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Test report No.: KES-RF-19T0112-R1 Page (1) of (44)

TEST REPORT

Part 15 Subpart E 15.407

Equipment under test Shift RED Drone

Model name SHIFT Drone1

FCC ID 2AR74-SFD1D

Applicant this is engineering Inc.

Manufacturer this is engineering Inc.

Date of test(s) 2019.08.12 ~ 2019.08.30

Date of issue 2019.08.30

Issued to

this is engineering Inc.

352, Daewangpangyo-ro 815, Sujeong-gu, Seongnam-si, Gyeonggi-do, Republic of Korea, Tel: +82-31-5182-9056 / Fax: +82-31-5182-9057

Issued by

KES Co., Ltd.

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

Test and report completed by :	Report approval by :
Jog	
Jun-Su Jeong	Hyeon-Su, Jang
Test engineer	Technical manager

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Revision history

Revision	Date of issue	Test report No.	Description
-	2019.08.23	KES-RF-19T0112	Initial
R1	2019.080	KES-RF-19T0112-R1	Add Occupied Bandwidth and Frequency stability test



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1. General	information
Applicant:	this is engineering Inc.
Applicant address:	352, Daewangpangyo-ro 815, Sujeong-gu, Seongnam-si,
	Gyeonggi-do, Republic of Korea
Test site:	KES Co., Ltd.
Test site address:	3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si,
	Gyeonggi-do, 14057, Korea
	473-29, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea

	475-29, Gayeo-ro, 16	eoju-si, Gyeonggi-do, Korea	
Test Facility	FCC Accreditation D	Designation No.: KR0100, Registrat	tion No.: 444148
FCC rule part(s):	15.407		
FCC ID:	2AR74-SFD1D		
Test device serial No.:	Production	Pre-production	Engineering

1.1. EUT description

Equipment under test	Shift RED Drone		
Frequency range	2 402 MHz ~ 2 480 MHz (LE)		
	UNII-1 5 180 Mz ~ 5 240 Mz (11an_HT20/ac_VHT20)		
Model:	SHIFT Drone1		
Modulation technique	WIFI : DSSS, OFDM		
	BT(LE) : GFSK		
Number of channels	2 402 MHz ~ 2 480 MHz (LE) : 40 ch		
	5 180 MHz ~ 5 240 MHz (11an_HT20/ac_VHT20) : 4 ch		
Antenna specification	2.4 GHz Antenna type : FPCB antenna, Peak gain : 1.49 dBi		
	5 GHz Antenna type : FPCB antenna, Peak gain : 2.07 dBi		
Power source	DC 3.7 V (Internal Rechargeable Battery)		

1.2. Test configuration

The <u>this is engineering Inc. // SHIFT Drone1 // FCC ID: 2AR74-SFD1D</u> 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. Frequency/channel operations

UNII-1

Ch.	Frequency (Mz)	
36	5 180	
44	5 220	
48	5 240	

Table 1.4. 802.11n_HT20/ac_VHT20 mode

1.5. Maximum average output power

Refer to the average output power.

Note.

- 1. Radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.
- 2. Worst-case data rates as provided by the client were: UNII-1 an_HT20 : $\underline{MCS 0}$, ac_VHT20 : $\underline{MCS 0}$

1.6. Accessory information

N/A

1.7. Software and Firmware description

The software and firmware installed in the EUT is version 1.0

1.8. 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).

- UNII-1 : 1.73 + 10 = 11.73 (dB)

1.9 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 1 GHz	5.00 dB
Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.		

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2. Summary of	tests	
Reference	Parameter	Test results
15.407(a)	26 dB bandwidth & 99 % Occupied Bandwidth	Pass
15.407(a)	Maximum conducted output power	Pass
15.407(a)	Power spectral density	Pass
15.407(g)	Frequency stability	Pass
15.205 15.209	Radiated restricted band and emission	Pass
15.407(d)	General field strength limit (Restricted bands and radiated emission limit)	Pass



3. Test results

3.1. 26 dB bandwidth & 99% Occupied Bandwidth

Test procedure

KDB 789033 D02 v02r01- Section C.1

Test setup

EUT	Attenuator	 Spectrum analyzer
201	110001100001	

Test procedure

26 dB bandwidth

KDB 789033 D02 v02r01- Section C.1

- 1. Set RBW = approximately 1% of the emission bandwidth.
- 2. Set the VBW > RBW.
- 3. Detector = Peak.
- 4. Trace mode = max hold.
- 5. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

Limit

N/A

99 % bandwidth

KDB 789033 D02 v02r01- Section D

- 1. Set span = 1.5 times to 5.0 times the OBW.
- 2. Set RBW = 1% to 5% of the OBW
- 3. Set the VBW > 3 x RBW.
- 4. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak bandwidth function of the instrument (if available).
- 5. Use the 99% power bandwidth function of the instrument (if available).
- 6. If the instrument does not have a 99% power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

In the result,

-DFS requirements are not applicable in the 5 150 Mz ~ 5 250 Mz.



Test results

Band	Frequency(Mz)	Mode	26 dB bandwidth(Mz)	99% Occupied Bandwidth
	5 180		22.793	-
UNII-1	5 220	HT20	24.385	-
	5 240		24.168	18.017
	5 180		29.305	-
	5 220	VHT20	23.806	-
	5 240		25.326	18.017



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Test plots

26 dB bandwidth



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99% Occupied Bandwidth-5240 MHz



Date: 30.AUG.2019 17:48:50

Date: 30.AUG.2019 18:05:45



3.3. 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

EUT	 Attenuator	Power meter, Power sensor
		i i i i i i i i i i i i i i i i i i i

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 %).
- v. In case of band crossing channels 138, 142 and 144, the measurement is complied with section E.2.d of KDB 644545_D03 v01

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				
Band	EUT Category		Limit	
UNII-1	Outdoor access point			
	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 + $10\log B^*$	
UNII-2C			250 mW or 11 dBm + $10\log B^*$	
UNII-3			1 W (30 dBm)	

Note.

1. B is the 26 dB emission bandwidth.

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Band	mode	Frequency (Mz)	Detector mode	Output power(dBm)	Limit (dBm)	
UNII-1		5 180		-5.49		
	HT20	5 220	AX7	-4.51	24.00	
		5 240		-4.59		
		5 180	Av	-5.54	24.00	
	VHT20	5 220		-4.88		
		5 240		-4.65		

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3.4. Maximum Power spectral density Test procedure

KDB 789033 D02 v02r01 - Section F

Test setup



Section F

- Create an average power spectrum for the EUT operating mode being tested by following the instructions in section II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, "Compute power...." (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)
- 2. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
- 3. Make the following adjustments to the peak value of the spectrum, if applicable:
 - a) If Method SA-2 or SA-2 Alternative was used, add 10 log (1/x), where x is the duty cycle, to the peak of the spectrum.
 - b) If Method SA-3 Alternative was used and the linear mode was used in step II.E.2.g)(viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.
- 4. The result is the Maximum PSD over 1 Mz reference bandwidth.
- 5. For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the preceding procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, "provided that the measured power is integrated over the full reference bandwidth" to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 kHz</p>
 - a) Set RBW $\geq 1/T$, where T is defined in section II.B.1.a)
 - b) Set VBW \geq 3 RBW.
 - c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10 log (500 kHz/RBW) to the measured result, whereas RBW (< 500 kHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
 - d) If measurement bandwidth of Maximum PSD is specified in 1 Mb, add 10 log (1 Mb/RBW) to the measured result, whereas RBW (< 1 Mb) is the reduced resolution bandwidth of spectrum analyzer set during measurement.
 - e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Note.

