

Test Report

Verified code: 163058

Report No.: E20240129544701-2

Customer: Alps Alpine North America, Inc

Address: 1500 Atlantic Blvd Auburn Hills, Michigan 48326 United States

Sample Name: Car Radio with Bluetooth

Sample Model: KAC-CMD-CTR

Receive Sample Date: Jun.05,2024

Test Date: Jul.09,2024 ~ Sep.18,2024

Reference Document: 47 CFR Part 15 Subpart C Intentional Radiators

Test Result: Pass

Prepared by: Huang Lifang
Huang Lifang

Reviewed by: Wu Haoting
Wu Haoting

Approved by: Xiao Liang
Xiao Liang



GRG METROLOGY & TEST GROUP CO., LTD.

Issued Date: 2024-11-22

GRG METROLOGY & TEST GROUP CO., LTD.

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REPORT ISSUED HISTORY

Report Version	Report No.	Description	Compile Date
1.0	E20240129544701-2	Original Issue	2024-09-19

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1. TEST RESULT SUMMARY

47 CFR Part 15 Subpart C 15.247, ANSI C63.10-2020 KDB 558074 D01 15.247 measurement guidance v05r02			
Standard	Item	Limit / Severity	Result
FCC 47 CFR Part 15 Subpart C (15.247)	Antenna Requirement	Section 15.203	PASS
	20dB Bandwidth	Section 15.247(a)(1)	PASS
	Carrier Frequencies Separated	Section 15.247(a)(1)	PASS
	Hopping Channel Number	Section 15.247(a)(1)(iii)	PASS
	Dwell Time	Section 15.247(a)(1)(iii)	PASS
	Maximum Peak Output Power	Section 15.247(b)(1)	PASS
	Conducted band edges and Spurious Emission	Section 15.209 &15.247(d)	PASS
	Radiated Spurious Emission	Section 15.209 &15.247(d)	PASS
	Restricted bands of operation	Section 15.247 (d) &15.205	PASS

Note: The EUT antenna is PCB antenna. Max Antenna gain is 0dBi .Which accordance 15.203.is considered sufficient to comply with the provisions of this section.

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2. GENERAL DESCRIPTION OF EUT

2.1 APPLICANT

Name: Alps Alpine North America, Inc
Address: 1500 Atlantic Blvd Auburn Hills, Michigan 48326 United States

2.2 MANUFACTURER

Name: Alpine Electronics of America Inc
Address: 1500 Atlantic Blvd Auburn Hills, Michigan 48326 United States

2.3 FACTORY

Name: Huizhou Foryou General Electronics Co., Ltd.
Address: No.2 District A, Foryou Industry Park, No. 1 North Shangxia Road, Dongjiang Hi tech Industry Park, 516005 Huizhou city, Guangdong Province, China(PROC)

2.4 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment: Car Radio with Bluetooth
Model No.: KAC-CMD-CTR
Adding Model: KAC-CMD-NP
Models Difference: The model name KAC-CMD-CTR and KAC-CMD-NP have the same technical construction including circuit diagram, PCB LAYOUT, hardware version, software, except the model name different.
Trade Name: Alpine
FCC ID: 2ACH3KACCMDCTR
Power supply: DC 12V,15A
Frequency Range: 2402MHz~2480MHz
Transmit Power: GFSK:3.13 dBm
 $\pi/4$ -DQPSK:6.93dBm
8DPSK:4.79dBm
Type of Modulation: GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps,8DPSK for 3Mbps
Antenna Specification: PCB Antenna with 0dBi gain (Max)
Temperature Range: -20°C~+60°C

Hardware Version: V04

Software Version: HMS209A-V01.00.19-240605

Sample No: E20240129544701-0001, E20240129544701-0003

Note: The EUT antenna gain is provided by the applicant. This report is made solely on the basis of such data and/or information. We accept no responsibility for the authenticity and completeness of the above data and information and the validity of the results and/or conclusions.

2.5 TEST OPERATION MODE

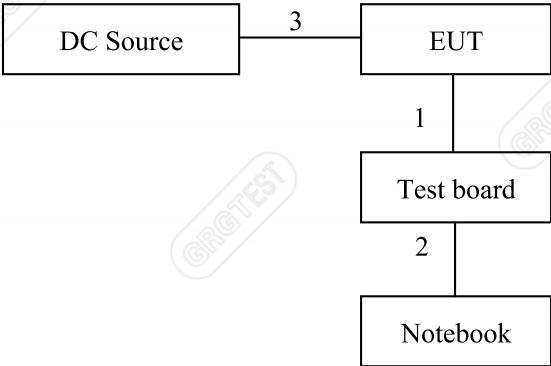
Mode No.	Description of the modes
1	Bluetooth(BT) fixed frequency transmitting

2.6 LOCAL SUPPORTIVE

Name of equipment	Manufacturer	Model	Serial number	Note
Notebook	DELL	Latitude3420	4KBCGL3	/
Test board	/	/	/	/
DC Source	Keysight	E36131A	/	/

No.	Cable Type	Qty.	Shielded Type	Ferrite Core(Qty.)	Length
1	Serial cable	1	No	0	0.2m
2	USB cable	1	No	0	1.0m
3	DC cable	1	No	0	1.0m

