

Report No.: KES-RF1-20T0205 Page (1) of (43)

TEST REPORT

Part 15 Subpart E 15.407

Equipment under test BLACK BOX

Model name F790

FCC ID 2ADTG-F790

Applicant THINKWARE CORPORATION

Manufacturer THINKWARE CORPORATION

Date of test(s) 2020.09.21 ~ 2020.09.25

Date of issue 2020.10.23

Issued to THINKWARE CORPORATION

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Revision history

Revision	Date of issue	sue Test report No. Description	
-	2020.10.23	KES-RF1-20T0205	Initial



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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, Yeoju-si, Gy	eonggi-do, Korea	
Test Facility	FCC Accreditation Designation	No.: KR0100, Registration No.:	444148
FCC rule part(s):	15.247		
FCC ID:	2ADTG- F790		
Test device serial No.:	Production	Pre-production	Engineering

1.1. EUT description

Equipment under test	BLACK BOX
Frequency range	$2 412$ MHz ~ $2 462$ MHz (11b/g/n_HT20)
	5 180 MHz ~ 5 240 MHz (11n_HT20, 11ac_VHT20)
	5 190 MHz ~ 5 230 MHz (11n_HT40, 11ac_VHT40)
Model:	F790
Modulation technique	DSSS, OFDM
Number of channels	2 412 MHz ~ 2 462 MHz $(11b/g/n_HT20)$: 11ch
	5 180 MHz ~ 5 240 MHz (11n_HT20, 11ac_VHT20) : 4ch
	5 190 MHz ~ 5 230 MHz (11n_HT40, 11ac_VHT40) : 2ch
Antenna specification	Antenna type(2.4GHz WIFI) : Chip antenna, Peak gain : 0.80 dBi
	Antenna type(5GHz WIFI) : Chip antenna, Peak gain : 1.95 dBi
Power source	DC 12 V / DC 24V
H/W version	V 3.1 PP2
S/W version	V 1.00.00

1.2. Test configuration

The <u>THINKWARE CORPORATION // F790 // FCC ID: 2ADTG-F790</u> was tested according to the specification of EUT, the EUT must comply with following standards and KDB documents.

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

1.3. Device modifications

N/A

1.4. Accessory information

N/A

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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.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).= 1.40 + 10.00 = 11.40 (dB)

1.6. Measurement Uncertainty

Test Item	Uncertainty	
Uncertainty for Conduction emission test		2.46 dB
Uncertainty for Radiation emission test	Below 1 GHz	4.40 dB
(include Fundamental emission)	Above 1GHz	5.94 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 (Mz)	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 (Mtz)	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: <u>54 Mbps</u>
- 802.11n_HT20/HT40: MCS7
- 802.11ac_VHT20: MCS8
- 802.11ac_VHT40: MCS9

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2. Summary of tests

Reference	Reference Parameter	
15.407(a)	26 dB bandwidth & 99 % Occupied Bandwidth	N/A ¹⁾
15.407(a)	Maximum conducted output power	Pass
15.407(a)	Power spectral density	N/A ¹⁾
15.407(g)	Frequency stability	N/A ¹⁾
15.205 15.209	Radiated restricted band and emission	Pass
15.407(d)	General field strength limit (Restricted bands and radiated emission limit)	N/A ¹⁾
15.207	AC power line conducted emissions	N/A ¹⁾

Note 1) Please Refer to the approved Module Report (Report No.: EC1905007RI03, EC1905007RI04) for these parameters.



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

FUT	Attenuator	Power meter,
EUI	Attenuator	Power sensor

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 ba ndwidth 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 transmit-ting 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.



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FCC				
Band	EUT Category		Limit	
	Outdoor access point			
UNII-1		Indoor access point	1 W (30 dBm)	
		Fixed point-to-point access point		
	\checkmark	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

Deril	Frequency	Mada	Peak Output Power	Average Output Power	Limit (dB m)
Band	(MHz)	Mode	(dBm)	(dBm)	FCC
	5 180		16.89	10.93	
UNII-1	5 220	802.11a	16.59	10.95	24.00
	5 240		16.43	10.90	

Dand	Frequency	Mada	Peak Output Power	Average Output Power	Limit (dB m)	
Band	(MHz)	Mode	(dBm)	(dBm)	FCC	
	5 180		15.50	10.74		
UNII-1	5 220	802.11n_ HT20	15.43	10.50	24.00	
	5 240	11120	15.27	10.43		

Band	Frequency (Mz)	Mode	Peak Output Power (dBm)	Average Output Power (dB m)	Limit (dBm) FCC
UNII-1	5 180	802.11n	15.48	10.30	24.00
UNII-1	5 220 HT40	15.85	10.31	24.00	

Frequency		Mada	Peak Output Power	Average Output Power	Limit (dBm)	
Band	(MHz)	Mode	(dBm)	(dBm)	FCC	
	5 180		15.26	10.56		
UNII-1	5 220	802.11ac VHT20	15.41	10.31	24.00	
	5 240		15.22	10.45		

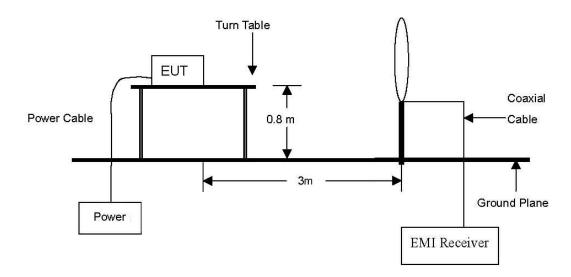
Band	Frequency (Mz)	Mode	Peak Output Power (dBm)	Average Output Power (CBm)	Limit (dBm) FCC
UNII-1	5 180	802.11ac	15.09	10.23	24.00
UNII-1	5 220	_VHT40	15.11	10.40	24.00



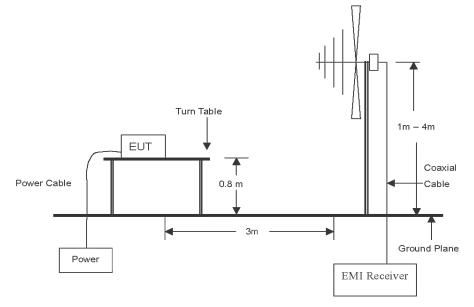
3.2. Radiated restricted band and emissions

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.

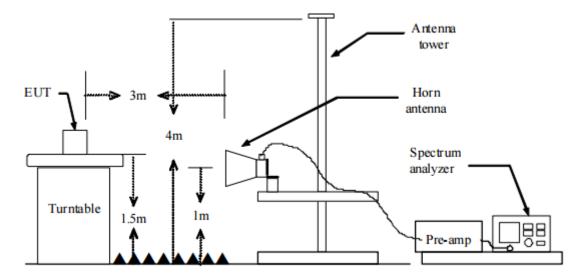


The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.