As a practical matter, it is recommended to use reduced RBW of 100 kHz for the II.F.5.c) and II.F.5.d), since RBW=100 kHz is available on nearly all spectrum analyzers.

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Lillill			
Band	EUT Category		Limit
	Outdoor access point		
LINIII 1	Indoor access point		17 dBm/Młz
UNII-1		Fixed point-to-point access point	
	\checkmark	Mobile and portable client device	11 dBm/M₂
UNII-2A			11 dBm/Młz
UNII-2C			11 dBm/Młz
UNII-3			30 dBm/500 kHz

Test results

Band	mode	Frequency (Mz)	DCF Note1	RBWF Note2	Measured PSD (dBm/Mz) ^{Note3}	Limit (dBm/Mbz)
UNII-1 -	HT20	5 180	0.42	_	-15.90	11.00
		5 220			-15.45	
		5 240			-15.49	
		5 180	0.32	_	-15.73	
	VHT20	5 220			-15.44	
		5 240			-15.48	

Note.

- 1. Refer to the page 21 on this report.
- 2. UNII-1 = $10\log(1 \text{ MHz}/1 \text{ MHz})$
- 3. PSD(dBm) = RBWF + Duty correction factor (dB)



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Test plots



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3.5. Frequency Stability

Test procedure

ANSI C63.10-2013, clause 6.8.1

Test setup



- 1. The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
- 2. Turn the EUT on and couple its output to a spectrum analyzer.
- 3. Turn the EUT off and set the chamber to the highest temperature specified.
- 4. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency.
- 5. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
- 6. The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.
- 7. While maintaining a constant temperature inside the environmental chamber, turn the EUT on and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.

Limit

N/A



Test results

Mode:	UNII-1
Operating frequency:	5180 MHz

Test	Test	Temperatur	Maintaining	Measure	Frequency	Deviation
voltage	voltage	e	time	frequency	deviation	
(%)	(V)	(°C)	time	(MHz)	(Hz)	(70)
			Startup	5 179.968 847	-311 53	-0.000 601
100.0/		20	2 minutes	5 179.977 234	-227 66	-0.000 440
100 %		-30	5 minutes	5 179.980 047	-199 53	-0.000 385
			10 minutes	5 179.981 004	-189 96	-0.000 367
			Startup	5 179.975 969	-240 31	-0.000 464
100.%		20	2 minutes	5 179.980 368	-196 32	-0.000 379
100 %		-20	5 minutes	5 179.981 642	-183 58	-0.000 354
			10 minutes	5 179.981 931	-180 69	-0.000 349
			Startup	5 179.982 648	-173 52	-0.000 335
100.0/		10	2 minutes	5 179.983 234	-167 66	-0.000 324
100 %		-10	5 minutes	5 179.982 597	-174 03	-0.000 336
			10 minutes	5 179.982 033	-179 67	-0.000 347
			Startup	5 179.983 046	-169 54	-0.000 327
100.04		0	2 minutes	5 179.978 299	-217 01	-0.000 419
100 %		0	5 minutes	5 179.976 331	-236 69	-0.000 457
			10 minutes	5 179.975 231	-247 69	-0.000 478
		10	Startup	5 179.972 438	-275 62	-0.000 532
100.04			2 minutes	5 179.969 544	-304 56	-0.000 588
100 %			5 minutes	5 179.967 937	-320 63	-0.000 619
	DC 27		10 minutes	5 179.967 214	-327 86	-0.000 633
	DC 5.7		Startup	5 179.964 869	-351 31	-0.000 678
100.04		20	2 minutes	5 179.962 091	-379 09	-0.000 732
100 %		20	5 minutes	5 179.960 344	-396 56	-0.000 766
			10 minutes	5 179.959 428	-405 72	-0.000 783
			Startup	5 179.957 012	-429 88	-0.000 830
100.%		24.4	2 minutes	5 179.953 785	-462 15	-0.000 892
100 %		24.4	5 minutes	5 179.953 250	-467 50	-0.000 903
			10 minutes	5 179.953 698	-463 02	-0.000 894
			Startup	5 179.955 405	-445 95	-0.000 861
100.%		30	2 minutes	5 179.955 839	-441 61	-0.000 853
100 %		50	5 minutes	5 179.955 969	-440 31	-0.000 850
			10 minutes	5 179.955 796	-442 04	-0.000 853
			Startup	5 179.954 031	-459 69	-0.000 887
100.0/		40	2 minutes	5 179.954 089	-459 11	-0.000 886
100 %		40	5 minutes	5 179.955 088	-449 12	-0.000 867
]		10 minutes	5 179.956 014	-439 86	-0.000 849
			Startup	5 179.954 943	-450 57	-0.000 870
100.%		50	2 minutes	5 179.962 208	-377 92	-0.000 730
100 %		50	5 minutes	5 179.964 914	-350 86	-0.000 677
			10 minutes	5 179.967 611	-323 89	-0.000 625

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Test voltage (%)	Test voltage (V)	Temperatur e (°C)	Maintaining time	Measure frequency (\\\\)	Frequency deviation (Hz)	Deviation (%)
		24.4	Startup	5 179.956 888	-431 12	-0.000 832
95 0/	DC 3.145		2 minutes	5 179.953 323	-466 77	-0.000 901
83 %			5 minutes	5 179.953 111	-468 89	-0.000 905
			10 minutes	5 179.953 088	-469 12	-0.000 906
		24.4	Startup	5 179.957 121	-428 79	-0.000 828
115 %	DC 4 255		2 minutes	5 179.954 091	-459 09	-0.000 886
	DC 4.255		5 minutes	5 179.954 018	-459 82	-0.000 888
			10 minutes	5 179.954 095	-459 05	-0.000 886



3.6. 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 klz to 30 Mlz Emissions.



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





The diagram below shows the test setup that is utilized to make the measurements for emission from 1 $\mathbb{G}\mathbb{Z}$ to the tenth harmonic of the highest fundamental frequency or to 40 $\mathbb{G}\mathbb{Z}$ 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 Mbz

- 1. Spectrum analyzer settings for f < 1 GHz:
 - (1) Span = wide enough to fully capture the emission being measured
 - ② RBW = 120 kHz
 - (3) VBW \geq RBW
 - ④ Detector = quasi peak
 - \bigcirc Sweep time = auto
 - 6 Trace = max hold
- 2. Spectrum analyzer settings for $f \ge 1$ GHz: Peak
 - 1 Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
 - 2 $\mathbf{RBW} = 1$ Mbz
 - ③ VBW = 3 MHz (\geq 3 x RBW)
 - (4) Detector = peak
 - (5) Sweep time = auto
 - \bigcirc Trace = max hold
 - \bigcirc Trace was allowed to stabilize

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- 3. Spectrum analyzer settings for $f \ge 1$ GHz: Average
 - ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
 - 2 RBW = 1 Mz
 - ③ VBW \ge 3 × 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
 - \bigcirc 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. The loop antenna was investigated with three polarizations, and horizontal and vertical polarizations were reported as the worst case.
- 2. f < 30 Mz, extrapolation factor of 40 dB/decade of distance. $F_d = 40\log(D_m/Ds)$

 $f \ge 30$ Mz, extrapolation factor of 20 dB/decade of distance. $F_d = 20\log(D_m/Ds)$ 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($dB\mu N/m$) = Level($dB\mu N$) + 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.
- 7. 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>.
- 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 Mz. 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.

