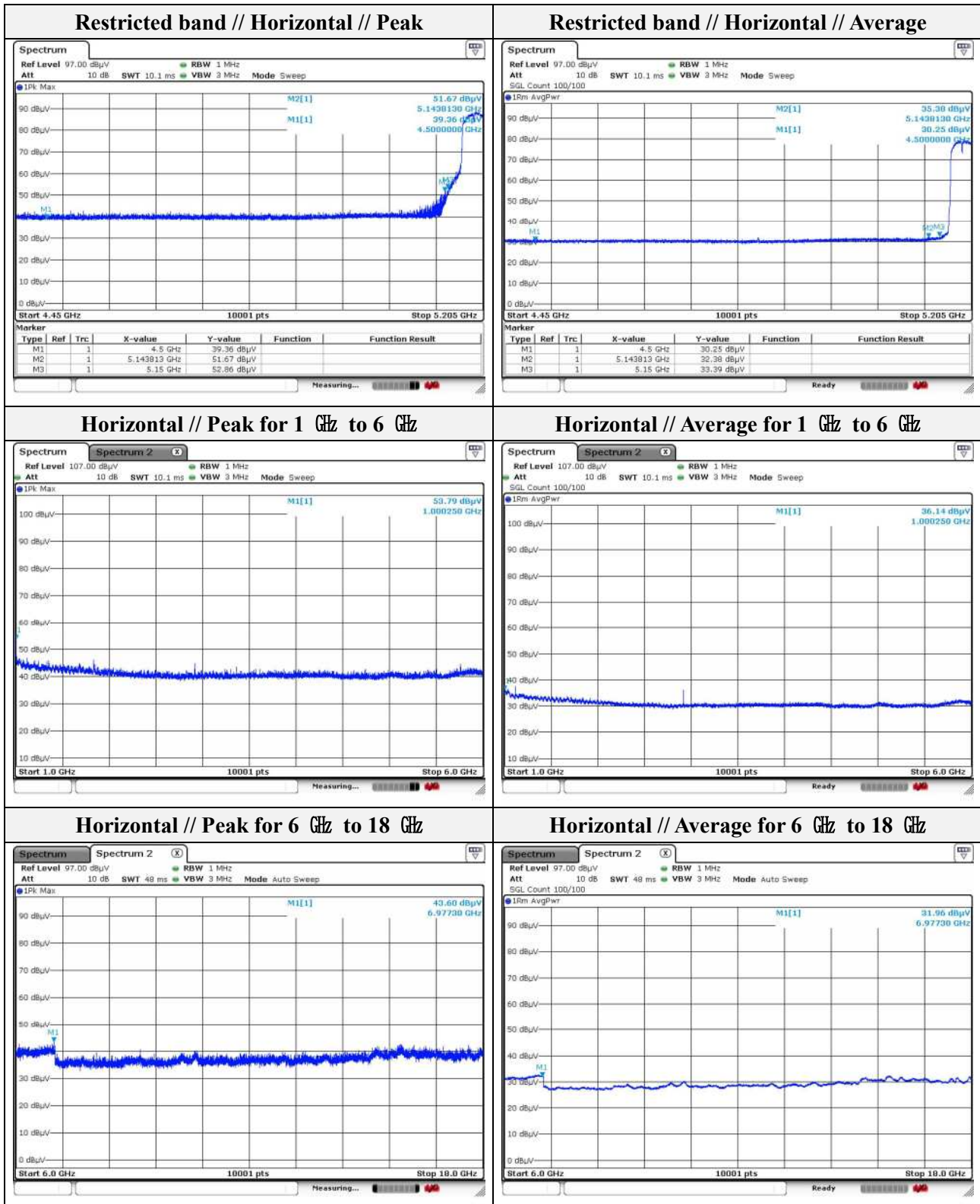
- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.25	53.79	Peak	H	23.90	-32.20	-	45.49	74.00	28.51
1 000.25	36.14	Average	H	23.90	-32.20	3.07	30.91	54.00	23.09
6 977.30	43.60	Peak	H	36.50	-20.86	-	59.24	74.00	14.76
6 977.30	31.96	Average	H	36.50	-20.86	3.07	50.67	54.00	3.33

