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시점확인 진본 2024-09-13 11:07:25 KST 정부시점확인센터

RF TEST REPORT

Report Number		KIEL2409-YW10504		
Applicant	Company Name	BETTERWHY		
	Address	24-13, 2saneopdanji 2-gil, Waegwan-eup, Chilgok-gun, Gyeongsangbuk-do, Republic of Korea		
Product	Product Name	EVCheck		
	Model Name	EVCHECK24BCV01		
	FCC/IC ID	2BKUPEVCHECK24BCV01		
	Manufacturer	DAEHYUN HI-TECH		
Other	Receipt Date	2024.08.21	Receipt Number	RQW2408-0666
	Issued Date	2024.09.12	Tested Date	2024.08.30 ~ 2024.09.06
Standards		FCC 47 CFR Part 15 Subpart C 15.247 ANSI C63.13 : 2020		
Tested by		Dominic Sim (Sign)		
Approved by		David Jang (Sign)		

KIEL Institute

Daewoo Technopark A-403, 261, Doyak-ro, Bucheon-si, Gyeonggi-do, 14523, Korea.
Tel : +82-32-670-8888, Fax : +82-32-670-8889

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o This test report is irrelevant to KS Q ISO/IEC 17025 and KOLAS accreditation

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Revision History

Issued Date	Issued Report No.	Revisions
2024.09.12	KIEL2409-YW10504	Initial Issue

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1.0 Laboratory Information

Laboratory Name	KIEL Institute
Location	1-1, Gilju-ro, Bucheon-city, Gyeonggi-do, Korea 14505
FCC Registration No.	KR0167 (RRA accredited Lab.)
IC Registration No.	KR0167 (31291)
Phone	+82-32-325-7045
Fax	+82-32-670-8889

2.0 Applicant Information

Applicant Name	BETTERWHY
Address	24-13, 2saneopdanji 2-gil, Waegwan-eup, Chilgok-gun, Gyeongsangbuk-do, Republic of Korea
Manufacturer	DAEHYUN HI-TECH
Address	35-7, Geumo-daero 4-gil, Buksam-eup, Chilgok-gun, Gyeongsangbuk-do, Republic of Korea

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3.0 Summary of Test Results

Applied standard: FCC part 15, subpart C 15.247

FCC Part Section(s)	Test Item	Reference	Result
15.247 (b)(1)	Maximum Peak Output Power	Section 6.2	P
15.247 (a)(1)	Carrier Frequency Separation	Section 6.4	P
15.247 (a)(1)	20 dB Channel Bandwidth	Section 6.3	P
15.247 (a)(1)(iii)	Number of Hopping Channels	Section 6.5	P
15.247 (a)(1)(iii)	Time of Occupancy (Dwell Time)	Section 6.6	P
15.247 (d)	Band Edge / Out-of-Band Emissions (Conducted Spurious Emission)	Section 6.7	P
15.205 15.209	General Field Strength (Restricted Bands and Radiated Emission Limits)	Section 6.7	P
15.207	AC Power Line Conducted Emissions (150 kHz – 30 MHz)	Section 6.8	P

(Note 1) P = Pass, NC = Not comply, NT = Not Tested, NA = Not Applicable
(Note 2) The general test methods used to test on this devices are ANSI C63.10.
(Note 3) If The Frequency Hopping System operating in 2400-2483.5MHz band and the output power less than 125mW. The hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20dB bandwidth of hopping channel whichever is greater.
(Note 4) Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.
(Note 5) For emission test from 9 ㎑ to 30 ㎒,
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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3.1 Meaurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2

Measurement Items	Frequency Range	Expanded Uncertainty U = kUc (*k* = 2)
Conducted Emission at main ports	150 kHz – 30 MHz	3.24 dB
Radiated Spurious Emissions	9 kHz – 30 MHz	3.39 dB
	30 MHz – 1 GHz	5.14 dB
	1 GHz – 18 GHz	3.18 dB
	18 GHz – 40 GHz	4.54 dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of k = 2.