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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 (Mz)	Distance (Meters)	Radiated (µV/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 $54 \sim 72$ Mb, $76 \sim 88$ Mb, $174 \sim 216$ Mb or $470 \sim 806$ Mb. 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 Mz.

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 Mz.

(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.



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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.

For the band 5.15-5.25 GHz

Test mode	T _{on} time (ms)	Period (ms)	Duty cycle (Linear)	Duty cycle (%)	Duty cycle correction factor (dB)
802.11an_HT20	1.289 9	1.420 3	0.908 2	90.82	0.42
802.11ac_VHT20	1.318 8	1.420 3	0.928 5	92.85	0.32

Note:

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

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





Test results	(Below 30 Mz)) – Worst c	ase		
Mode:		UNII-1 H	Т20		
Distance of measurement:		3 meter			
Channel:		44 (Worst	case)		
Frequency	Level	Ant. Pol.	CF	Distance factor	1

Frequency (MHz)	Level (dBµN)	Ant. Pol. (H/V)	CF (dB)	Distance factor (dB)	Field strength (dBµN/m)	Limit (dBµV/m)	Margin (dB)
0.196	35.70	Н	19.20	- 80.00	-25.10	21.70	46.80
0.684	27.00	Н	20.30	- 40.00	7.30	30.90	23.60
1.471	26.00	Н	19.90	-40.00	5.90	24.30	18.40
0.189	33.70	V	19.20	-80.00	-27.10	22.10	49.20
0.684	26.70	V	20.30	-40.00	7.00	30.90	23.90
1.501	25.20	V	19.80	-40.00	5.00	24.10	19.10



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-19T0112-R1 Page (26) of (44)





Mode	e:		UNII	-1 HT20						
Dista	nce of meas	ureme	nt: 3 me	ter						
Channel:			44 (V	Worst case)						
				Н	orizontal // V	/ertical				
KES SAC #4	l(10 m)				< <d (30="" -="" 000)="" 1="" mhz="" re<="" th=""><th>TEST>></th><th></th><th></th><th>KES D-SAC</th><th>#4(10 m)</th></d>	TEST>>			KES D-SAC	#4(10 m)
Mo Op Po Rei	del . Mode erator wer mark1 [dB(uV/m)]	: SHIFT Drone : UNII-1 HT20 : KES : DC 3.7 V : 5220 MHz	1		Standar Ant.Fact	d : FCC Part or : 715(+6 d	.15 Class B 3 m B), KOLAS			
Level		50.00	10	0.00 Freque	July and the second stands	500.00	1000.00 [MHz]	FCC B MHz 3 m> Limit(5G_30MHz~1GHz> 9pett 9 8pett 9 8uspe X 8uspe	pP) um(V.PK) um(V.PK) cted Item(H) cted Item(V)	
No.	Frequency	(P)	Reading	c.f	Result PK	Limit QP	Margin QP	Height	Angle	Remark
1 2 3 4	[MHZ] 599.996 550.041 450.010 400.055	H H H H	[dB(uV)] 55.6 54.1 53.6 49.3	[dB(1/m)] -11.6 -13.4 -16.1 -16.7	[dB(uV/m)] 44.0 40.7 37.5 32.6	[dB(uV/m)] 46.0 46.0 46.0 46.0	[dB] 2.0 5.3 8.5 13.4	[cm] 100.0 100.0 200.0 200.0	[deg] 131.0 227.0 128.0 124.0	

30.7 34.0

37.3 38.9

33.4

33.8 29.0 25.0

46.0 46.0

46.0 46.0

46.0

46.0

46.0

46.0

100.0 200.0

100.0

100.0

100.0

100.0 100.0

100.0

15.3 12.0

8.7

7.1

12.6

12.2 17.0

21.0

111.0

120.0

143.0

310.0

182.0

214.0

139.0

128.0

Test results (Below 1 000 M₂) – Worst case

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349.979 499.965

599.996

550.041

499.965

450.010 400.055

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48.3 48.4

48.9 52.3 47.8

49.9 45.7

42.6

-17.6

-14.4

-11.6

-13.4

-14.4

-16.1 -16.7

-17.6



Test results (Above 1 000 Mz)

Mode:	UNII-1 (an_HT20)
Distance of measurement:	3 meter
Channel:	36

- Spurio	us							
Frequency (Mz)	Level (dBµN)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµN/m)	Limit (dBµN/m)	Margin (dB)
1 799.60	52.33	Peak	Н	-2.82	-	49.51	68.20	18.69
2 429.09	56.41	Peak	Н	-0.05	-	56.36	68.20	11.84
1 799.60	37.16	Average	Н	-2.82	0.42	34.76	58.20	23.44
1 199.00	54.17	Peak	V	-7.52	-	46.65	74.00	27.35
1 799.60	51.44	Peak	V	-2.82	-	48.62	68.20	19.58
2 117.90	55.87	Peak	V	-0.69	-	55.18	68.20	13.02
2 429.10	55.28	Peak	V	-0.05	-	55.23	68.20	12.97
1 141.10	36.86	Average	V	-7.84	0.42	29.44	54.00	24.56
2 125.20	36.00	Average	V	-0.67	0.42	35.75	58.20	22.45

Frequency (Maz)	Level (dBµN)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµV/m)	Limit (dBµN/m)	Margin (dB)
5 150.00	49.41	Peak	Н	8.22	-	57.63	74.00	16.37
5 150.00	37.19	Average	Н	8.22	0.42	45.83	54.00	8.17
5 144.80	52.20	Peak	V	8.23	-	60.43	74.00	13.57
5 150.00	39.69	Average	V	8.22	0.42	48.33	54.00	5.67

Restricted band //	ak		Restricted	band //	Vertica	l // Peak		
Spectrum 2 Spectrum 3	Spectrum 4 (X)		Spectrum	Spectrum 2 🛛 🛞	Spectrum 3	Spectrun	n 4 🛛 🛪	
Ref Level 97.00 dBµV		(-)	Ref Level 97.00	o dBµV ● RE	W 1 MHz			(-)
Att 10 dB SWT 1 ms VBW 3 MHz M	ode Sweep		Att	10 dB SWT 1 ms 🖷 VI	W 3 MHz Mode	Sweep		
• 1Pk Max			Count 100/100					
	M2[1]	49.41 dBµV	The lugy			M9[1]	52.20	n dBuW
90 dBµV	M1[1]	43.79 dBdV	90 dBµV			(index)	5.1448	30 GH2
		4.50000 GHz				M1[1]	43.62	ε αθήν
80 dBµV			80 dBµV-				4.5000	JO GHZ
			70 dBµV					
70 dBµV								17
			60 dBµV				N	MS
60 dBµV			50 dBuV					1
		No.	M1	mon men man	monom	sam when we	manus marshall and a second of the	
50 dBµV		7	40 dBµV					
have been been been about the and the and the and the service of t	when enter who where we are shown	manauther	20 dp.4/					
40 dBµV			50 dbµv					
			20 dBµV					
30 dBµV			10 10 11					
			10 dBµV					F2
20 dBµV			0 dBµV F1					—
			Start 4.4 GHz		691 pts		Stop 5.19	9 GHz
10 dBµV			Marker					
		F2	Type Ref Tr	C X-value	Y-value	Function	Function Result	
0 dBµV F1			M2	1 4.5 GHz 1 5.15 GHz	51.79 dBµV			
Start 4.4 GHz 691	pts	Stop 5.19 GHz	M3	1 5.1448 GHz	52.20 dBµV			
	Measuring 🚺 🕌					Measuring	4,40	