2.7 CONFIGURATION OF SYSTEM UNDER TEST



Test software:

Software version	Test level
Teraterm	DH5: 12 2DH5: 14 3DH5: Default

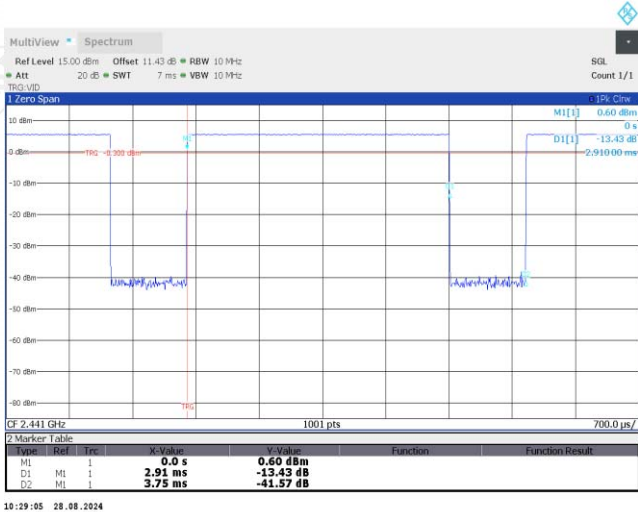
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2.8 DUTY CYCLE

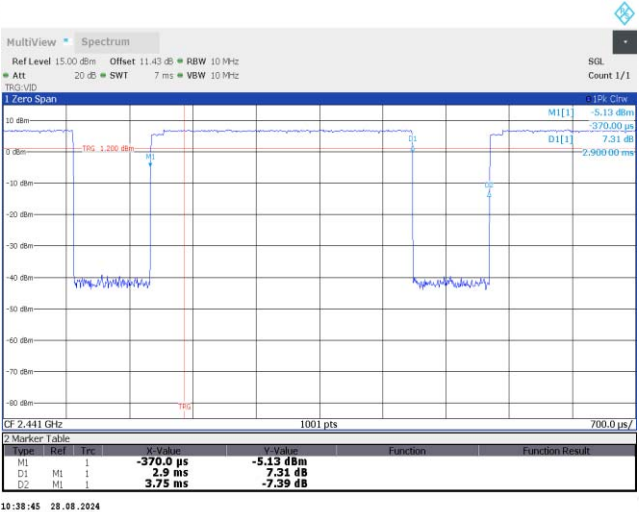
EUT Name	Car Radio with Bluetooth	Model	KAC-CMD-CTR
Environmental Conditions	25.3°C/49%RH/101.0kPa	Test Voltage	DC 12V
Tested By	Qin Tingting	Tested Date	2024-08-28

Test Mode	Antenna	Frequency [MHz]	ON Time [ms]	Period [ms]	DC [%]	T [s]
DH5	Ant1	2441	2.91	3.75	77.60	0.00291
2DH5	Ant1	2441	2.90	3.75	77.33	0.00290
3DH5	Ant1	2441	2.90	3.76	77.13	0.00290

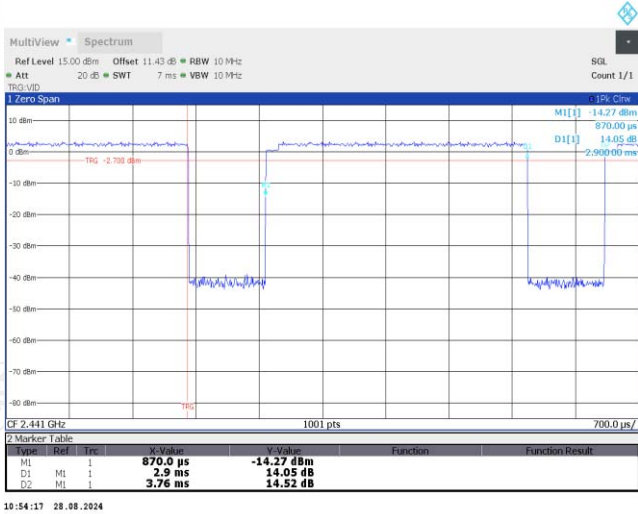
DH5_2441MHz



2DH5_2441MHz



3DH5_2441MHz



3. LABORATORY AND ACCREDITATIONS

3.1 LABORATORY

The tests & measurements refer to this report were performed by Shenzhen EMC Laboratory of GRG METROLOGY & TEST GROUP CO., LTD.