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4.0 General Information

4.1 EUT Description

Product name	EVCheck
Basic model	EVCHECK24BCV01
Product S/N	-
Variant model(s)	-
Model Difference	-
Power supply	DC 12 V
Modulation	GFSK, π/4DQPSK, 8DPSK
Transfer Rate	BDR : 1 [Mbps] EDR : 2, 3 [Mbps]
Operating Frequency	2 402 ~ 2 480 [MHz]
Number of channel	79 Channels
Output Power	6.71 dBm (4.69 mW)
Antenna Type	PCB Pattern(1T1R)
Antenna Connector	Integral antenna

(Note 1) The above equipment has been tested by KIEL Institute, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

4.1.1 List of Accessories

Accessories	Brand	Model	Manufacturer	Specification
-	-	-	-	-

4.1.2 Auxiliary Test equipment

Auxiliary Test equipment	Brand	Model	Manufacturer	Specification
Laptop	Lenovo IdeaPad S500 Touch	20248	Lenovo PC HK Limited	-
AC Adapter(Laptop)	Lenovo	ADLX45NCC3A	CHICONY POWER TECHNOLOGY (SUZHOU) CO.,LTD.	Input: AC 100 V ~ 240 V / 50 ~ 60 Hz Ouput: DC 20 V

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4.1.3 Antenna Information

Antenna	Type	Frequency Range	Peak Gain
Ant A (Bluetooth)	PCB Pattern	2 400 MHz – 2 483.5 MHz	3.42 dBi

4.1.4 Channel List of EUT

Channel	Frequency [MHz]	Channel	Frequency [MHz]	Channel	Frequency [MHz]	Channel	Frequency [MHz]
0	2 402	20	2 422	40	2 442	60	2 462
1	2 403	21	2 423	41	2 443	61	2 463
2	2 404	22	2 424	42	2 444	62	2 464
3	2 405	23	2 425	43	2 445	63	2 465
4	2 406	24	2 426	44	2 446	64	2 466
5	2 407	25	2 427	45	2 447	65	2 467
6	2 408	26	2 428	46	2 448	66	2 468
7	2 409	27	2 429	47	2 449	67	2 469
8	2 410	28	2 430	48	2 450	68	2 470
9	2 411	29	2 431	49	2 451	69	2 471
10	2 412	30	2 432	50	2 452	70	2 472
11	2 413	31	2 433	51	2 453	71	2 473
12	2 414	32	2 434	52	2 454	72	2 474
13	2 415	33	2 435	53	2 455	73	2 475
14	2 416	34	2 436	54	2 456	74	2 476
15	2 417	35	2 437	55	2 457	75	2 477
16	2 418	36	2 438	56	2 458	76	2 478
17	2 419	37	2 439	57	2 459	77	2 479
18	2 420	38	2 440	58	2 460	78	2 480
19	2 421	39	2 441	59	2 461		

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4.2 Description of Test Mode

4.2.1 Test Mode Configuration

- Axis worst case

Pre-Scan has been performed to determine the worst case axis between antenna port, XYZ axis and frequency band.

EUT Configuration	Applicable to	Description
	Ant A(Bluetooth)	
Transmission	X axis	-

- Radiated Emission (Below 1 GHz, Above 18 GHz, and AC Power line conducted emission) worst case

Radiated emission below 1 GHz, above 18 GHz and AC power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Tested Mode	Tested Channel	Packet Type	Description
EDR	39	3-DH1	-

- Radiated Emission (Above 1 GHz)

Radiated emission above 1 GHz was performed with the EUT set to transmit Low/Mid/High channels.

Tested Mode	Tested Channel	Packet Type	Description
BDR	0, 39, 78	DH1	-
EDR	0, 39, 78	3- DH1	-

- Antenna Port Conducted Measurement

This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.

Tested Mode	Tested Channel	Packet Type	Description
BDR	0, 39, 78	DH1	-
EDR	0, 39, 78	3-DH1	-

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- Test Conditon

Applecable to	Environmental Conditions	Test Voltage	Tested by
Radiated emissions(< 1GHz)	(21.5 ± 2) ºC, (43.7 ± 3) % R.H.	DC 12 V	Dominic Sim
Radiated emissions(> 1GHz)	(23.2 ± 2) ºC, (45.6 ± 3) % R.H.	DC 12 V	Dominic Sim
AC power line emission	(20.4 ± 2) ºC, (57.6 ± 3) % R.H.	DC 12 V	Dominic Sim
Antenna port conducted	(22.3 ± 2) ºC, (45.2 ± 3) % R.H.	DC 12 V	Dominic Sim