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 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. We have done x, y, z planes in EUT and horizontal and vertical polarization and Parallel to the ground plane in detecting antenna.
- 4. 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.
- 5. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum hold mode.

Test procedure above 30 Mz

1. Spectrum analyzer settings for f < 1 GHz:

Span = wide enough to fully capture the emission being measured

RBW = 100 kHz VBW RBW

Detector = quasi peak

Sweep time = auto

Trace = max hold

2. Spectrum analyzer settings for f = 1 GHz: Peak

Analyzer center frequency was set to the frequency of the radiated spurious emission of interest RBW = 1 MHz

VBW 3 MHz Detector = peak Sweep time = auto Trace = max hold Trace was allowed to stabilize

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3. Spectrum analyzer settings for f = 1 GHz: Average

Analyzer center frequency was set to the frequency of the radiated spurious emission of interest RBW = 1 MHz

 $VBW \ge 3 \times RBW$

Detector = RMS, if span/(# of points in sweep) (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.

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.

Sweep = auto

Trace = max hold

Perform a trace average of at least 100 traces.

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 (1/x), 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 $x = 10^{-1}$, 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. The loop antenna was investigated with three polarizations, and horizontal and vertical polarizations were reported as the worst case.
- 2. f < 30 MHz, extrapolation factor of 40 dB/decade of distance. $F_d = 40\log(D_m/Ds)$

 $f \ge 30$ MHz, extrapolation factor of 20 dB/decade of distance. $F_d = 20log(D_m/Ds)$ Where:

- F_d = Distance factor in dB
- D_m = Measurement distance in meters
- D_s = Specification distance in meters
- 3. $CF(Correction factors(dB)) = Antenna factor(dB/m) + Cable loss(dB) + or Amp. gain(dB) + or F_d(dB)$
- 4. Field strength($dB\mu V/m$) = Level($dB\mu V$) + CF (dB) + or DCF(dB)
- 5. Margin(dB) = Limit(dB μ V/m) Field strength(dB μ V/m)
- 6. Emissions below 18 GHz were measured at a 3 meter test distance while emissions above 18 GHz were measured at a 1 meter test distance with the application of a distance correction factor.
- 5. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z, it was determined that <u>X orientation</u> was worst-case orientation; therefore, all final radiated testing was performed with the EUT in <u>X orientation</u>.
- 6. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
- 7. According to exploratory test no any obvious emission were detected from 9kHz to 30MHz. Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test 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.

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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 (Mtz)	Distance (Meters)	Radiated (µV/m)
$0.009 \sim 0.490$	300	2400/F(kHz)
0.490 ~ 1.705	30	24000/F(kHz)
$1.705 \sim 30.0$	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 $54 \sim 72$ MHz, $76 \sim 88$ MHz, $174 \sim 216$ MHz or $470 \sim 806$ MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.



Duty cycle

Regarding to KDB 558074 D01_v05 r02, 6. Measurements of duty cycle and transmission duration shall be performed using one of the following techniques:

a) A diode detector and an oscilloscope that together have sufficiently short response time to permit accurate measurements of the on- and off-times of the transmitted signal.

b) The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on- and off-times of the transmitted signal.

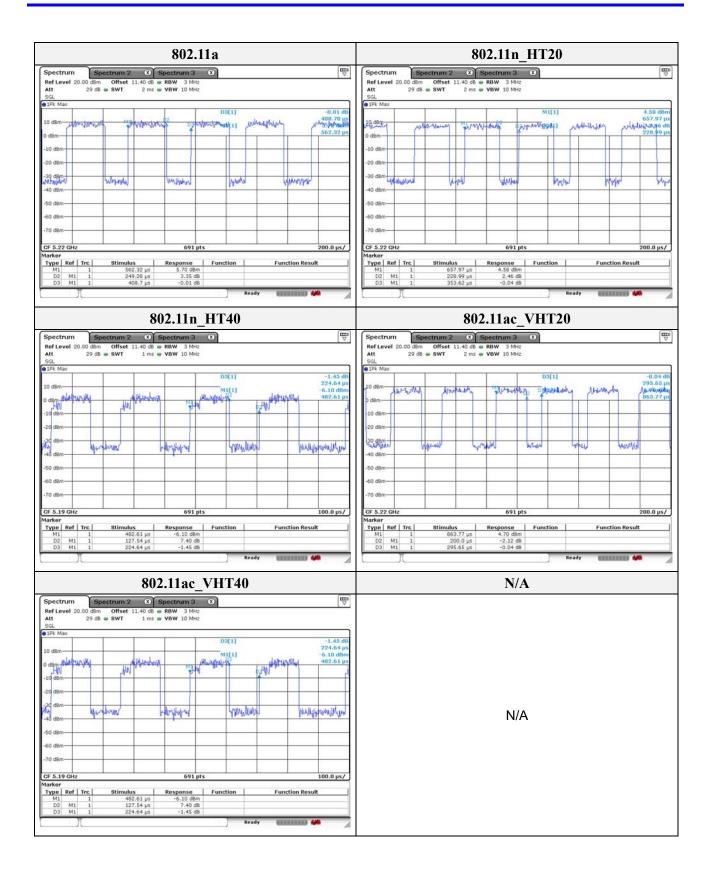
Test mode	T _{on} time (ms)	Period (ms)	Duty cycle (Linear)	Duty cycle (%)	Duty cycle correction factor (dB)
802.11a	0.249	0.409	0.609	60.880	2.16
802.11n_HT20	0.229	0.354	0.647	64.689	1.89
802.11n_HT40	0.128	0.225	0.569	56.889	2.45
802.11ac_VHT20	0.2	0.296	0.676	67.568	1.70
802.11ac_VHT40	0.128	0.225	0.569	56.889	2.45

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

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



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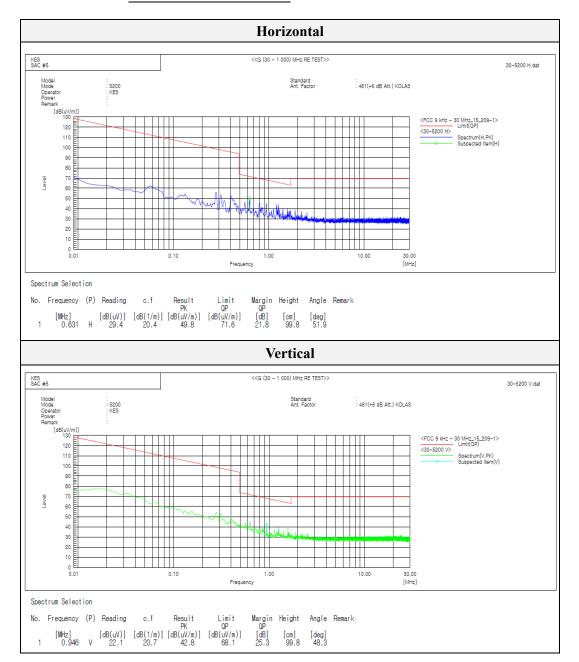