- Band edge

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 500.00	39.36	Peak	H	32.10	-25.14	-	46.32	74.00	27.68
4 500.00	30.25	Average	H	32.10	-25.14	3.07	40.28	54.00	13.72
5 143.81	51.67	Peak	H	34.19	-24.45	-	61.41	74.00	12.59
5 143.81	32.38	Average	H	34.19	-24.45	3.07	45.19	54.00	8.81
5 150.00	52.86	Peak	H	34.20	-24.42	-	62.64	74.00	11.36
5 150.00	33.39	Average	H	34.20	-24.42	3.07	46.24	54.00	7.76

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr

**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

Test report No.:
KES-RF-19T0084
Page (71) of (75)

Mode: 802.11ac_VHT40

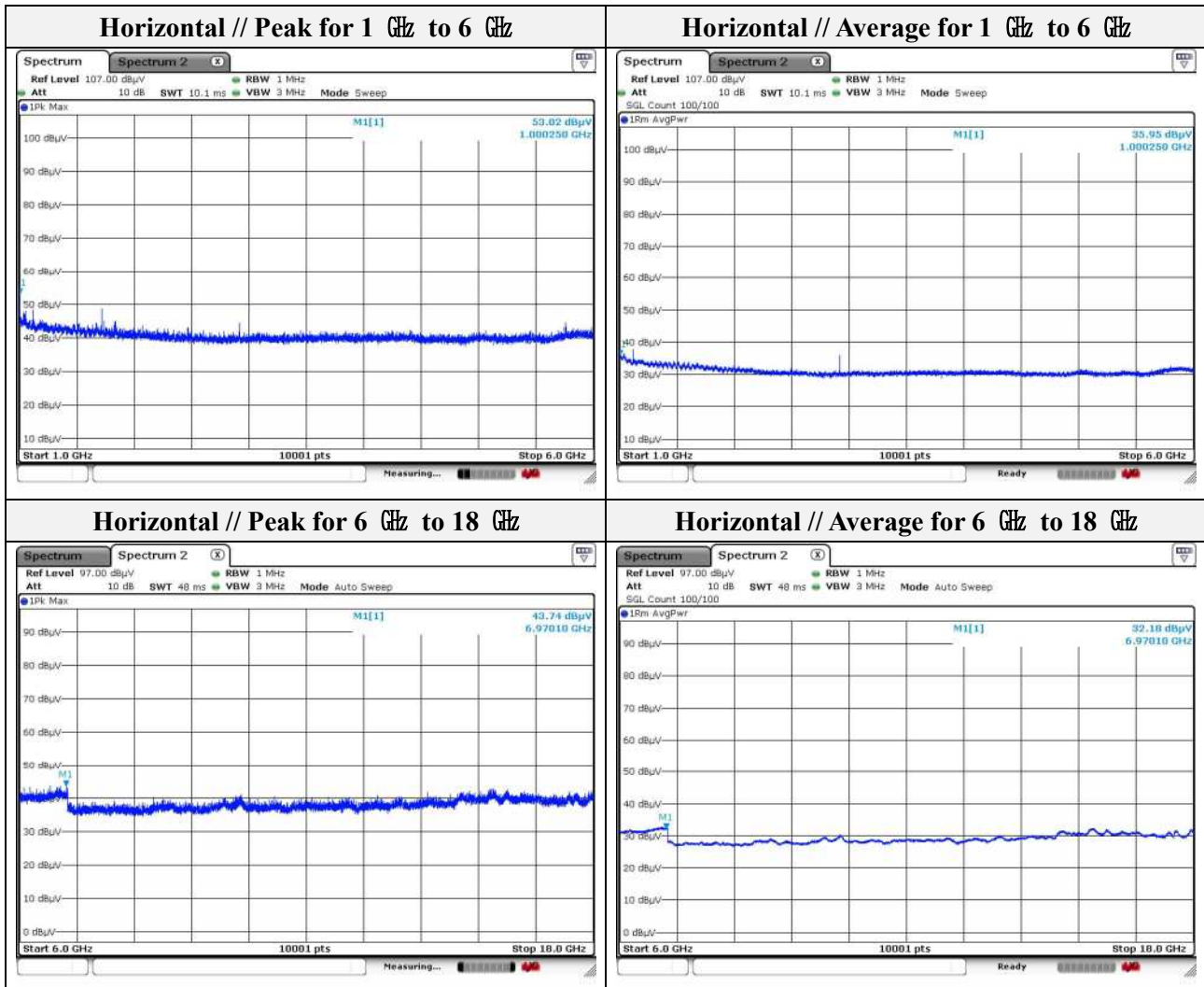
Distance of measurement: 3 meter

Channel: 46

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 000.25	53.02	Peak	H	23.90	-32.20	-	44.72	74.00	29.28
1 000.25	35.95	Average	H	23.90	-32.20	3.07	30.72	54.00	23.28
6 970.10	43.74	Peak	H	36.50	-20.87	-	59.37	74.00	14.63
6 970.10	32.18	Average	H	36.50	-20.87	3.07	50.88	54.00	3.12