Add : No.1301 Guangang Road Xinlan Community, Guanlan Street, Longhua District
Shenzhen, 518110, People's Republic of China
P.C. : 518110
Tel : 0755-61180008
Fax : 0755-61180008

3.2 ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to GB/T 27025(ISO/IEC 17025:2017)

USA A2LA(Certificate #2861.01)

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada ISED (Company Number: 24897, CAB identifier:CN0069)

USA FCC (Registration Number: 759402, Designation Number:CN1198)

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4. MEASUREMENT 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		Frequency	Uncertainty
Radiated Emission	X	9kHz~30MHz	4.4dB ¹⁾
	Y	9kHz~30MHz	4.4dB ¹⁾
	Z	9kHz~30MHz	4.4dB ¹⁾
	Horizontal	30MHz~200MHz	4.6dB ¹⁾
		200MHz~1000MHz	4.8dB ¹⁾
		1GHz~18GHz	5.0dB ¹⁾
		18GHz~26.5GHz	5.2dB ¹⁾
	Vertical	30MHz~200MHz	4.7dB ¹⁾
		200MHz~1000MHz	4.7dB ¹⁾
		1GHz~18GHz	5.1dB ¹⁾
		18GHz~26.5GHz	5.4dB ¹⁾

Measurement	Uncertainty
RF frequency	6.0×10^{-6}
RF power conducted	0.78dB
Occupied channel bandwidth	0.40dB
Unwanted emission, conducted	0.68dB
Humidity	6.0%
Temperature	2.0°C

Note:

¹⁾ This uncertainty represents an expanded uncertainty expressed at approximately the 95%.
This uncertainty represents an expanded uncertainty factor of $k=2$.

5. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Radiated Spurious Emission&Restricted bands of operation				
Test Receiver	R&S	ESR26	101758	2024-09-22
Spectrum Analyzer	R&S	FSW43	102072	2025-06-14
Bi-log Antenna	Schwarzbeck	VULB9160	VULB9160-3402	2024-10-06
Loop Antenna	Schwarzbeck	FMZB 1513-60	1513-60-56	2025-05-07
Preamplifier	SHIRONG ELECTRONIC	DLNA-30M1G-G41	20200928002	2024-10-24
Horn Antenna	Schwarzbeck	BBHA9120D	02143	2025-09-07
Board-Band Horn Antenna	Schwarzbeck	BBHA 9170	BBHA 9170-497	2025-08-30
Amplifier	Tonscend	TAP01018048	AP20E8060075	2025-03-01
Amplifier	Tonscend	TAP184050	AP20E806071	2025-03-01
Amplifier	SHIRONG ELECTRONIC	DLNA-1G18G-G40	20200928005	2025-07-19
Test S/W	Tonscend	JS32-RE/5.0.0		
20dB Bandwidth& Carrier Frequencies Separated & Hopping Channel Number & Dwell Time &Conducted band edges and Spurious Emission				
Spectrum Analyzer	R&S	FSW43	102072	2025-06-14
Automatic power measuring unit	TONSCEND	JS0806-2	21B8060365	2024-12-28
BT/WIFI System	Tonscend	JS1120-3		
Maximum Peak Output Power				
Pulse power sensor	Anritsu	MA2411B	1126150	2025-01-11
Power meter	Anritsu	ML2495A	1204003	2025-01-11

Note: The calibration interval of the above test instruments is 12 months.

6. E.U.T. TEST CONDITIONS

Type of antenna: PCB

Test frequencies: According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top 1 near middle and 1 near bottom

EUT channels and frequencies list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	14	2416	28	2430
1	2403	15	2417	29	2431
2	2404	16	2418	30	2432
3	2405	17	2419	31	2433
4	2406	18	2420	32	2434
5	2407	19	2421	33	2435
6	2408	20	2422	34	2436
7	2409	21	2423	35	2437
8	2410	22	2424	36	2438
9	2411	23	2425	37	2439
10	2412	24	2426	38	2440
11	2413	25	2427	39	2441
12	2414	26	2428	40	2442
13	2415	27	2429	41	2443

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
42	2444	55	2457	68	2470
43	2445	56	2458	69	2471
44	2446	57	2459	70	2472
45	2447	58	2460	71	2473
46	2448	59	2461	72	2474
47	2449	60	2462	73	2475
48	2450	61	2463	74	2476
49	2451	62	2464	75	2477
50	2452	63	2465	76	2478
51	2453	64	2466	77	2479
52	2454	65	2467	78	2480
53	2455	66	2468		
54	2456	67	2469		

Test frequency is the lowest channel: 0 frequency(2402MHz), middle channel: 39 frequency (2441MHz) and highest channel: 78 frequency(2480MHz)

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7. 20dB BANDWIDTH

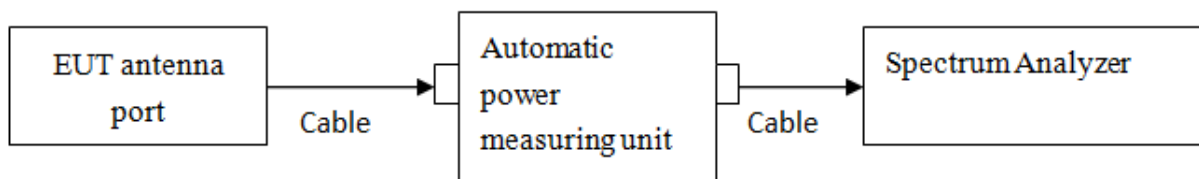
7.1 LIMITS

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.

7.2 TEST PROCEDURES

- 1) Remove the antenna from the EUT, and then connect a low loss RF cable from antenna port to the spectrum analyzer.
- 2) Set the spectrum analyzer as RBW=30 kHz, VBW=100 kHz, Span=3MHz, Sweep = auto. Allow the trace to stabilize, record 20dB bandwidth value
- 3) Repeat until all the test channels are investigated.