- Worst case of data rates

Transmission	Test Mode	Worst Case Data Rate
SISO	BDR	DH1
	EDR	3-DH1

Test Mode	Data Rate	Max Peak Output Power
BDR	DH1	4.20 dBm
	DH3	4.05 dBm
	DH5	3.99 dBm
EDR	2-DH1	6.36 dBm
	2-DH3	6.14 dBm
	2-DH5	6.03 dBm
	3-DH1	6.71 dBm
	3-DH3	6.44 dBm
	3-DH5	6.49 dBm

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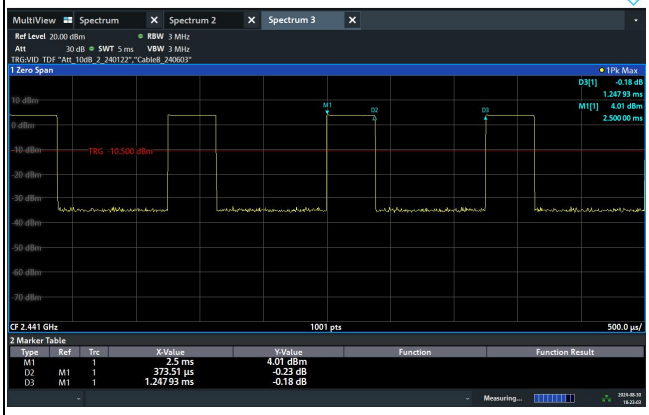
- Duty Cycle of Test Signal

Test Mode	Packet Type	On Time [msec]	Period [msec]	Duty cycle X [Linear]	Duty Cycle [%]	DCCF [dB]	1/T min.VBW [kHz]
BDR	DH1	0.374	1.248	0.299	29.93	5.24	2.677
EDR	3-DH1	0.389	1.253	0.310	31.01	5.09	2.574

- Test Plots of Duty Cycle

BDR(GFSK)_DH1



EDR(8DPSK)_3-DH1

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4.3 General Description of Applied Standard

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards.

FCC CFR 47 Part 15, Subpart C (§15.247)
KDB 558074 D01 15.247 Meas Guidance v05r02
ANSI C63.10-2020

All test items in this test report have been performed and recorded as per the above standards.

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5.0 Test Equipment

Test Equipment is traceable to the National Institute of Standards and Technology (NIST). Measurement antenna used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

	Equipment	Manufacturer	Model	S/N	Description	Cal Due
■	Spectrum Analyzer	Rohde & Schwarz	FSV3044	101034	10 Hz ~ 44 GHz	2025-01-22
■	Spectrum Analyzer	Rohde & Schwarz	FSV3030	102117	10 Hz ~ 30 GHz	2025-05-21
■	DC Power Supply	ODA	OPM-305D	ODA-04-0923-07960	DC 30 V, 5 A, 2Ch	2025-01-24
■	Signal Generator	Rohde & Schwarz	SMBV100B	101818	8 kHz ~ 6 GHz	2025-01-23
■	Vector Signal Generator	Rohde & Schwarz	SMB100A	180880	100 kHz ~ 40 GHz	2025-05-20
■	Attenuator	INMET	26A-10	2	DC to 26.5 GHz,10 dB.	2025-01-22
■	Attenuator	INMET	26A-10	3	DC to 26.5 GHz,10 dB.	2025-01-22
■	True RMS Multimeter	FLUKE	177	59570153	1000 V, 10 A	2025-01-24
■	Power Meter	Rohde & Schwarz	NRX	101971	DC ~ 40 GHz	2025-01-23
■	Power Sensor	Rohde & Schwarz	NRP-Z86	104137	50 MHz ~ 40 GHz	2025-05-27
■	Notch Filter	Micro-Tronics	BRM50702	G577	Stop band: 2 400 MHz ~ 2 500 MHz	2025-05-22
■	High Pass Filter	WT Microwave INC.	WT-A3331-HS	23041001-1	Pass band: 6.0 GHz ~ 24.5 GHz	2025-05-22
■	EMI Test Receiver	Rohde & Schwarz	ESW44	101737	1 Hz ~ 44 GHz	2025-01-22
■	EMI Test Receiver	Rohde & Schwarz	ESW26	103106	1 Hz ~ 26.5 GHz	2025-01-22
■	Active Loop Antenna	Rohde & Schwarz	HFH2-Z2E	100858	8.3 kHz ~ 30 MHz	2026-05-24
■	Bi-Log Antenna	SCHWARZBECK	VULB9168	00916	25 MHz ~ 2 GHz	2025-06-01
■	Horn Antenna	Rohde & Schwarz	HF907	102722	800 MHz ~ 18 GHz	2025-05-30
■	Horn Antenna	SCHWARZBECK	BBHA9170	00981	15 GHz ~ 40 GHz	2025-01-30
■	Preamplifier	Rohde & Schwarz	SCU-01F	010096	10 kHz ~ 1 GHz, 35 dB	2025-05-20
■	Preamplifier	Rohde & Schwarz	SCU-18F	180084	1 GHz ~ 18 GHz	2025-05-20
■	Preamplifier	EXYNOD	ELNA40-50	2305161	18 GHz ~ 40 GHz	2025-05-22
■	6dB Attenuator	Fairview Microwave	SA3N5W-06	190311029	DC ~ 3 GHz, 6 dB	2025-06-01
■	EMI Test Receiver	Rohde & Schwarz	ESR3	102444	10 Hz ~ 3 GHz	2025-05-20
■	LISN	Rohde & Schwarz	ENV216	102347	9 kHz ~ 30 MHz	2025-05-20
■	LISN	AFJ	LT32C/10	32031816260	9 kHz ~ 30 MHz	2025-05-20
■	Turntable	Innco	DT 3000-3t	-	-	-
□	Antenna Mast_L	Innco	MA4000-EP	-	-	-
■	Antenna Mast_R	Innco	MA4000-EP	-	-	-
■	Controller_1	Innco	CO3000	1062	-	-
■	Controller_2	Innco	CO3000	1063	-	-