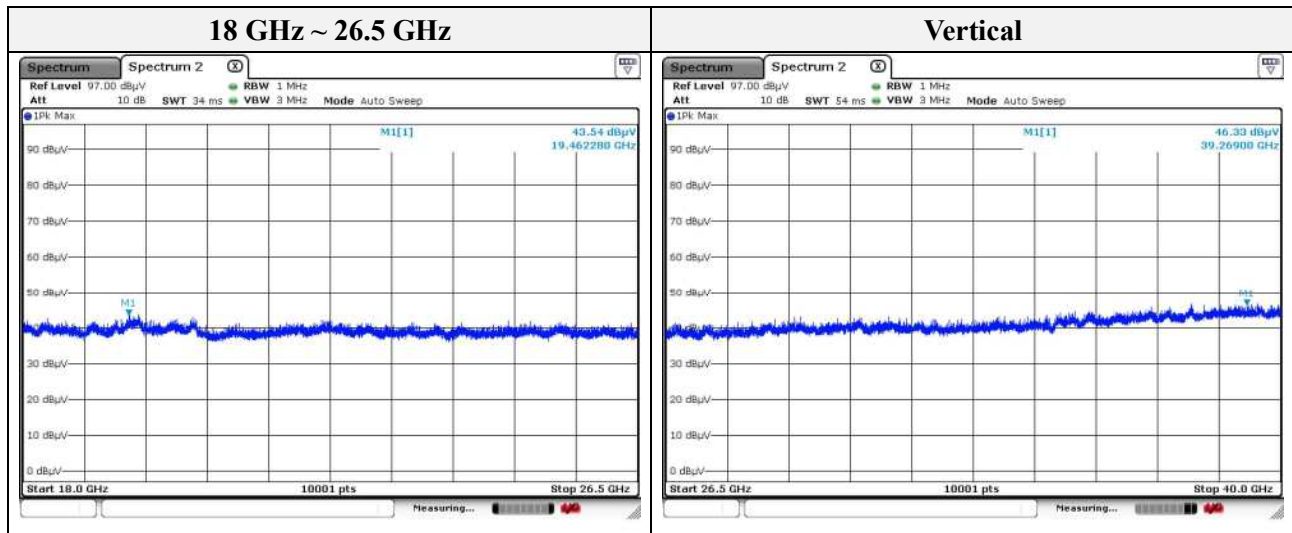
This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
The authenticity of the test report, contact shchoi@kes.co.kr



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.
 The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
 The authenticity of the test report, contact shchoi@kes.co.kr

Test results (18 GHz to 40 GHz) – Worst case

Mode: 802.11a
 Distance of measurement: 3 meter
 Channel: 48



Note.