7.3 TEST SETUP



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7.4 TEST RESULTS

Environment: 25.3℃/49%RH/101.0kPa
Tested By:Qin Tingting

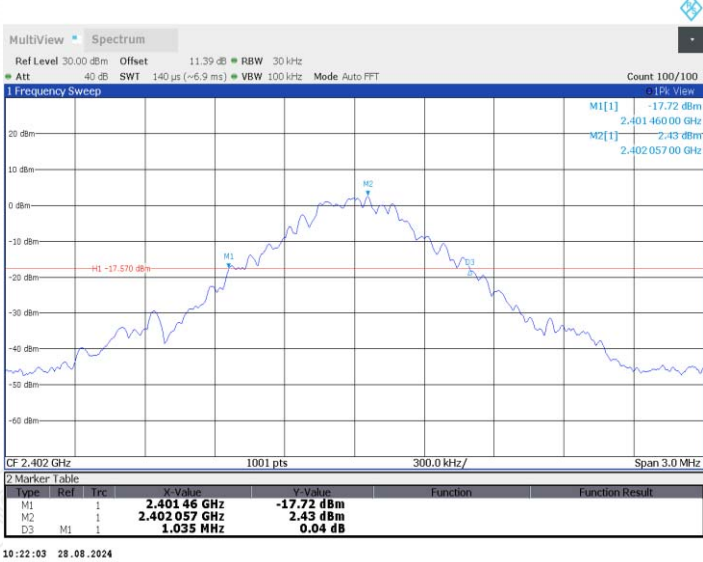
Voltage:DC 12V
Date: 2024-08-28

Test Mode	Antenna	Channel	Frequency [MHz]	20 dB Bandwidth [MHz]
DH5	Ant1	Lowest	2402	1.04
		Middle	2441	1.02
		Highest	2480	1.04
2DH5	Ant1	Lowest	2402	1.36
		Middle	2441	1.36
		Highest	2480	1.35
3DH5	Ant1	Lowest	2402	1.34
		Middle	2441	1.34
		Highest	2480	1.34

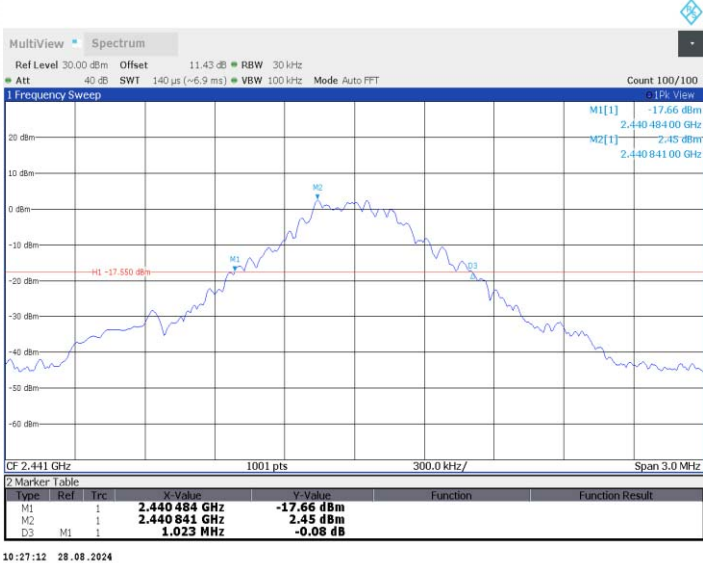
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Test Graphs