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Restricted	d band // Horizontal // .	Average	Restricted band // Vertical // Average					
Spectrum Spectrum 2	Spectrum 3 Spectrum 4	X	Spectrum Spectru	um 2 🗴 Spectrum 3 🔿	Spectrum 4 🛛 🔊	(E)		
Ref Level 97.00 dBµV	RBW 1 MHz	(•)	Ref Level 97.00 dBµV	RBW 1 MHz		(*)		
Att 10 dB SWT 1 m	ms 🖷 VBW 3 MHz 🛛 Mode Sweep		Att 10 dB St SGL Count 100/100	WT 1 ms 🖶 VBW 3 MHz Mode Swe	зер			
●1Rm AvgPwr			1Rm AvgPwr					
_	M2[1]	37.17 dBµV			M2[1]	39.69 dBµV		
90 dBµV	M1[1]	5.15000 GHz 33.09 dBuV	90 dBµV		M1[1]	33.53 dBuV		
PD dB:A/		4.50000 GHz	en deux			4.50000 GHz		
90 GBHA			00 UBHV			Δ		
70 dBµV			70 dBµV					
60 dBµV			60 dBµV					
50 dBµV-			50 dBµV-					
40 dB:04			40 d9:44			Mg		
M1		1 T	M1					
30 dBµV	and the second	and man and a subserved and a subserved of the subserved	30 dBµV			warmen and		
20 dBµV			20 dBµV					
10 dBµV-			10 dBµV					
P doubt F1		F2	F1			P2		
Start 4 4 GHz	601 pts	Stop 5 19 GHz	Start 4 4 GHz	601 pts		Stop 5 19 CHz		
orare in and	Ready			051 pc	Ready			
Horizon	ntal // Peak for 1 🖽 to	o 6 GHz	Ver	tical // Peak for	1 GHz to 6 GHz	r E		
Horizon Spectrum Ref Level 97.00 dBµV	• RBW 1 MHz	o6 GHz 	Ver	tical // Peak for	1 GHz to 6 GHz			
Horizon Spectrum Ref Level 97.00 dBµV Att 10 dB swt 5 r	REAL // Peak for 1 GHz to	● 6 GHz	Spectrum Spectru Ref Level 97.00 dBµV Att 10 dB St	tical // Peak for m 2 (2) RBW 1 MHz vr 5 ms VBW 3 MHz Mode Aut	1 GHz to 6 GHz			
Ref Level 97.00 dBµV Att 10 dB swr 5 r	e RBW 1 MHz ms e VBW 3 MHz Mode Auto Sweep	6 GHz ♥ 84.15 dBµY	Spectrum Spectru Ref Level 97.00 dBµV Att 10 dB St 1Pk Max	tical // Peak for	1 GHz to 6 GHz	₩ 55.28 dBµV		
Spectrum Ref Level 97.00 dBµV Att 10 dB SWT 5 r 90 dBµV	RBW 1 MHz Node Auto Sweep	→ 6 GHz (♥) 84.15 dBµV 5.17870 GHz	Spectrum Spectru Ref Level 97.00 dBµV Att 10 dB St 91Pk Max 90 dBµV	RBW 1 MHz WT 5 ms VBW 3 MHz Mode Aut	Sweep	(₩ 55.28 dBµV 1 2.42910 GHz		
Spectrum Ref Level 97.00 dBµV Att 10 dB 90 dBµV 80 dBµV	RBW 1 MHz Node Auto Sweep	● 6 GHz (Spectrum Spectrum Ref Level 97.00 dBµV 10 dB w Att 10 dB w 90 dBµV 90 dBµV 80 dBµV 90 dBµV	tical // Peak for	1 GHz to 6 GHz	55.28 dBµV 55.28 dBµV 85.78 dBµV 5.17870 GHz		
Spectrum Swetzen Att 10 dB jV #1Pk Max 90 dB jV 90 dB jV 90 dB jV	RBW 1 MH2 ms = VBW 3 MH2 Mode Auto Sweep	→ 6 GHz (Spectrum Spectrum Ref Level 97.00 dBµV 10 dB st @10k Max 90 dBµV 80 dBµV 90 dBµV	tical // Peak for	1 GHz to 6 GHz	(∰) 55.28 dBµV М1 2.42910 GHz 85.78 dBµV 5.17870 GHz		
Spectrum Swetzen Ref Level 97.00 dBj/V dBj V Att 10 dB SWT 5 r 90 dBj/V 80 dBj/V 80 dBj/V 90 dBj/V 70 dBj/V 90 dBj/V	mtal // Peak for 1 Hz to	→ 6 GHz (₩) 84.15 dBµV 5.17870 GHz 5.233 dH₂V 1.79960 GHz	Spectrum Spectru Ref Level 97.00 dBµ/ Att 10 dB sv @10k Max 00 dBµ/ 400 dBµ/ 70 dBµ/ 70 dBµ/ 10 dB sv	RBW 1 MH2 WT 5 ms • VBW 3 MH2 Mode Aut	1 GHz to 6 GHz	(100) 55.28 dBµV 5.42910 GHz 85.78 dBµV 5.17870 GHz		
Spectrum Swetzevel Swetzevel <th< td=""><td>RBW 1 MHz ms WBW 3 MHz Mode Auto Sweep M1[1] M2[1]</td><td>→ 6 GHz (</td><td>Spectrum Spectrum Ref Level 97.00 dBµV 10 dB St 4tt 10 dB St 90 dBµV 90 dBµV 80 dBµV 90 dBµV 70 dBµV 90 dBµV 90 dBµV 90 dBµV</td><td>RBW 1 MHz WT 5 ms VBW 3 MHz Mode Aut</td><td>O Sweep M1[1]</td><td>55.28 dByV 5.242910 GHz 85.78 dByV 5.17870 GHz</td></th<>	RBW 1 MHz ms WBW 3 MHz Mode Auto Sweep M1[1] M2[1]	→ 6 GHz (Spectrum Spectrum Ref Level 97.00 dBµV 10 dB St 4tt 10 dB St 90 dBµV 90 dBµV 80 dBµV 90 dBµV 70 dBµV 90 dBµV 90 dBµV 90 dBµV	RBW 1 MHz WT 5 ms VBW 3 MHz Mode Aut	O Sweep M1[1]	55.28 dByV 5.242910 GHz 85.78 dByV 5.17870 GHz		
Spectrum Ref Level 97.00 dBµV Att 10 dB swr 5 r 90 dBµV 90 dBµV 90 dBµV 90 dBµV 70 dBµV 90 dBµV 60 dBµV 10 dB swr 5 r 60 dBµV 10 dB swr 5 r	RBW 1 MHz Mode Auto Sweep	→ 6 GHz (Spectrum Spectrum Ref Level 97.00 dBµV 10 dB sV Att 10 dB sV 90 dBµV 90 dBµV	RBW 1 MHz WT 5 ms VBW 3 MHz Mode Aut	MS[1] MI[1]	S5.28 dBµV 4.42910 GHz 85.78 dBµV 5.17870 GHz		
Horizoi Spectrum	ntal // Peak for 1 Hz to	→ 6 GHz (₩) 84.15 dBµV 5.17070 GHz 52.33 dBµV 1.79960 GHz	Spectrum Spectrum Ref Level 97.00 dBµV 10 dB v 4nt 10 dB v 90 dBµV 90 dBµV 90 dBµV 90 dBµV 90 dBµV 10 dB v	tical // Peak for	I CHz to 6 CHz o Sweep MS[1] MI[1]	Т 55.28 dBµV 2.42910 GH2 85.78 dBµV 5.17870 GH2 4 4 4 4 4 4 4 4 4 4 4 4 4		
Spectrum Swetzen Ref Level 97.00 dBµV 10 dB swrt 5 m 10 dB swrt 5 m 10 dB swrt 5 m 10 dB v 10 dB swrt 5 m	mtal // Peak for 1 Hz to	→ 6 GHz (₩) 84.15 dBµV M1 5.17070 GHz 1.79960 GHz	Spectrum Spectrum Ref Level 97.00 dBµ/ Att 10 dB sv 90 dBµ/ 10k Max 00 dBµ/ 10 dB sv 90 dBµ/ 10	RBW 1 MH2 WT 5 ms • VBW 3 MH2 Mode Aut	1 GHz to 6 GHz	(