1. No spurious emission were detected above 18 GHz.

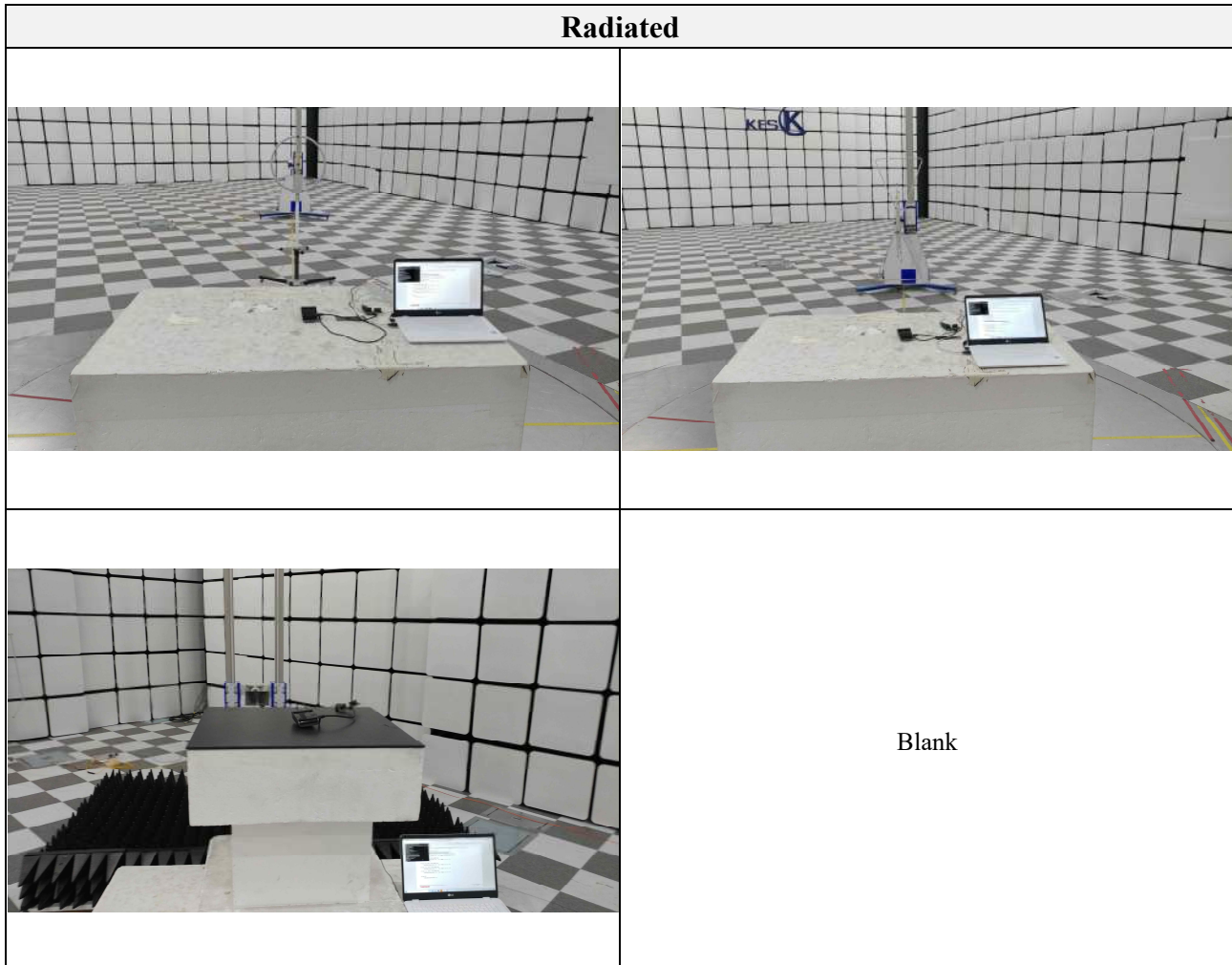
Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV30	101389	1 year	2020.01.09
Spectrum Analyzer	R&S	FSV40	101002	1 year	2019.06.29
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2020.01.15
Power Meter	Anritsu	ML2495A	1438001	1 year	2020.01.15
Pulse Power Sensor	Anritsu	MA2411B	1339205	1 year	2020.01.15
Attenuator	HP	8494B	2630A12857	1 year	2020.01.15
Loop Antenna	Schwarzbeck	FMZB1513	225	2 years	2021.02.15
Trilog-broadband antenna	SCHWARZBECK	VULB 9163	714	2 years	2020.11.26
Horn Antenna	A.H	SAS-571	414	2 years	2021.02.11
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA 9170550	2 years	2021.02.19
High Pass Filter	Wainwright Instrument Gmbh	WHJS3000-10TT	1	1 year	2019.06.29
Band Reject Filter	MICRO-TRONICS	BRM50702	G272	1 year	2020.01.16
Low Pass Filter	Wainwright Instrument Gmbh	WLK1.0/18G-10TT	1	1 year	2019.06.29
Broadband Amplifier	Schwarzbeck	BBV9721	PS9721-003	1 year	2020.01.16
Preamplifier	AGILENT	8449B	3008A00538	1 year	2019.06.29
Amplifier	R&S	SCU 01	100603	1 year	2019.11.26
EMI Test Receiver	R&S	ESU26	100551	1 year	2020.04.09
EMI Test Receiver	R&S	ESR3	101781	1 year	2020.04.22
DC Power supply	Agilent	6632B	MY43004090	1 year	2019.06.28

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook computer	LG Electronics Inc.,	LGS53	306QCZP560949

Appendix B. Test setup photos



The end of test report.