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■	Software	Rohde & Schwarz	EMC32	101535	-	-
■	Software	Rohde & Schwarz	ELEKTRA	102739	-	-

6.0 Test Results

6.1 Antenna Requirement

Except from §15.203 of the FCC Rules/Regulations:
An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of the section.

- The antenna(s) of the EUT are permanently attached antenna
- There are no provisions for connection to an external antenna.

6.1.1 Result

The EUT complies with the requirement of §15.203

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6.2 Maximum Peak Output Power

6.2.1 Regulation

§15.247(a)(1) : Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

§15.247(b)(1) : For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

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

6.2.2 Test Procedure

The method of measurement used to test this FHSS device is ANSI C63.10-2020.

This is an RF conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation.

Peak Power Measurement

a) Use the following spectrum analyzer settings:
   1) Span : Approximately five times the 20 dB bandwidth, centered on hopping channel
   2) RBW > 20 dB bandwidth of emission being measured
   3) VBW ≥ RBW
   4) Sweep : No faster than coupled (auto) time
   5) Detector function : Peak
   6) Trace : Max hold
b) Allow trace to stabilize
c) Use the marker-to-peak function to set the marker to the peak of the emissions
d) The indicated level is the peak output power, after any corrections for external attenuators and cables
e) A spectral plot of the test results and setup description shall be included in the test report.

NOTE—A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.

Average Power Measurement

Measurement using a power meter.

a) Averge Power measurement using an RF average power meter, as follows:

1) The EUT is configured to transmit continuously, or to transmit with a constant duty cycle.
2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

b) If the transmitter does not transmit continuously, measure the duty cycle, D, of the transmitter output signal.
c) Measure the average power of the transmitter.
This measurement is an average over both the ON and OFF periods of the transmitter.
d) Correct the measurement in dBm by adding [10 log (1 / D)], where D is the duty cycle.

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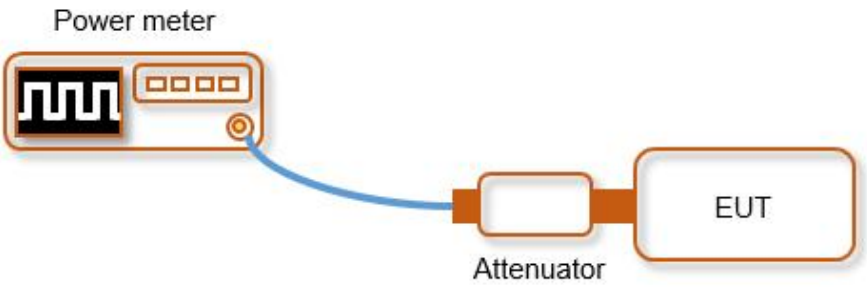
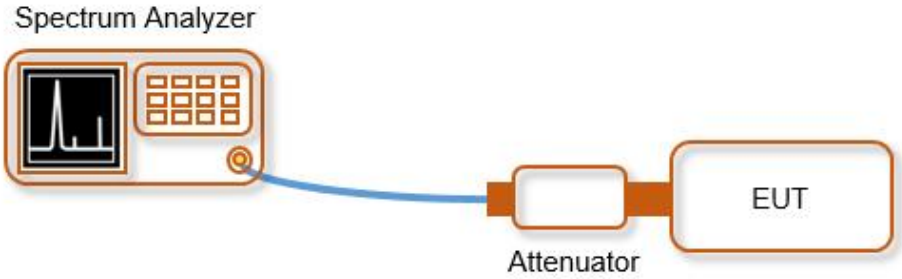
6.2.3 Test Setup