Spectrum Bottom Ref Level 97.00 dBµV Att 10 dB SWT 5 r 90 dBµV 90 dBµV 90 dBµV 90 dBµV 40 dBµV 90 dBµV 42 90 dBµV 40	RBW 1 MHz ms WBW 3 MHz Mode Auto Sweep M1[1] M2[1]	→ 6 GHz (♥) 84.15 dBµV 5.17870 GHz 52.33 dBµV 1.79900 GHz 1.79900 GHz	Spectrum Spectrum Ref Level 97.00 dBµV 10 dB st 10 dB st 10 dB st 90 dBµV 90 dBµV	tical // Peak for	Sweep M1[1]	55.28 dByV 1.2.42910 GHz 95.78 dByV 5.17670 GHz 1.17670 GHz 1.17670 GHz 1.17670 GHz		
Spectrum Spectrum Ref Level 97.00 dBµV 10 dB SWT 5 r ●1Pk Max 90 dBµV 90 dBµV 40 dBµV 70 dBµV 40 dBµV 90 dBµV 40 dBµV	RBW 1 MHz ms • VBW 3 MHz Mode Auto Sweep M1[1] M2[1]	→ 6 GHz → 6 GHz → 6 GHz → 0 → 0 → 0 → 0 → 0 → 0 → 0 → 0	Spectrum Spectrum Ref Level 97.00 dBµV 10 dB sV Att 10 dB sV 90 dBµV 90 dBµV	RBW 1 MHz WT 5 ms VBW 3 MHz Mode Aut	MS[1] MS[1]	S5.28 dBµV 45.78 dBµV S.17870 GHz S.17870 GHz Jul		
Horizon Spectrum Spectrum Ref Level 97.00 dBµ/ Att 10 dB Swrt 5 r @ IPk Max 90 dBµ/ 90 dBµ/ 70 dBµ/ 50 dBµ/ 40 dBµ/ 30 dBµ/ 30 dBµ/ 20 dBµ/ 20 dBµ/ 10 dB 10 dB	Mal // Peak for 1 Hz to	→ 6 GHz (₩) 84.15 dBµV 5.17070 GHz 52.33 dBµV 1.79960 GHz +************************************	Spectrum Spectrum Ref Level 97.00 dBµV 10 dB av 0 10k Max 00 dBµV 90 dBµV 00 dBµV 10 dBµV 00 dBµV 10 dBµV 10 dBµV 10 dBµV 10 dBµV	tical // Peak for	I CHz to 6 CHz o Sweep MS[1] MI[1]	S5.28 dBµV 2.42910 GHz 85.78 dBµV 5.17870 GHz 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
Betrum Ref Level 97.00 dBµ/v Att 10 dB Swrt 5 m 90 dBµ/v - - - 90 dBµ/v - - - - 70 dBµ/v - - - - - 70 dBµ/v -	mtal // Peak for 1 Hz to	→ 6 GHz (₩) 84.15 dBµV M1 5.17070 GHz 1.79960 GHz 1.79960 GHz	Spectrum Spectrum Ref Level 97.00 dBµV 10 dB sv 10 dB sv 90 dBµV 90 dBµV 10 dBµV 90 dBµV 10 dBµV 90 dBµV 10 dBµV 90 dBµV 90 dBµV 90 dBµV 90 dBµV 90 dBµV 90 dBµV	tical // Peak for	1 GHz to 6 GHz	(TS 55.28 dBµV M1 2.42910 GHz 85.78 dBµV 5.17870 GHz 4 4 4 4 4 4 4 4 4 4 4 4 4		
Spectrum Sectrum Ref Level 97.00 dBµV dBµV Att 10 dB SWT 5 r ● 1/k Max 90 dBµV 90 dBµV 90 dBµV 80 dBµV 90 dBµV 70 dBµV 90 dBµV 60 dBµV 90 dBµV 70 dBµV 90 dBµV 60 dBµV 90 dBµV 90 dBµV 90 dBµV 10 dBµV 10 dBµV 10 dBµV 10 dBµV	mtal // Peak for 1 Hz to	→ 6 GHz (♥) 84-15 dBµV 5.17970 GHz 1.79900 GHz 1.79900 GHz	Spectrum Spectrum Ref Level 97.00 dBµV 10 dB st 10 dB st 10 dB st 90 dBµV 90 dBµV	tical // Peak for	Sweep	Т 55:28 dBµV 5:78 dBµV		
Spectrum Sweet used of the second secon	Antal // Peak for 1	→ 6 GHz → 6 GHz → 6 GHz → 04.15 dBµV 5.17870 GHz 5.233 dBµV 1.79960 GHz ↓ 1.79960 GHz	Spectrum Spectrum Ref Level 97.00 dBµV 10 dB sV 4tt 10 dB sV 90 dBµV 90 dBµV 80 dBµV 90 dBµV 70 dBµV 90 dBµV 80 dBµV 90 dBµV 90 dBµV </td <td>RBW 1 MHz WT 5 ms VBW 3 MHz Mode Aut 691 pts</td> <td>O Sweep M1[1] M1[1]</td> <td>55.28 dBµV 85.78 dBµV 5.17870 GHz 9.17870 GHz</td>	RBW 1 MHz WT 5 ms VBW 3 MHz Mode Aut 691 pts	O Sweep M1[1] M1[1]	55.28 dBµV 85.78 dBµV 5.17870 GHz 9.17870 GHz		
Bootizoot Spectrum Att Switz 10 dB Switz Switz 10 dB Switz Switz 10 dB Switz Switz 10 dB Switz Switz 10 dB Switz Switz 10 dB Switz 10 dB	ntal // Peak for 1 Hz to	→ 6 GHz B4.15 dBµV M1 5.17870 GHz 5.2.33 dH₂V 1.79950 GHz Stop 6.0 GHz	Spectrum Spectrum Ref Level 97.00 dBµ/v Max ● 10k Max 00 dB µ/v ● 10k Max 00 dB µ/v ● 0 dBµ/v 00 dB µ/v 90 dBµ/v M3 90 dBµ/v 00 dBµ/v 90 dBµ/v 00 dBµ/v 90 dBµ/v 00 dBµ/v 90 dBµ/v 10 dBµ/v 90 dBµ/v 10 dBµ/v 90 dBµ/v 10 dBµ/v 90 dBµ/v 10 dBµ/v	tical // Peak for	I CHz to 6 CHz o Sweep MS[1] MI[1] Image: A state of the st	(TTN S5.28 dBµV 2.42910 GHz 85.78 dBµV 5.17870 GHz 0 Stop 6.0 GHz on Result		
Betrum Ref Level 97.00 dBµV Att 10 dB SWT 5 m ● 1Pk Max 90 dBµV ● 0 dBµV 90 dBµV 80 dBµV 90 dBµV 70 dBµV 90 dBµV 80 dBµV 90 dBµV 90 dBµV 90 dBµV	e Y-value Function	● 6 GHz Image: State of the state of	Spectrum Spectrum Ref Level 97.00 dBµV 10 dB st #11 10 dB st #19k Max 00 dBµV #0 dBµV 10 dB st #1 dB start 1.0 GHz 1 Marker Trape Ref Trc M2 1	tical // Peak for	1 GHz to 6 GHz	(
Horizon Spectrum Spectrum Ref Level 97.00 (Bµ/V) 0 Att 10 dB SWT 5 r @1Pk Max 90 dBµ/V 90 dBµ/V 40 90 dBµ/V 5	e RBW 1 MH2 ms • VBW 3 MH2 Mode Auto Sweep M1[1] M2[1]	> 6 GHz Image: Constraint of the second	Spectrum Spectrum Ref Level 97.00 dBµV 10 dB st 4tt 10 dB st 90 dBµV 90 dBµV 90 dBµV 10 dBµV 90 dBµV 1	tical // Peak for	I CHz to 6 CHz o Sweep M1[1]	Т 55:28 dBµV 85:78 dBµV 5:78		
Horizon Spectrum Spectrum Ref Level 97.00 (Bµ/V) 10 dB SWT 5 (Bµ/V) @1Pk Max 90 dBµ/V 90 dBµ/V 90 dBµ/V 80 dBµ/V 10 dB SWT 5 (Bµ/V) 90 dBµ/V 10 dB SWT 5 (Bµ/V) 90 dBµ/V 10 dB SWT 5 (Bµ/V) 90 dBµ/V 10 dB SWT 5 (Bµ/V) 10 dBµ/V 10 dBµ/V 10 dBµ/V 10 dBµ/V 10 dBµ/V 10 dHz Marker Trp Ref Trc X-valut Maj 1 1.2,429	Matal // Peak for 1	6 GHz () 84.15 dBµV 5.17070 GHz 52.33 dBµV 1.79960 GHz 4 5.17070 GHz 1.79960 GHz 5.1700 GHz Stop 6.0 GHz Function Result	Spectrum Spectrum Ref Level 97.00 dBµ/v Att 10 dB µ/v Bold Price 90 dBµ/v Bold Price <	tical // Peak for m 2 2	I GHz to 6 GHz o Sweep MS[1] MI[1]	S5.28 dBµV 2,42910 GHz 85.78 dBµV 5,17870 GHz 9 10 <td< td=""></td<>		