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Test results (Below 30 Mz)				
Mode:	802.11a			
Distance of measurement:	3 meter			
Channel:	36 (Worst case)			

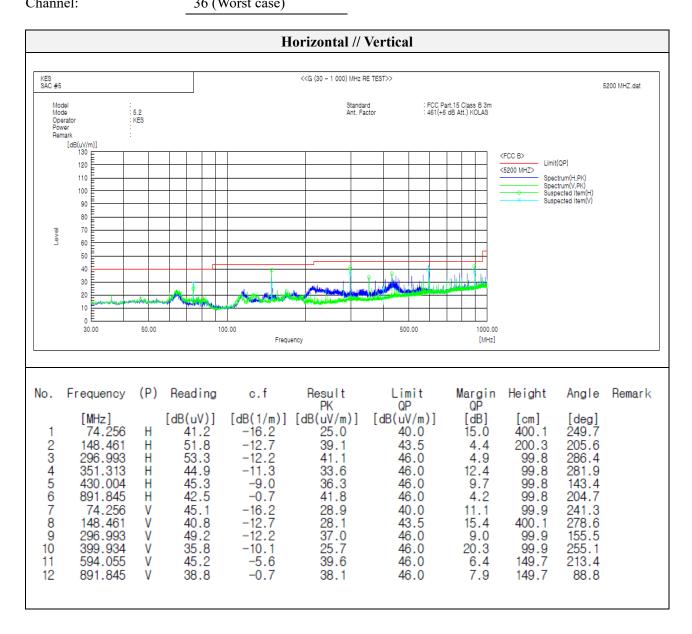


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Test results (Below 1 000	MHz)
Mode:	802.11a
Distance of measurement:	3 meter
Channel	36 (Worst case)





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Test results (Above 1 000 MHz)

Mode:	UNII-1_802.11a
Distance of measurement:	3 meter
Channel:	36

- Spurious

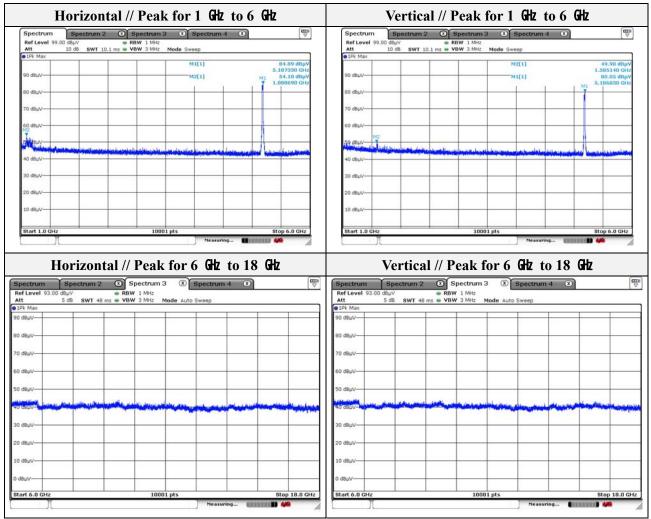
Frequency (Mz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV /m)	Margin (dB)
1088.69	54.10	Peak	Н	-9.19	-	44.91	74.00	29.09
1585.14	49.90	Peak	V	-7.44	-	42.46	74.00	31.54

- 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)
5150.00	46.62	Peak	Н	3.26	-	49.88	74.00	24.12
5146.60	44.34	Peak	V	3.26	-	47.60	74.00	26.40

Restricted	l band // Horizontal	// Peak	Rest	ricted band // Ver	tical // Peak
Spectrum Spectrum 2	Spectrum 3 Spectrum 4	₩ (8)	Spectrum Spectr	um 2 🗵 Spectrum 3 🙁	Spectrum 4 🗶
Ref Level 97.00 dBµV	RBW 1 MHz		Ref Level 97.00 dBµV	RBW 1 MHz	
Att 10 dB SWT 10.1 n 1Pk Max	ms 🖶 VBW 3 MHz Mode Sweep		Att 10 dB St	WT 10.1 ms VBW 3 MHz Mode Swe	ep
90 d8uV	M1[1]	46.62 d8µV 5.1500000 GHz	90 dBuy	м	1[1] 44.34 dBp 5.1466030 G
90 GBHA			90 GBDA		
80 dBuy		M	80 dBµV		
70 d8µ <mark>V</mark>			70 dBµV		
50 dBµ <mark>y</mark>			60 dBµ <mark>y</mark>		
50 dBµV			50 dBµV		M
40 dBuy	en de de la constante a constante de la constante	the model and the state of the	40 dBµV	and also a mading the state in the state in the state is the	
30 dBµV			30 dBµV		
20 d8µV			20 dBµ <mark>y</mark>		
0 d8µ <mark>v</mark>			10 dBµV		
dBuy		F2	0 dBuV		F2
Start 4.45 GHz	10001 pts	Stop 5.205 GHz	Start 4.45 GHz	10001 pts	Stop 5.205 GH
- N.	Neasuring	(()() Measuring 🚺 🗰





Note.

1. No spurious emission were detected above 6 GHz.

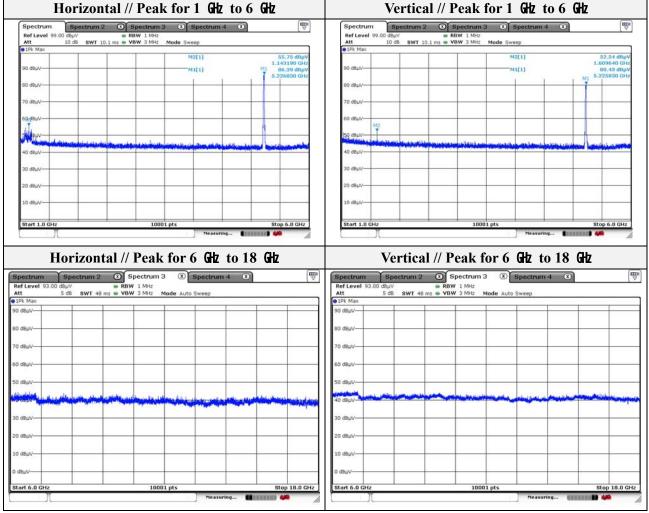


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Mode:	UNII-1_802.11a
Distance of measurement:	3 meter
Channel:	44

с ·

- Spurio	us							
Frequency (Mtz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1143.19	55.75	Peak	Н	-9.03	-	46.72	74.00	27.28
1609.64	52.54	Peak	V	-7.25	-	45.29	74.00	28.71



Note.