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6.2.4 Test Result

Test Mode	Channel	Frequency [MHz]	Peak Output Power [dBm]	Limit [dBm]	Margin [dB]
BDR	0	2 402	3.33	30.00	26.67
	39	2 441	4.20		25.80
	78	2 480	4.14		25.86
EDR	0	2 402	5.69	21.00	15.31
	39	2 441	6.71		14.29
	78	2 480	6.60		14.40

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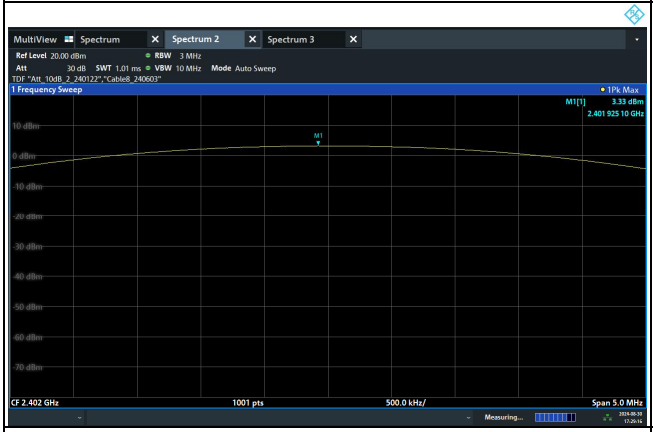
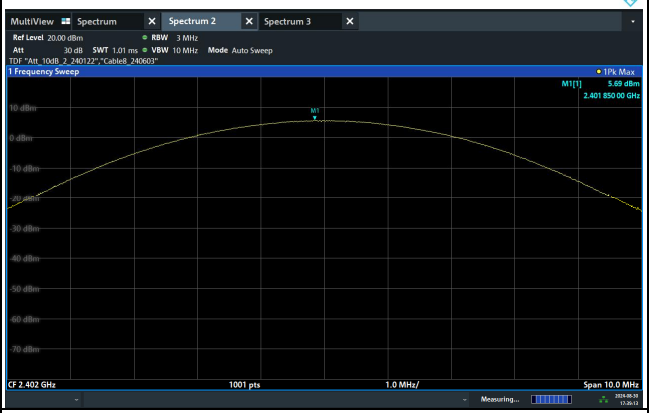
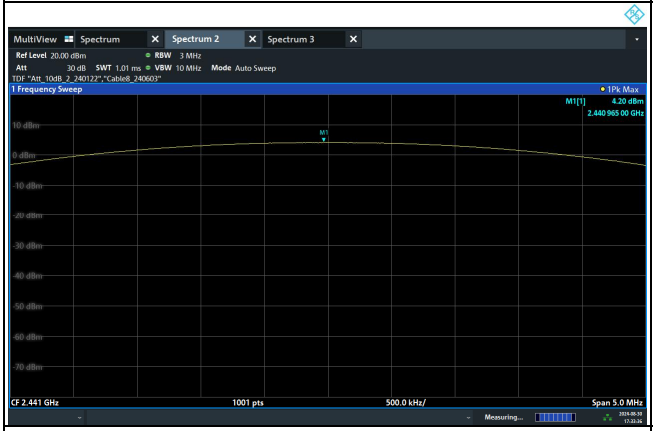
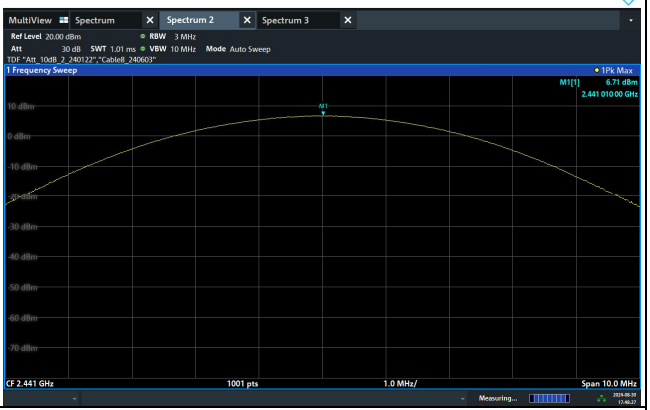
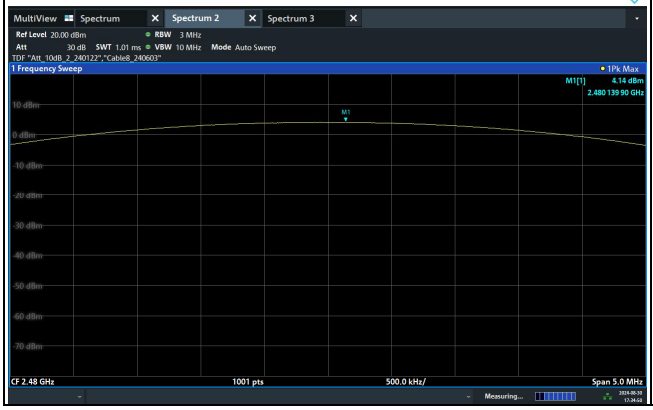
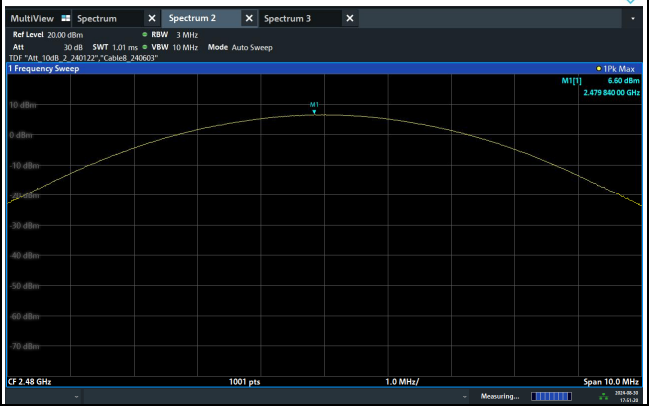
Test Plot of Peak Output power