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.



Mode:	UNII-1 (an_HT20)
Distance of measurement:	3 meter
Channel:	44

- Spurio	us							
Frequency (Mbz)	Level (dB, W) Detect mode		de Ant. Pol. CF DCF 1 (H/V) (dB) (dB)		Field strength (dBµN/m)	Limit (dBµN/m)	Margin (dB)	
1 199.00	51.71	Peak	Н	-7.52	-	44.19	74.00	29.81
1 799.60	52.27	Peak	Н	-2.82	-	49.45	68.20	18.75
2 429.10	56.72	Peak	Н	-0.05	-	56.67	68.20	11.53
1 799.60	37.49	Average	Н	-2.82	0.42	35.09	58.20	23.11
1 799.60	51.22	Peak	V	-2.82	-	48.40	68.20	19.80
2 117.90	55.69	Peak	V	-0.69	-	55.00	68.20	13.20
2 429.10	55.11	Peak	V	-0.05	_	55.06	68.20	13.14
2 125.20	41.01	Average	V	-0.67	0.42	40.76	58.20	17.44

Ho	rizontal //	/ Peak f	or 1 GHz	to 6 GHz			V	//ertical	Peak fo	or 1 GHz	to 6 GHz	,
Spectrum Spe	ectrum 2 🛛 🛞					Spectrum	Sp	ectrum 2 🛛 🛞				Ē
Ref Level 97.00 dBµV	RBW	1 MHz			()	Ref Level	97.00 dBµV	e Re	W 1 MHz			
Att 10 dB	SWT 5 ms 🖷 VBW	3 MHz Mode	Auto Sweep			Att	10 dB	SWT 5 ms 🖷 VE	W 3 MHz Mod	e Auto Sweep		
• 1Pk Max			M4[1]		56 70 dp	1Pk Max				MOLT		EE 60 dDud
90 dBμV				M1	2.42910 GHz	90 dBµV				matri		M1 2.11790 GHz
			M1[1]	Ţ	84.80 dBµV					M1[1]		87.29 dBµV
80 dBµV				1 1	5.21490 GHz	80 dBµV					I I	5.22210 GHz
70 dBµV						70 dBµV			_			
	MA											
M2 M3	Ţ					60 dBµV	M2	T T				
50 dBuV				<u> </u>		50. dBµV						
	rellonente any marine	a warmen ward	manneuholina	- whole management h	advanter market	- opening	water	where the second	Paran Mariana	munderstore	monenow	J humananan
40 dBhA						40 GBhA						
30 dBµV						30 dBµV			_			
0.0 10.11						00.40.44						
20 dBhA						20 aBhA						
10 dBµV						10 dBµV						
0.10.41						0.40.44						
Start 1.0 GHz		691 nts			Stop 6.0 GHz	Start 1.0 G	Hz		691 pt	·s		Stop 6.0 GHz
Marker					otop olo alla	Marker						otop oto uniz
Type Ref Trc	X-value	Y-value	Function	Function Re	esult	Type Ref	Trc	X-value	Y-value	Function	Functio	on Result
M1 1	5.2149 GHz	84.80 dBµV				M1	1	5.2221 GHz	87.29 dBµV			
M3 1	1.7996 GHz	52.27 dBµV				M2 M3	1	2.1179 GHz	55.69 dBuV			
M4 1	2.4291 GHz	56.72 dBµV				M4	1	2.4291 GHz	55.11 dBµV			
			Measuring	444	lh					Measuring.	4	a h





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.