1. No spurious emission were detected above 6 GHz.



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DCF

(**dB**)

-

Field strength

 $(dB\mu V/m)$

46.36

46.04

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Limit

 $(dB\mu V/m)$

74.00

74.00

Margin

(**dB**)

27.64

27.96

Mode:	UNII-1_802.11a
Distance of measurement:	3 meter
Channel:	48

Spurious Level (dBµV) Detect mode Ant. Pol. (H/V) CF (dB) 1143.19 55.39 Peak H -9.03

V

Peak

- Band edge

52.40

1725.13

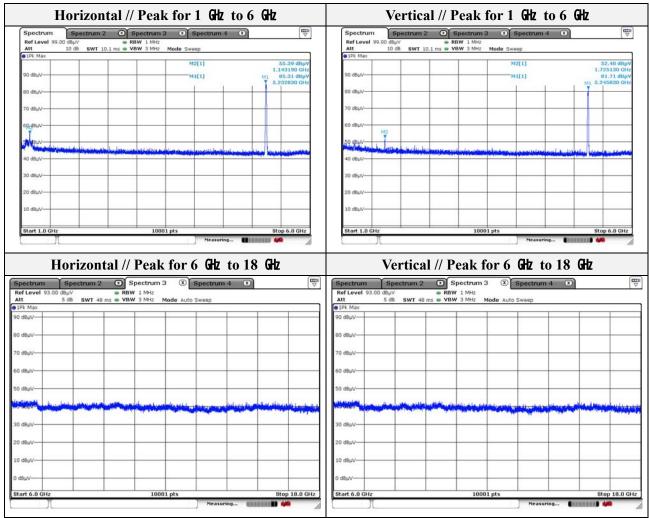
Frequency (Mz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
5420.53	43.80	Peak	Н	3.39	-	47.19	74.00	26.81
5425.52	42.90	Peak	V	3.37	-	46.27	74.00	27.73

-6.36

Restricted	band // Horizonta	l // Peak	Restr	cted band // Vertica	l // Peak
Spectrum 2	Spectrum 3 Spectrum 4	E (x)	Spectrum Spectrum	2 Spectrum 3 Spectrum	m 4 🗷 🕅
Ref Level 100.00 dBµV Att 10 dB SWT 32.1	RBW 1 MHz FFT BW 3 MHz Mode Auto FFT		Ref Level 100.00 dBµV Att 10 dB SW1	RBW 1 MHz 32.1 us VBW 3 MHz Mode Auto FFT	
• 1Pk Max			• 1Pk Max		2 Per 112
	M1[1]	43.80 d8pV 5.4205340 GHz		M1[1]	42.90 d8µ\ 5.4255240 GH
90 dBuV			90 dBuV-		
ми 80 ¢8µV			Лосович-		
70 d8µV			70 dBµV		
60 day			60 dbuV		
50 dBuv		(M)	50 dBUV		
40 daur minhammen	mound many many	montherman	40 dBur Manny Manner	and an and the second	marinoman
30 d8µV			30 d8µV		
20 dBµV			20 dBµV		
10 dBµV		FZ	10 dBµV		FZ
Start 5.24 GHz	F1 10001 pts	Stop 5.47 GHz	Start 5.24 GHz	F1 10001 pts	Stop 5.47 GHz
	Measurin	9 🚺 X X X X X X X X X X X X X X X X X X		Meas	uring 🚺 🗰 🗰



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Note.

1. No spurious emission were detected above 6 GHz.



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Mode:	UNII-1_802.11n(HT20)
Distance of measurement:	3 meter
Channel:	36

- Spurious

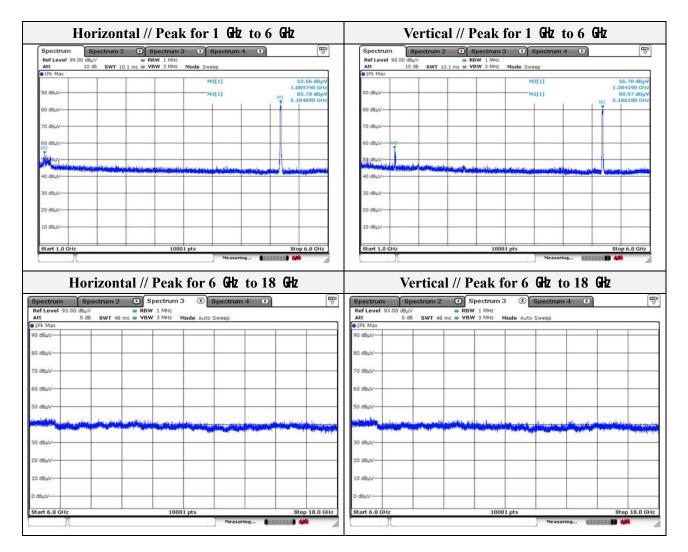
Frequency (MHz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1089.74	53.56	Peak	Н	-9.19	-	44.37	74.00	29.63
1584.19	56.70	Peak	V	-7.45	-	49.25	74.00	24.75

Band edge

Frequency (Mtz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
5135.96	45.02	Peak	Н	3.26	-	48.28	74.00	25.72
5118.52	45.84	Peak	V	3.25	-	49.09	74.00	24.91

Spectrum Ref Level 97.0 Att		Spectrum RBW 1 MHz SN 3 MHz			Spectrum Spectr Ref Level 97.00 dBµV Att 10 dB S	um 2 Spectrum 3 Spect RBW 1 MH2 WT 10.1 ms VBW 3 MH2 Mode Sweep	trum 4 🛞 🕎
1Pk Max	10 00 341 10	TA HIS W FOR STATE	Hude Sweep		e 1Pk Max	WI TOT INS . FOR STARL HOUR SWEEP	
90 dBµV			M1[1]	45.02 dBµV 5.1359580 GHz	90 d8µV	M1[1]	45.84 d8µ 5.1185230 GH
80 dBµ <mark>V</mark>				M	80 dBµV		
70 dBµV					70 dBµV		
50 dBuV					50 dBuV		
40 dBuy	lagente parterierten			- The second		,	and the state of the second
30 d8µV	_				30 d8µV		
20 dBµV					20 dBµV		
10 dBµV				F2	10 dBµV		F2
D dBLIV					0 dBµv		





Note.