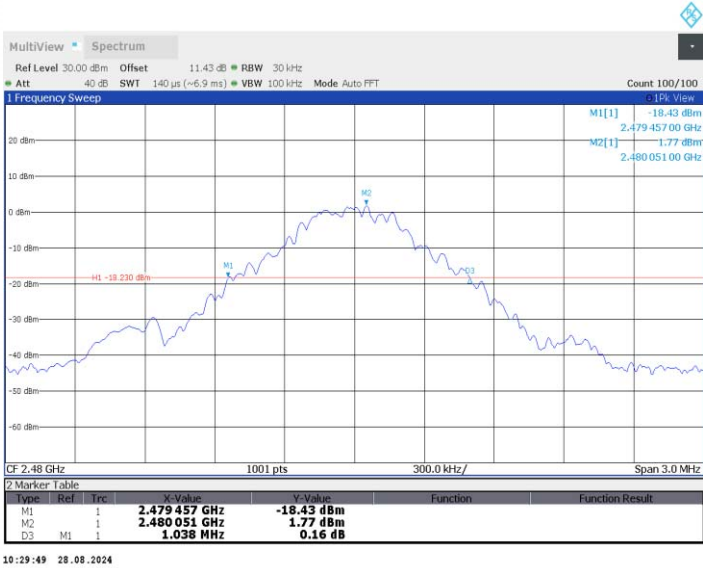
DH5
Lowest Channel



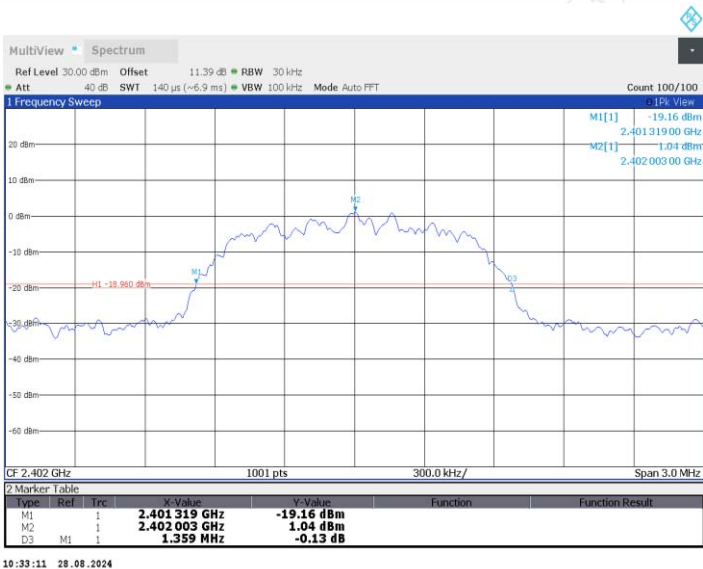
Middle Channel



Highest Channel



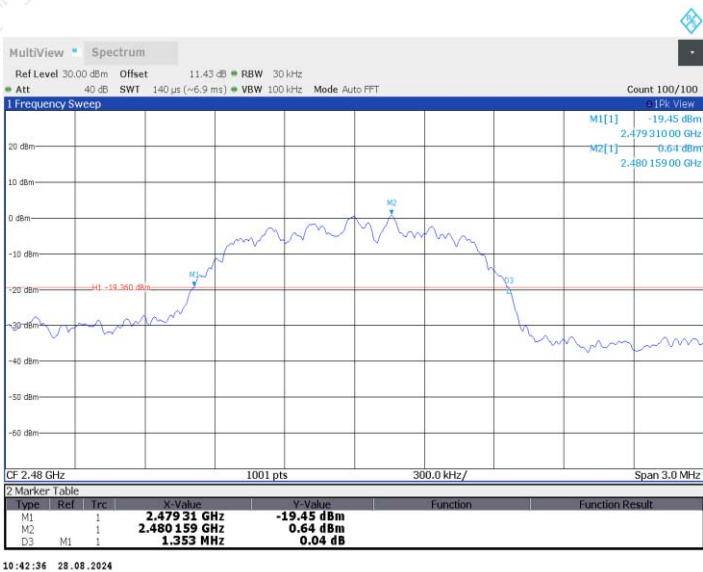
2DH5
Lowest Channel



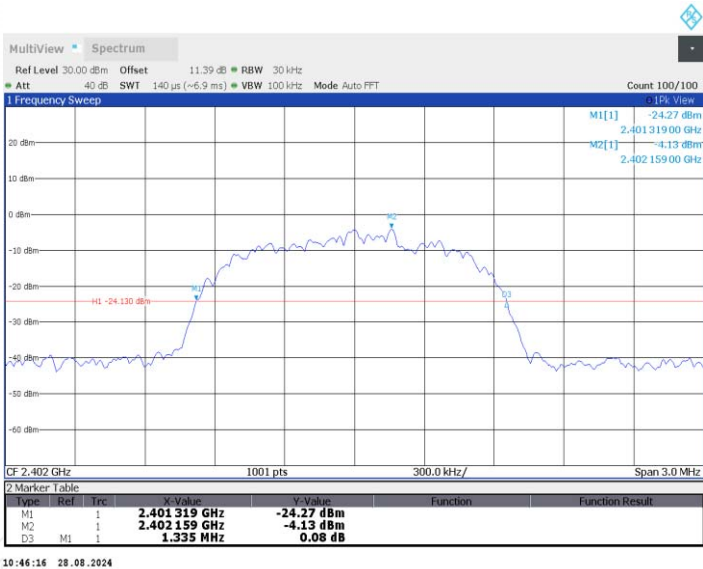
Middle Channel



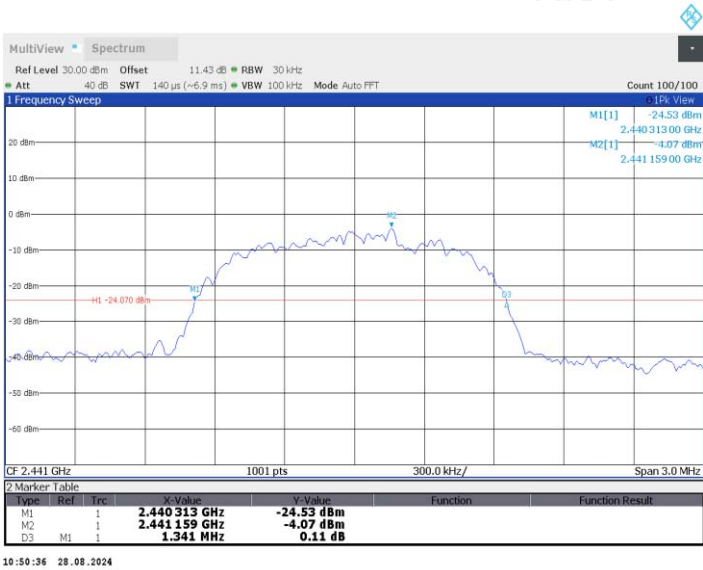
Highest Channel



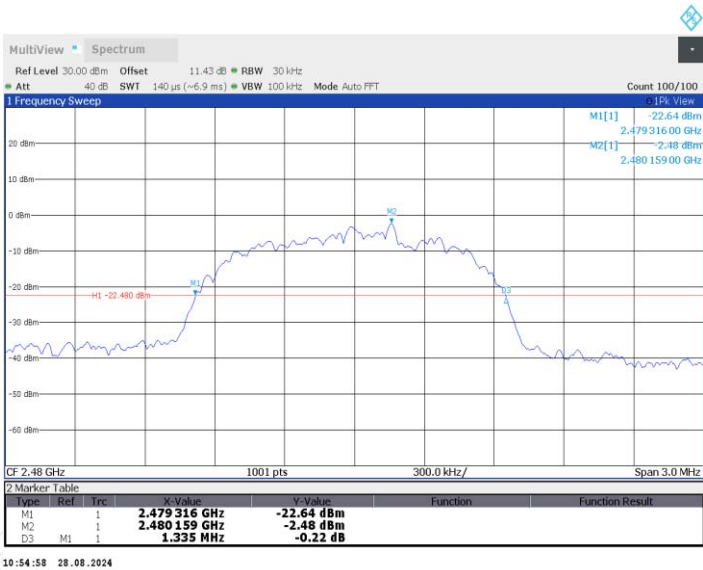
3DH5
Lowest Channel



Middle Channel



Highest Channel



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8. CARRIER FREQUENCIES SEPARATED

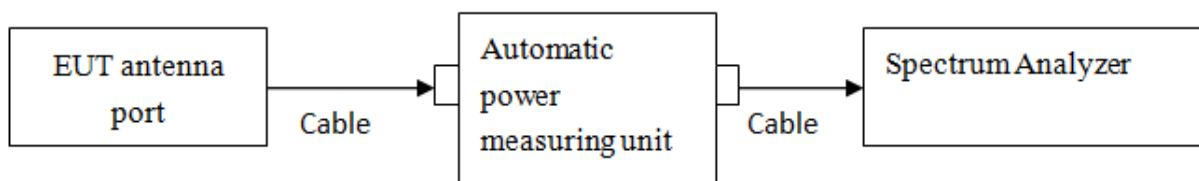
8.1 LIMITS

1) 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.

8.2 TEST PROCEDURES

- 1) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 2) Set center frequency of spectrum analyzer = middle of hopping channel.
- 3) Set the spectrum analyzer as RBW=300kHz, VBW=300kHz, Adjust Span to 2MHz, Sweep = auto
- 4) Use the marker-delta function to mark hopping channel carrier frequencies and record the channel separation.