Mode:	UNII-1 (an_HT20)
Distance of measurement:	3 meter
Channel:	48

- Spurio	us							
Frequency (MLz)	Level (dBµV) Detect mode		Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµN/m)	Limit (dBµN/m)	Margin (dB)
1 799.60	53.25	Peak	Н	-2.82	-	50.43	68.20	17.77
2 429.10	56.43	Peak	Н	-0.05	-	56.38	68.20	11.82
1 799.60	37.64	Average	Н	-2.82	0.42	35.24	58.20	22.96
1 199.00	52.60	Peak	V	-7.52	-	45.08	74.00	28.92
2 117.90	52.79	Peak	V	-0.69	-	52.10	68.20	16.10
2 429.10	55.79	Peak	V	-0.05	-	55.74	68.20	12.46
1 148.30	37.04	Average	V	-7.80	0.42	29.66	54.00	24.34
2 117.90	36.11	Average	V	-0.69	0.42	35.84	58.20	22.36

E	Iorizontal /	// Peak f	or 1 GHz	to 6 GHz			V	/ertical /	/ Peak fo	or 1 GHz	to 6 G	łz	
Spectrum	Spectrum 2 🛛 🛞					Spectrum	Sp	ectrum 2 🛛 🗶	1				
Ref Level 97.00 d	BμV e RB	W 1 MHz				Ref Level 9	7.00 dBµV	- R	BW 1 MHz				
Att 10) dB SWT 5 ms 🖷 VBN	W 3 MHz Mode	Auto Sweep			Att	10 dB	SWT 5 ms 🖷 V	BW 3 MHz Mod	le Auto Sweep			
O TAK Wax			M1[1]		95.12 dpuV	отък мах				M4[1]			55 70 dpuV
90 dBµV				M1	5.24380 GHz	90 dBµV				1014[1]		M1	2.42910 GHz
			M2[1]	X	53.25 dBµV					M1[1]		1	87.27 dBµV
80 dBµV					1.79960 GHz	80 dBµV							5.24380 GHz
70 dBuV						70 dBµV							
60 dBµVM2	M3	+				BU dBUV		M3					
50 dBi//						50.cBuV							
al Marner work	why Anno Marian	man	and a second second	money have the	un manua	manne	- and the stand have	of the war to be a second	Anotherneter	with man white man and a second	manund	por h	and merely and a second
40 dBµV						40 dBhA							
00.40.44						30 dBµV			_		_		
30 dBµV						00.40.44							
20 dBµV						20 dBhA							
						10 dBµV					_		
10 dBµV													
0 dBuV						Start 1.0 GH	17		691 pl	te l			Stop 6.0 GHz
Start 1.0 GHz		691 pts			Stop 6.0 GHz	Marker			051 p				otop olo drie
Marker						Type Ref	Trc	X-value	Y-value	Function	Fund	tion Re	sult
Type Ref Trc	X-value	Y-value	Function	Function Result		M1	1	5.2438 GHz	87.27 dBµV				
M1 1 M2 1	5.2438 GHZ 1.7996 GHZ	53.25 dBµV				M2 M3	1	2.1179 GHz	52.60 dBµV 52.79 dBµV				
M3 1	2.4291 GHz	56.43 dBµ∨				M4	1	2.4291 GHz	55.79 dBµV				
			Measuring	40	lh					Measuring		цa	lin lin

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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.



Mode:	UNII-1 (ac_HT20)
Distance of measurement:	3 meter
Channel:	36

- Spurio	us							
Frequency (MLz)	Level (dBµN)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµN/m)	Limit (dBµN/m)	Margin (dB)
1 799.60	52.08	Peak	Н	-2.82	-	49.26	68.20	18.94
2 429.10	57.68	Peak	Н	-0.05	-	57.63	68.20	10.57
2 125.20	37.78	Average	Н	-0.67	0.32	37.43	58.20	20.77
1 799.60	52.58	Peak	V	-2.82	-	49.76	68.20	18.44
2 125.20	52.30	Peak	V	-0.67	-	51.63	68.20	16.57
2 429.10	56.39	Peak	V	-0.05	-	56.34	68.20	11.86
1 148.30	37.43	Average	V	-7.80	0.32	30.05	54.00	23.95
2 117.90	35.62	Average	V	-0.69	0.32	35.35	58.20	22.85

- Band edge

Frequency (Mz)	Level (dBµN)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµN/m)	Limit (dBµN/m)	Margin (dB)
5 149.40	48.70	Peak	Н	8.22	-	56.92	74.00	17.18
5 150.00	34.17	Average	Н	8.22	0.32	42.71	54.00	11.29
5 147.10	51.91	Peak	V	8.23	-	60.17	74.00	13.54
5 150.00	37.58	Average	V	8.22	0.32	46.12	54.00	7.88



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Spectrum	Horizontal // Peak for 6 🕀 to 18 🕀	Vertical // Peak for 6
■ Pk Max ■ Pk Max 90 dBµ/ ■ Pk Max 80 dBµ/ ■ Pk Max 70 dBµ/ ■ Pk Max 70 dBµ/ ■ Pk Max 80 dBµ/ ■ Pk Max 70 dBµ/ ■ Pk Max 90 dBµ/ ■ Pk Max 70 dBµ/ ■ Pk Max 90 dBµ/ ■ Pk Max </th <th>Spectrum Spectrum 3 ③ Spectrum 4 ∅ Ref Level 101.00 dbµV ● RBW 1 MHz Att 10 db SWT 48 ms ● VBW 3 MHz Mode Sweep</th> <th>Spectrum Spectrum 2 Spectrum 3 Spectrum 4 The sector is a s</th>	Spectrum Spectrum 3 ③ Spectrum 4 ∅ Ref Level 101.00 dbµV ● RBW 1 MHz Att 10 db SWT 48 ms ● VBW 3 MHz Mode Sweep	Spectrum Spectrum 2 Spectrum 3 Spectrum 4 The sector is a s
90 dBµ/- Image: Second Sec	●1Pk Max	1Pk Max
80 dbµ/	90 dBµV	90 dBµV
60 dBµ/	80 dBµV	80 dBµV
40 dB _µ V 20 dB _µ V		60 dBµV
20 dBµV	40 dBµV	40 dBµV
10 dB/M	20 dBµV	20 dBµV
Start 6.0 GHz 691 pts Stop 18.0 GHz 691 pts	Start 6.0 GHz 691 pts Stop 18.0 GHz	Start 6.0 GHz 691 pts Stop 18.0 GHz

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.



Mode:	UNII-1 (ac_VHT20)
Distance of measurement:	3 meter
Channel:	44

- Spurio	us							
Frequency (MLz)	Level (dBµN)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµN/m)	Limit (dBµN/m)	Margin (dB)
1 799.60	52.12	Peak	Н	-2.82	-	49.30	68.20	18.90
2 429.11	56.77	Peak	Н	-0.05	-	56.72	68.20	11.48
1 799.60	37.10	Average	Н	-2.82	0.32	34.60	58.20	23.60
1 799.60	50.94	Peak	V	-2.82	-	48.12	68.20	20.08
2 125.20	53.90	Peak	V	-0.67	-	53.23	68.20	14.97
2 429.10	56.23	Peak	V	-0.05	-	56.18	68.20	12.02
1 148.30	36.90	Average	V	-7.80	0.32	29.42	54.00	24.58
2 125.20	37.66	Average	V	-0.67	0.32	37.31	58.20	20.89