1. No spurious emission were detected above 6 GHz.



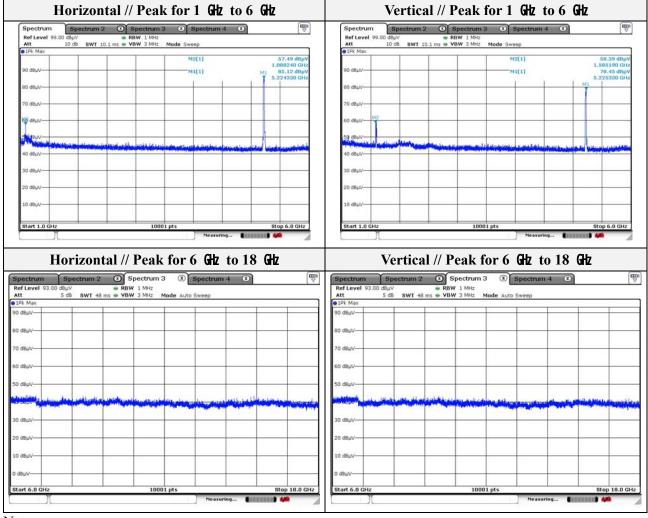
3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea Tel: +82-31-425-6200 / Fax: +82-31-424-0450 www.kes.co.kr

Report No .: KES-RF1-20T0205 Page (25) of (43)

Mode:	UNII-1_802.11n(HT20)
Distance of measurement:	3 meter
Channel:	44

Channel:

- Spurio	ous							
Frequency (MHZ)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV /m)	Margin (dB)
1088.24	57.49	Peak	Н	-9.19	-	48.30	74.00	25.70
1585.19	58.39	Peak	V	-7.44	-	50.95	74.00	23.05



Note.

1. No spurious emission were detected above 6 GHz.



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Mode:	UNII-1_802.11n(HT20)
Distance of measurement:	3 meter
Channel:	48

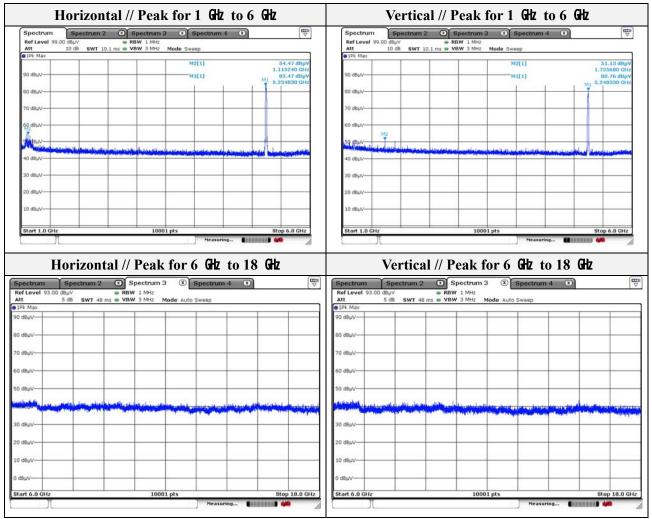
- Spurio	us							
Frequency (Mtz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV /m)	Margin (dB)
1115.24	54.47	Peak	Н	-9.11	-	45.36	74.00	28.64
1725.68	51.13	Peak	V	-6.36	-	44.77	74.00	29.23

- Band edge

Frequency (Mz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµ V/m)	Margin (dB)
5384.13	43.79	Peak	Н	3.46	-	47.25	74.00	26.75
5355.36	44.15	Peak	V	3.43	-	47.58	74.00	26.42

Spectrum	Spectrum 2	Spectrum	3 🗴 Spectrum 4	∞ 🖾	Spectrum Spec	trum 2 Spectrum 3	Spectrum 4	∞ 5
Ref Level 10		RBW 1 MH			Ref Level 100.00 dBpV	RBW 1 MHz		<u> </u>
Att 1Pk Max	10 dB SWT 3	2.1 µs 💭 VBW 3 MH	Mode Auto FFT		Att 10 dB	SWT 32.1 µs 🖶 VBW 3 MHz	Mode Auto FFT	
			M1[1]	43.79 dBµV 5.3841290 GHz			M1[1]	44,15 dBµ 5,3553580 GH
90 dBµV					90 dBµV			
BO BUV								
70 dBµV					70 dBµV			
60 dBuV					60 d8µV			
50 dBuV	_				50 dBUV-			
40 dBUN	Managhanad	mananthan	manning	mmmmmmmm	40 dBuy	growth more want	mono	montenant
30 d8µV					30 d8µV			
20 dBµV					20 dBhA			
10 dBµV				F2	10 dBµV			F2
		F				F1		Ĩ
Start 5.24 GH	2	100	001 pts	Stop 5.47 GHz	Start 5.24 GHz	10001	pts	Stop 5.47 GHz





Note.

1. No spurious emission were detected above 6 GHz.



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Mode:	UNII-1_802.11n(HT40)
Distance of measurement:	3 meter
Channel:	38

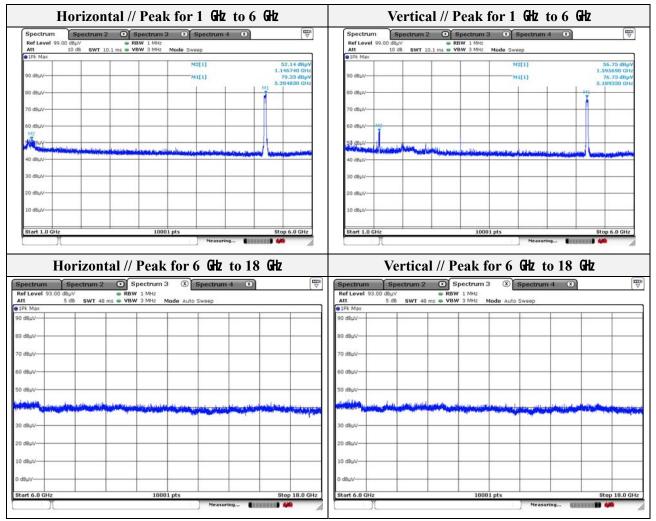
- Spurio	us							
Frequency (Mtz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV /m)	Margin (dB)
1146.74	52.14	Peak	Н	-9.02	-	43.12	74.00	30.88
1595.69	56.75	Peak	V	-7.36	-	49.39	74.00	24.61

- Band edge

Frequency (Mz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
5149.70	46.06	Peak	Н	3.26	-	49.32	74.00	24.68
5141.85	44.61	Peak	V	3.26	-	47.87	74.00	26.13

Spectrum	Spectrum 2 🗵	Spectrum 3 🛛 🔊	Spectrum 4 🛞		Spectrum	pectrum 2 🗵 Spect	rum 3 🛞 Spectrum 4	×
Ref Level 97.0		RBW 1 MHz VBW 3 MHz Mode 5			Ref Level 97.00 d8µ			
1Pk Max	10 GB SWT 10.1 ms	WEW 3 MHZ Mode 5	weep		10 c	35 SWT 10,1 ms - VBW 3	MHZ Mode Sweep	
90 dBµV			M1[1]	46.06 dBµV 5.1496980 GHz	90 dBµV-		M1[1]	44.61 dBp 5.1418510 GH
80 dBµV				MP	80 dBµV			
70 dBµV	_				70 dBµV			
60 dBuV					60 dBuV			
50 dBuV	-	Second de la Seconda de la site a sec	and the second second	and the second second	50 dBuy	and an an an and and	and a second second second second	Manual Contraction of the
40 dBµV					40 dBµV			
30 d8µV					30 d8µV			
20 dBµV					20 dBµV			
10 dBµV				F2	10 dBµV			F2
0 dBuy					0 dBuy			





Note.