8.3 TEST SETUP



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8.4 TEST RESULTS

Environment: 25.3°C/49%RH/101.0kPa
Tested By:Qin Tingting

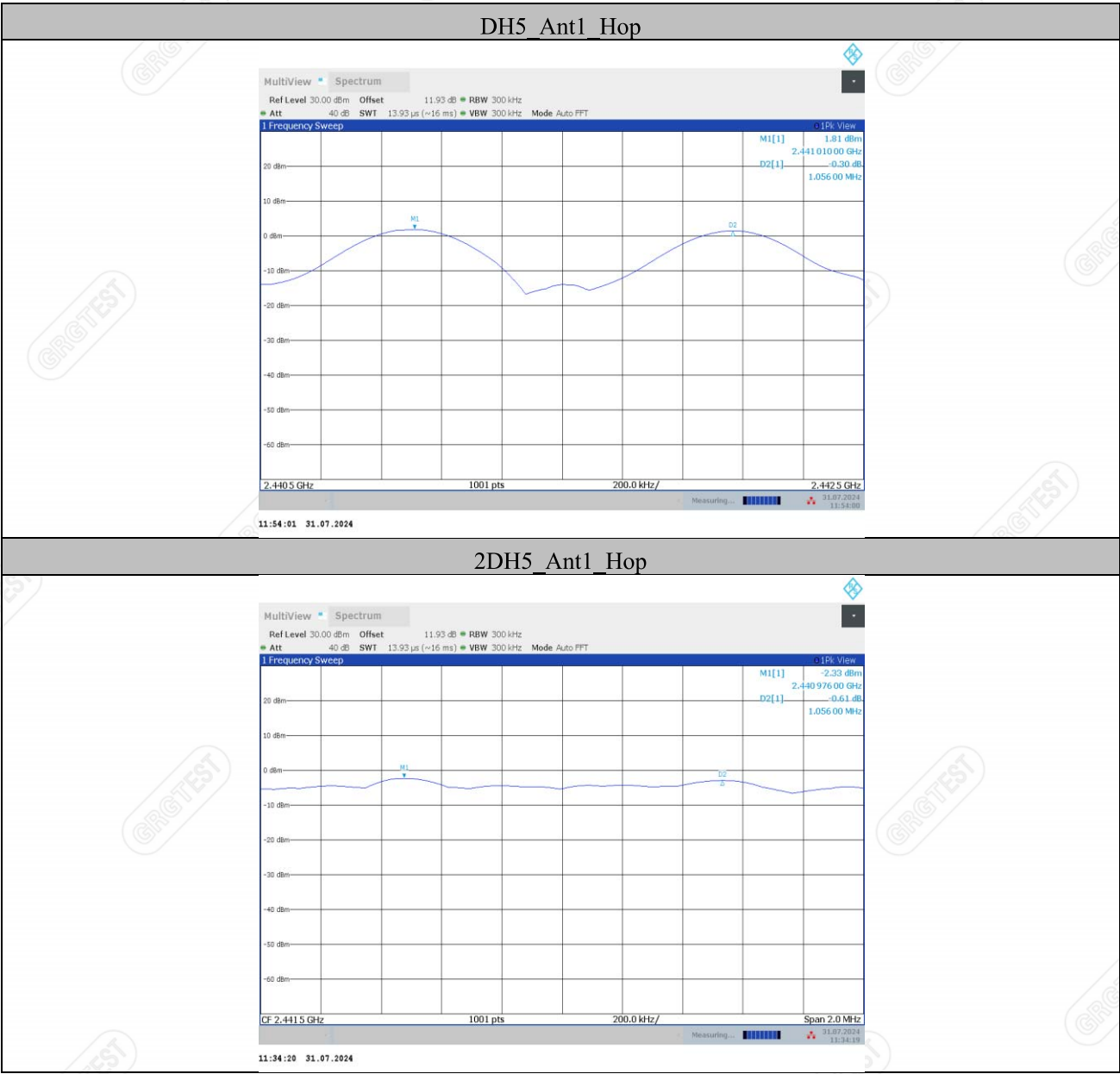
Voltage:DC 12V
Date: 2024-07-31

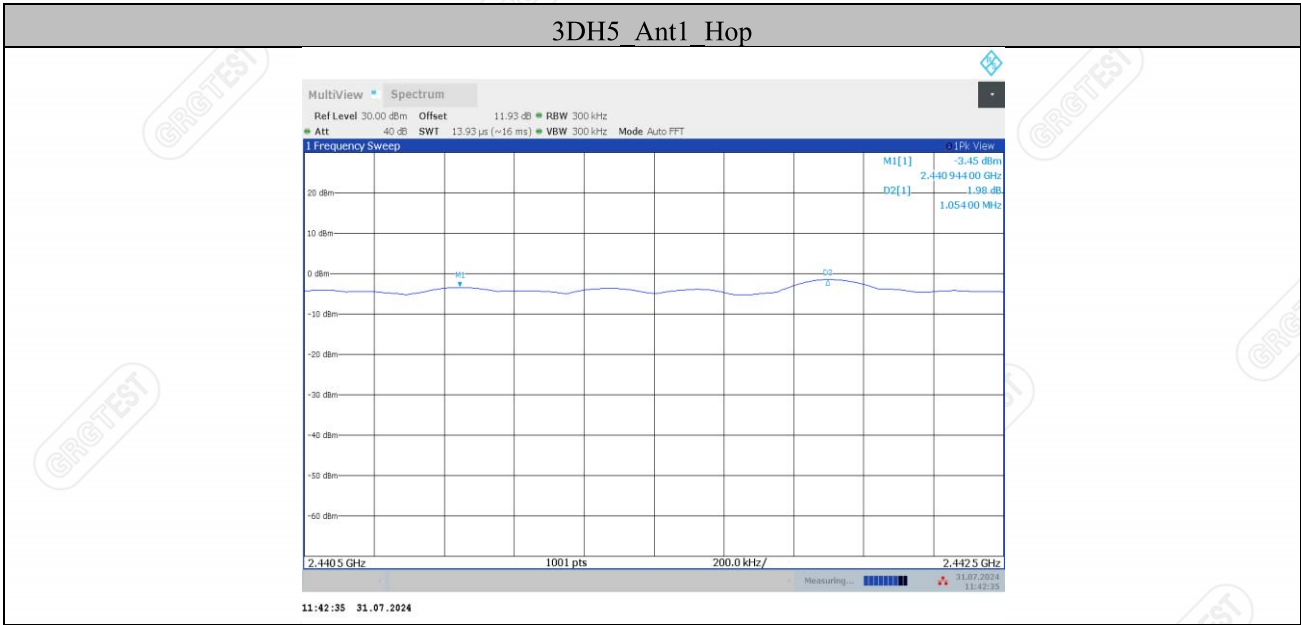
Test Mode	Antenna	Freq[MHz]	Result[MHz]	Limit[MHz]	Verdict
DH5	Ant1	Hop	1.056	≥0.694	PASS
2DH5	Ant1	Hop	1.056	≥0.907	PASS
3DH5	Ant1	Hop	1.054	≥0.900	PASS

Note: Limit[MHz]=2/3 * 20 dB Bandwidth [MHz].