Peak Output Power	
BDR_2 402 MHz	EDR_2 402 MHz
	
BDR_2 441 MHz	EDR_2 441 MHz
	
BDR_2 480 MHz	BDR_2 480 MHz
	

G4B(www.g4b.go.kr)진위확인코드 : TTxeD/ybTpw=

6.3 20 dB Bandwidth

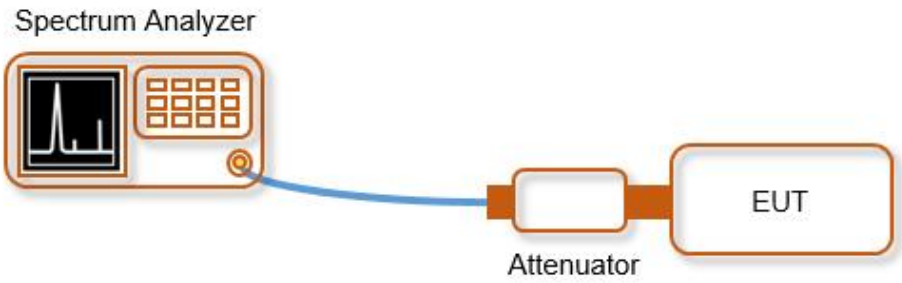
6.3.1 Regulation

§15.247(a)(1) : Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

6.3.2 Test Procedure

The method of measurement used to test this FHSS device is ANSI C63.10-2020.

The following procedures shall be used for measuring the OBW of the fundamental frequencies of certain unlicensed wireless devices, when required.

a) Use the following spectrum analyzer settings:
   1) Span : Set betwwen two times and five times the OBW
   2) RBW : 1 % to 5 % of the OBW
   3) VBW ≥ 3 x RBW
   4) Sweep : Auto
   5) Detector function : Peak
   6) Trace : Max hold
b) Allow trace to stabilize
c) Use the N dB down function and set N value to -20
d) In case of 99 % bandwidth, Use 99 % power bandwidth function
e) A plot of the test results and setup description shall be included in the test report

6.3.3 Test Setup