1. No spurious emission were detected above 6 GHz.



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Mode:	UNII-1_802.11n(HT40)
Distance of measurement:	3 meter
Channel:	46

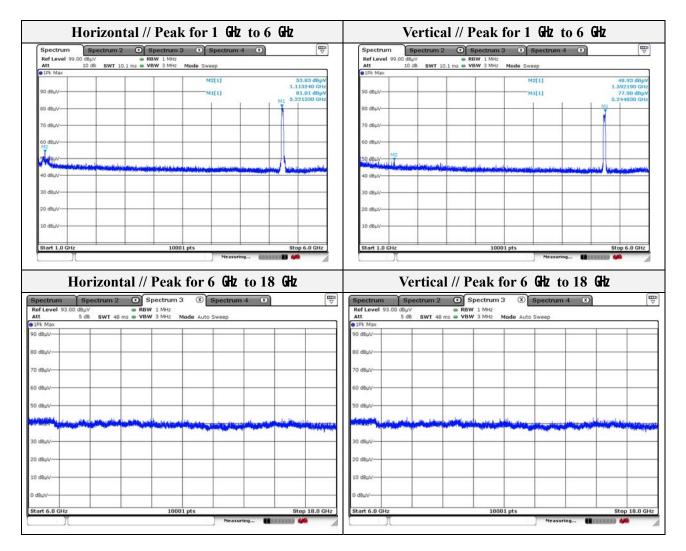
- Spurio	us							
Frequency (Mtz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV /m)	Margin (dB)
1113.24	53.83	Peak	Н	-9.12	-	44.71	74.00	29.29
1592.19	48.93	Peak	V	-7.39	-	41.54	74.00	32.46

- Band edge

Danu C	uge							
Frequency (MHz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV /m)	Margin (dB)
5364.51	43.91	Peak	Н	3.44	-	47.35	74.00	26.65
5420.08	44.38	Peak	V	3.39	-	47.77	74.00	26.23

Spectrum	Spectrum 2	Sp(ectrum 3		Spectrum 4	×			Spectru	m Sp	ectrum 2	O Sr	ectrum 3		Spectrum	4 🗶		1
Ref Level 100.			1 MHz					<u> </u>		100.00 dBu			W 1 MHz					
Att 1Pk Max	10 dB SWT 3	12:1 µs 🖷 VBV	V 3 MH2	Mode Aut	0 FFT				Att	10 di	8 SWT 32	.1 µs 🖷 VB	W 3 MHz	Mode Au	to FFT			
				M	1[1]		43.91	dBµV 20 GHz						M	1[1]			.38 dBµ 7870 GH
90 dBµV	_			$ \rightarrow$					90 dBµV-									-
80 dBuV									80 dBuV-									
N									m									
70 dBµV	_						-		70 dBµV-	-								-
				L												(L		
60 deuv									eo deuv-									
50 dB	_								50 dBUV-									
50 dBdVVV	1.			M1					MW		1.1.1					MI	al and a	
40 dBµV	"Your and a second	- marine	moniters	whome	- marken with	manutation	Aurona	10mm	40 dBµV-	muny	manne	mound	theman	maph Mins	water	man	mondan	- Andre
30 dBuV									30 dBuV									
30 0600									30 dbpv-									
20 dBuV	_		-						20 dBµV-						-			-
1999 1997 1997 1997 1997 1997 1997 1997				(- 1							i		
10 dBµV					2			F2	10 dBµV-						1			F2
			F1	1 1									FI			i		





Note.

1. No spurious emission were detected above 6 GHz.



Report No.: KES-RF1-20T0205 Page (32) of (43)

Mode:	UNII-1_802.11ac(VHT20)
Distance of measurement:	3 meter
Channel:	36

- Spurious

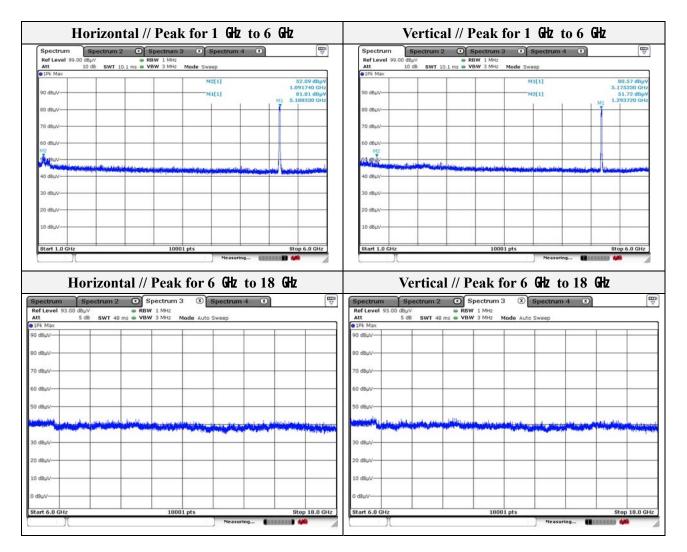
Frequency (Mtz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1091.74	52.09	Peak	Н	-9.18	-	42.91	74.00	31.09
1293.72	51.72	Peak	V	-8.64	-	43.08	74.00	30.92

Band edge

Frequenc (Mtz)	y Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
5139.88	45.16	Peak	Н	3.26	-	48.42	74.00	25.58
5118.97	45.68	Peak	V	3.25	-	48.93	74.00	25.07

Spectrum Ref Level 97.0 Att		Spectrum 3 RBW 1 MHz ms • VBW 3 MHz				Spectrum 2 Spectrum 2 dBµV ■ RBW 10 dB SWT 10.1 ms VBW	1 MHz	8
90 dBuV			M1[1]	45.16 dBµV 5.1398840 GHz	90 dBµV		M1[1]	45.68 dBp 5.1189730 GH
оо авру 70 dBµV					70 d8µV			M
60 dBuV					60 dBuV			
40 dBuV	an a		autom maran ilandar klasika manta daida	-	40 dBµV	unite house part and all and an and a loss		and the second
30 dBµV					30 dBµV			
20 dBuV					20 dBµV			
0 dBµV				F2	0 dBuy			F2





Note.