Но	orizontal /	/ Peak f	or 1 GH	to 6 GHz			V	/ertical	// Peak f	or 1 GHz	to 6 GHz	
Spectrum Sp	ectrum 2 🔍					Spectrum	Sp	ectrum 2	×			
Ref Level 97.00 dBµV	/ 😑 RBW	1 MHz				Ref Level 9	97.00 dBµV	· · · ·	RBW 1 MHz			
Att 10 de	8 SWT 5 ms 🖷 VBW	3 MHz Mode	Auto Sweep			Att	10 dB	SWT 5 ms (VBW 3 MHz Mo	de Auto Sweep		
• IPK Max			M1[1]		70.19 dpuV	отък мах				Md[1]		56.22 dpuV
90 dBµV-			mili		5.22210 GHz	90 dBµV						2.42910 GHz
			M2[1]	M1	52.12 dBµV					M1[1]		M1 79.15 dBµV
80 dBµV				T	1.79960 GHz	80 dBµV					1 1	5.22210 GHz
70 dBuV						70 dBµV						
						60 db. 11		MA				
60 dBµV	M3					во авру-	M2	M3				
50 dBiA/						50.dBµV						
Hiterinnershanderlin	mound	munon	monthem	uning the	uhunhanna	10 10 11	mather	munder	unadomorganiano	about madeline and my	amburn manual	I benton wannesse
40 dBµV						40 dBµV						
20. d0. 4/						30 dBµV						
30 dbpv						00 d0.41						
20 dBµV						20 UBµV						
						10 dBµV						
10 dBµV-						0.40.44						
0 dBµV						Start 1.0 GE	12		691	nts		Stop 6.0 GHz
Start 1.0 GHz		691 pts			Stop 6.0 GHz	Marker						
Marker						Type Ref	Trc	X-value	Y-value	Function	Function	1 Result
Type Ref Trc	X-value	Y-value	Function	Function Re	esult	M1	1	5.2221 (GHz 79.15 dBµ	V		
M2 1	1.7996 GHz	52.12 dBµV				M3	1	2.1252 0	GHz 53.90 dBµ	V		
M3 1	2.4291 GHz	56.77 dBµ∨				M4	1	2.4291 0	GHz 56.23 dBµ	V		
			Measuring	4/0	lh][Measuring.		

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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.



Mode:	UNII-1 (ac_VHT20)
Distance of measurement:	3 meter
Channel:	48

- Spurio	us							
Frequency (Mz)	Level (dBµN)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµN/m)	Limit (dBµN/m)	Margin (dB)
1 097.70	50.96	Peak	Н	-8.09	-	42.87	74.00	31.13
1 799.60	52.28	Peak	Н	-2.82	-	49.46	68.20	18.74
2 429.10	58.48	Peak	Н	-0.05	-	58.43	68.20	9.77
2 479.70	53.13	Peak	Н	0.06	-	53.19	68.20	15.01
1 799.60	36.57	Average	Н	-2.82	0.32	34.07	58.20	24.13
2 125.20	37.01	Average	Н	-0.67	0.32	36.66	58.20	21.54
1 191.80	52.86	Peak	V	-7.56	-	45.30	74.00	28.70
1 799.60	51.69	Peak	V	-2.82	-	48.87	68.20	19.33
2 117.90	53.56	Peak	V	-0.69	-	52.87	68.20	15.33
2 429.10	56.40	Peak	V	-0.05	-	56.35	68.20	11.85
2 479.70	54.59	Peak	V	0.06	-	57.65	68.20	13.55
1 148.30	37.05	Average	V	-7.80	0.32	29.57	54.00	24.43
2 117.90	37.02	Average	V	-0.69	0.32	36.65	58.20	21.55

	H	Iorizont	al // Peak	for 1 G	bz to6 GHz	z		•	Vertic	al //	Peak f	or 1 GHz	to 6 GHz	
Spectru	n	Spectrum 2	8				Spectru	n S	pectrum 2	×				
Ref Level	97.00 d	вµ∨	RBW 1 MHz				Ref Leve	97.00 dBµ	ν	e RBV	V 1 MHz			
Att	1	dB SWT 5 ms	VBW 3 MHz Mod	le Auto Sweep			Att	10 c	dB SWT 5r	ns 😑 VBN	₩ 3 MHz Mod	le Auto Sweep		
1Pk Max	-			M1[1]		70 22 dbuly	1Pk Max				_	M6[1]		54.50 dbuV
90 dBµV		_		milij		5.24380 GHz	90 dBµV				++	mo[1]		2.47970 GHz
00 40.44				M2[1]	N	M1 50.96 dBμV	en de M					M1[1]		M1 80.22 dBμV
80 dBhA-					1 1	1.09770 GHz	00 0000					1	- I I	5.23660 GHz
70 dBµV—		_					70 dBµV				+ +			
60 dBiA/		M4					60.dBµV-		M4 M5		+			
M2	M	M-					Ţ	M3	TY J	1				
50,dBuV-						8	20 GRhA-	maunt	June	man	wannehauser	and the second second second		Amproxima
40 dBuV-		ward the share	energen and and an an an	man	man man	1 Ulmonnormene	40 dBµV							
10 0.00							30 dBuV-							
30 dBµV	-													
20 dBµV-		_					20 dBµV-							
							10 dBµV—							
10 dBµV—							O dBuby							
0 dBµV							Start 1.0	GHz			691 p	ts		Stop 6.0 GHz
Start 1.0	ĠHz		691 p	its		Stop 6.0 GHz	Marker							
Marker							Type R	ef Trc	X-value		Y-value	Function	Functio	n Result
Type R	ef Trc	X-value	Y-value	Function	Function	Result	M1	1	5.23	66 GHz	80.22 dBµV			
M1 M2	1	1.0977	GHz 78.23 dBµV GHz 50.96 dBuV	/			M2 M3	1	1.19	96 GHz	52.86 dBµV			
M3	1	1.7996	GHz 52.28 dBµV	/			M4	1	2.11	79 GHz	53.56 dBµV			
M4	1	2.4291	GHz 58.48 dBµV	/			M5	1	2.42	91 GHz	56.40 dBµV			
M5	1	2.4797	GHZ 53.13 dBµV	·			Mb	1	2.47	97 GH2	54.59 dBµV	-		
				Measuring.		11.	L					Measuring		• ///

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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.



Test results (18 GHz to 40	0 GHz) – Worst case				
Mode:	UNII-1 (an_HT20)				
Distance of measurement:	3 meter				
Channel:	44 (Worst case)				

Horizontal	Vertical				
Spectrum Spectrum 3 © Spectrum 4 © Spectrum Spectrum 2 Spectrum 3 © Spectrum 4 © Ref Level 91.00 dBµV Ref Level 91.00 dBµV RBW 1 MH2 Ref Level 91.00 dBµV RBW 1 MH2 Ref Level 91.00 dBµV RBW 1 MH2 RBW 1 MH2 Ref Level 91.00 dBµV RBW 1 MH2 Ref Level 91.00 dBµV RBW 1 MH2 Ref Level 91.00 dBµV RBW 1 MH2 Ref Level 91.00 dBµV RBW 1 MH2 					
Att U db SWT 88 ms VBW 3 MHz Mode Sweep 					
80 dBµV	80 dBµV				
70 dBµV	70 dBµV				
50 dBµV	50 dBµV				
20 deur	20 abin				
10 dBµ.V	10 dBµV				
0 dBµV	0 dBµ/				
Neasuring					

Note.

1. No spurious emission were detected above 18 GHz.



Test report No.: KES-RF-19T0112-R1 Page (43) of (44)

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV40	101002	1 year	2020.06.24
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	2020.06.24
Low Pass Filter	Wainwright Instrument Gmbh	WLK1.0/18G-10TT	1	1 year	2020.06.24
Broadband Amplifier	Schwarzbeck	BBV9721	PS9721-003	1 year	2020.01.16
Preamplifier	AGILENT	8449B	3008A00538	1 year	2020.06.24
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	MY43004130	1 year	2020.06.24
Pulse Limiter	R&S	ESH3-Z2	101915	1 year	2019.11.26
LISN	R&S	ENV216	101787	1 year	2020.01.04

Appendix A. Measurement equipment

Peripheral devices

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