1. No spurious emission were detected above 6 GHz.



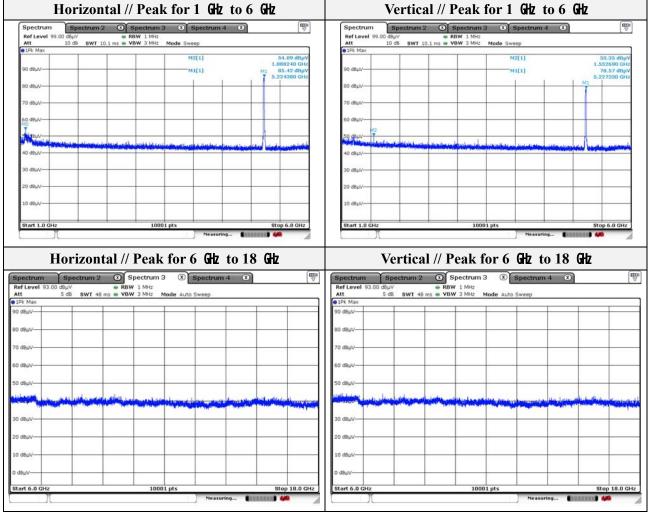
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Report No .: KES-RF1-20T0205 Page (34) of (43)

Mode:	UNII-1_802.11ac(VHT20)
Distance of measurement:	3 meter
Channel:	44

Channel:

<u>- Spurio</u>	us							
Frequency (Mtz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV /m)	Margin (dB)
1088.24	54.09	Peak	Н	-9.19	-	44.90	74.00	29.10
1552.69	50.35	Peak	V	-7.71	-	42.64	74.00	31.36



Note.

1. No spurious emission were detected above 6 GHz.



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Mode:	UNII-1_802.11ac(VHT20)
Distance of measurement:	3 meter
Channel:	48

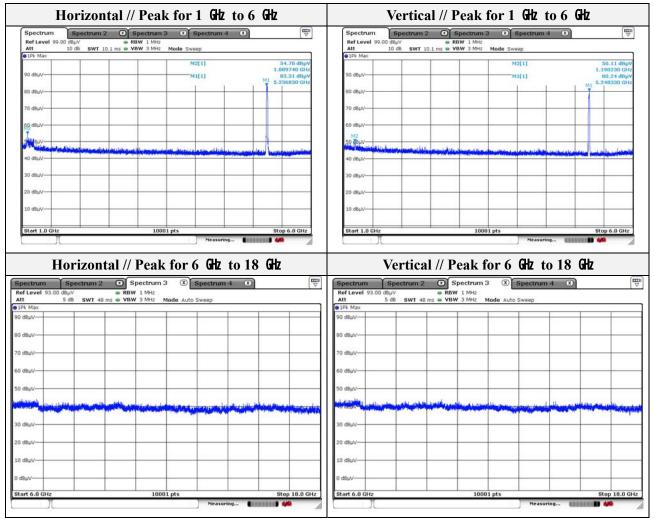
- Spurio	us							
Frequency (Mtz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV /m)	Margin (dB)
1089.74	54.70	Peak	Н	-9.19	-	45.51	74.00	28.49
1190.23	50.11	Peak	V	-8.90	-	41.21	74.00	32.79

- Band edge

Frequency (Mz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
5354.88	43.97	Peak	Н	3.43	-	47.40	74.00	26.60
5371.18	43.65	Peak	V	3.45	-	47.10	74.00	26.90

	dBuY			m 4 🛞		Spectrum	Spectrum 2	Spectrum 3	Spectrum 4	() () () () () () () () () () () () () (
		RBW 1 MHz				Ref Level 10		RBW 1 MHz		
IPk Max	10 dB SWT 32.1 ;	us 🖝 VBW 3 MH2	Mode Auto FFT			Att Pk Max	10 dB SWT 32.1 µ	s 🖝 VBW 3 MHz	Mode Auto FFT	
			M1[1]		43.97 dB	IV			M1[1]	43.65 dBp 5.3711810 GH
90 dBµV		_		1 1		90 dBµV				
водвил				_		80.d8uV				
70 dBµV						70 dBuV-				
60 dBuV-	_			-		60 dBuV				i i
50 dBuV						50 dBµV				
40 dBuy	monorm	manner	Manasana	mon	man	40 deu Man	mannahan	manymy	manne	ngmannamprann
30 d8µV						30 d8µV	2012 - 10 Contra - 10			
20 dBµV						20 dBµV-				
10 dBuV						10 dBuV				
TO ODHA				1	F2	10 GBHA		51		F2





Note.

1. No spurious emission were detected above 6 GHz.



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Report No.: KES-RF1-20T0205 Page (37) of (43)

Mode:	UNII-1_802.11ac(VHT40)
Distance of measurement:	3 meter
Channel:	38

- Spurious

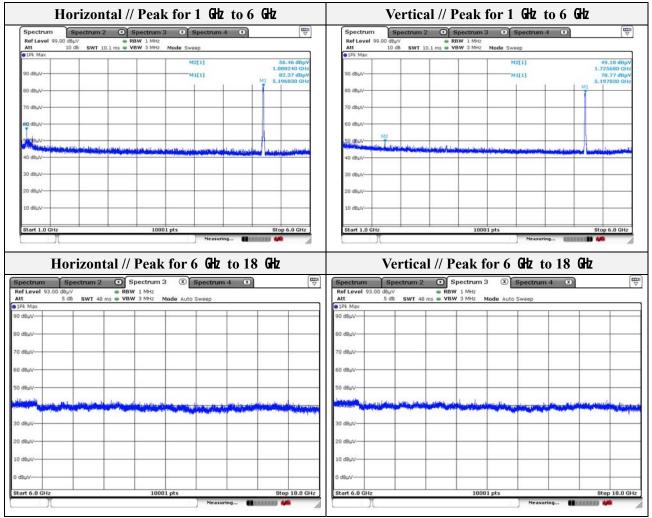
Frequency (MHz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµN/m)	Margin (dB)
1088.24	56.46	Peak	Н	-9.19	-	47.27	74.00	26.73
1725.68	49.18	Peak	V	-6.36	-	42.82	74.00	31.18

- Band edge

Frequency (Mz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
5140.11	44.67	Peak	Н	3.26	-	47.93	74.00	26.07
5004.15	46.24	Peak	V	3.22	-	49.46	74.00	24.54

Spectrum	Spectrum 2	Spectrum 3	Spectrum 4 X		Spectrum Spectrum	2 Spectrum 3	Spectrum 4 🛞	
Ref Level 97.0		RBW 1 MHz ms VBW 3 MHz			Ref Level 97.00 d8µV Att 10 d8 swT	RBW 1 MHz 10.1 ms VBW 3 MHz Mode		
1Pk Max	10 08 SWT 10.1	ms 🖷 YBW 3 MH2	Mode Sweep		10 db SWT	10.1 ms WBW 3 MHZ Mode	Sweep	
90 dBµV			M1[1]	44.67 dBµV 5.1401100 GHz	90 dBu/v		M1[1]	46.24 dBp 5.0041490 GH
80 dBµV					80 dBµV			
70 dBµV					70 dBµV			
60 dBµV					60 dBuV			
50 dBuy	بالمنابعة مندما	N Standing of the second	فالانجذائ مالحينان المتعادية	and an and a second	50 dBuy	en as deserts at dillana porta	any cine and indicates of	minund
30 d8µV					30 d8µV			
20 dBµV					20 dBuV			
10 dBµV				F2	10 dBµV			F2
0 dBuy	_				0 dBuy			





Note.

- 1. No spurious emission were detected above 6 GHz.
- 2. Average test would be performed if the peak result were greater than the average limit.



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Mode:	UNII-1_802.11ac(VHT40)
Distance of measurement:	3 meter
Channel:	46

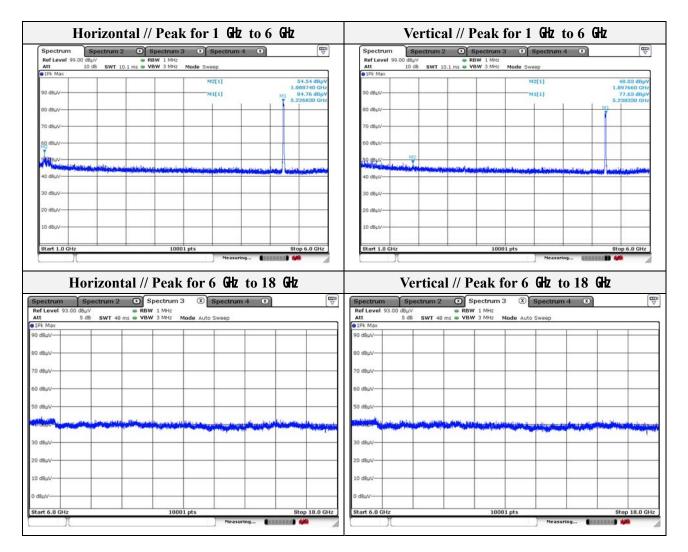
- Spurio	- Spurious											
Frequency (Mtz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV /m)	Margin (dB)				
1088.74	54.54	Peak	Н	-9.19	-	45.35	74.00	28.65				
1897.66	48.03	Peak	V	-5.04	-	42.99	74.00	31.01				

- Band edge

Frequency (Mz)	Level (dBµV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
5396.87	43.29	Peak	Н	3.47	-	46.76	74.00	27.24
5351.79	43.19	Peak	V	3.43	-	46.62	74.00	27.38

Spectrum	Spectrum 2	Spe Spe	ctrum 3	× Sp	ectrum 4	×			Spectru	m Sp	ectrum 2	Sp Sp	ectrum 3		Spectrum -	4 🗵		1	-
Ref Level 100		· RBW						-		100.00 dBµ			W 1 MHz						-
Att 1Pk Max	10 dB SWT 3	2.1 µs 🖷 VBW	3 MHz I	Mode Auto i	FT			_	Att Pk Max	10 d	8 SWT 32	1 µs 🖷 VB	W 3 MHz	Mode Au	to FFT				_
APR INSA				M1[]	1	5.	43.29 dB 3968690 0		APA max					N	1[1]		43. 5.3517	.19 dB	
90 dBµV-					-			_	90 dBµV-									-	-
80 dBµV								_	80 dBµV									+	_
70 dBµV							-	_	70 d8µV-									+	_
50 dBµV			_					-	60 dBuV-									+	-
SP dBUV				-	M1				to deuv-				013					+	_
HO dBUT	emphaneuropena	Marsonap	-Marriel	human	montan	polynynynn	warmon the	when	40 dBuV	mann	mound	mm	mont	manuf	man	horan	month	Method	m
30 dBµV					-	-	-	-	30 dBuV			-			-			+	-
o dahn					-			-	20 dBuV-								-+	+	-
10 dBµV	_						F2	-	10 dBµV									F2	-





Note.

1. No spurious emission were detected above 6 GHz.



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Test results (18 GHz to 40	GHz) – Worst case			
Mode:	802.11a			
Distance of measurement:	3 meter			
Channel:	36 (Worst case)			

Horizontal	Vertical						
Spectrum Spectrum 2 Spectrum 3 Spectrum 4 Imm Ref Level 80.00 dBµV # R8W 1 MHz Imm Imm	Spectrum Spectrum 2 Spectrum 3 Spectrum 4 Imm Ref Level 80.00 dBµV RBW 1 MHz RBW 1 MHz Imm Imm						
70 dBuV	70 deuv- 60 deuv- 50 deuv- 30 deuv- 30 deuv-						
20 dBuV	20 dbµv						
0 dBuV	0 dBuV						
CF 12.0 GHz 691 pts Span 12.0 GHz	CF 12.0 GHz 691 pts Span 12.0 GHz						

Note.

No spurious emission were detected above 18 GHz.



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Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV30	101389	1 year	2021.01.15
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2021.01.15
DC Power Supply	Agilent	6632B	US36351824	1 year	2021.01.14
Power Meter	Anritsu	ML2495A	1438001	1 year	2021.01.14
Pulse Power Sensor	Anritsu	MA2411B	1339205	1 year	2021.01.14
Attenuator	KEYSIGHT	8493C	82506	1 year	2021.01.14
Loop Antenna	Schwarzbeck	FMZB1513	225	2 years	2021.02.15
Trilog-broadband antenna	SCHWARZBECK	VULB 9163	715	2 years	2020.11.29
Horn Antenna	A.H	SAS-571	414	2 years	2021.02.11
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA 9170550	2 years	2021.02.19
Preamplifier	R&S	SCU01	100603	1 year	2020.11.25
Preamplifier	AGILENT	8449B	3008A01742	1 year	2021.01.02
EMI Test Receiver	R&S	ESU26	100551	1 year	2021.04.01
EMI TEST RECEIVER	R & S	ESR3	101781	1 year	2021.01.10
PULSE LIMITER	R & S	ESH3-Z2	101915	1 year	2021.01.02

Appendix A. Measurement equipment

Peripheral devices

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