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Test Graphs





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9. HOPPING CHANNEL NUMBER

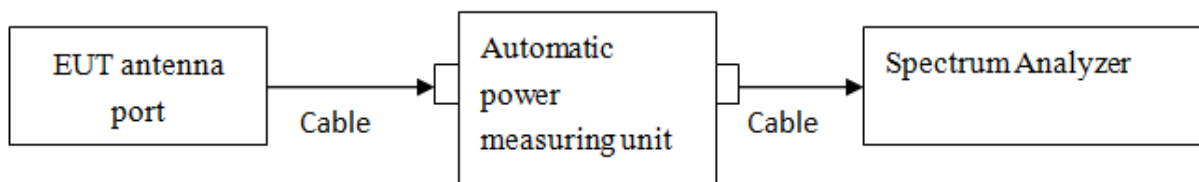
9.1 LIMITS

Regulation 15.247 (a) (1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

9.2 TEST PROCEDURES

- 1) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 2) Set the spectrum analyzer as RBW=300kHz, VBW=300kHz.
- 3) Set the spectrum analyzer: start frequency = 2400MHz. stop frequency = 2483.5MHz. Submit the test result graph.

9.3 TEST SETUP



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9.4 TEST RESULTS

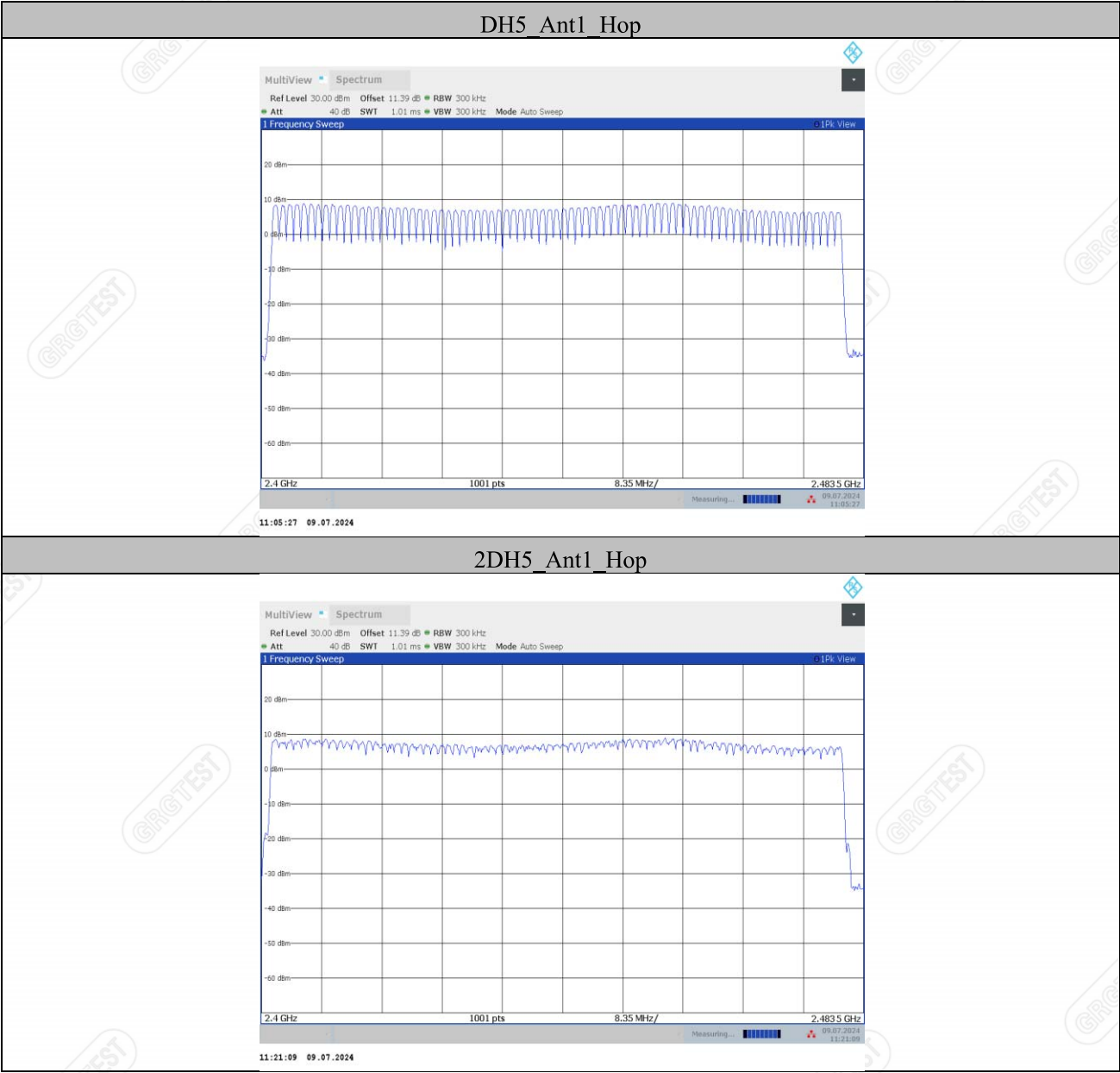
Environment: 25.3°C/49%RH/101.0kPa
Tested By:Qin Tingting

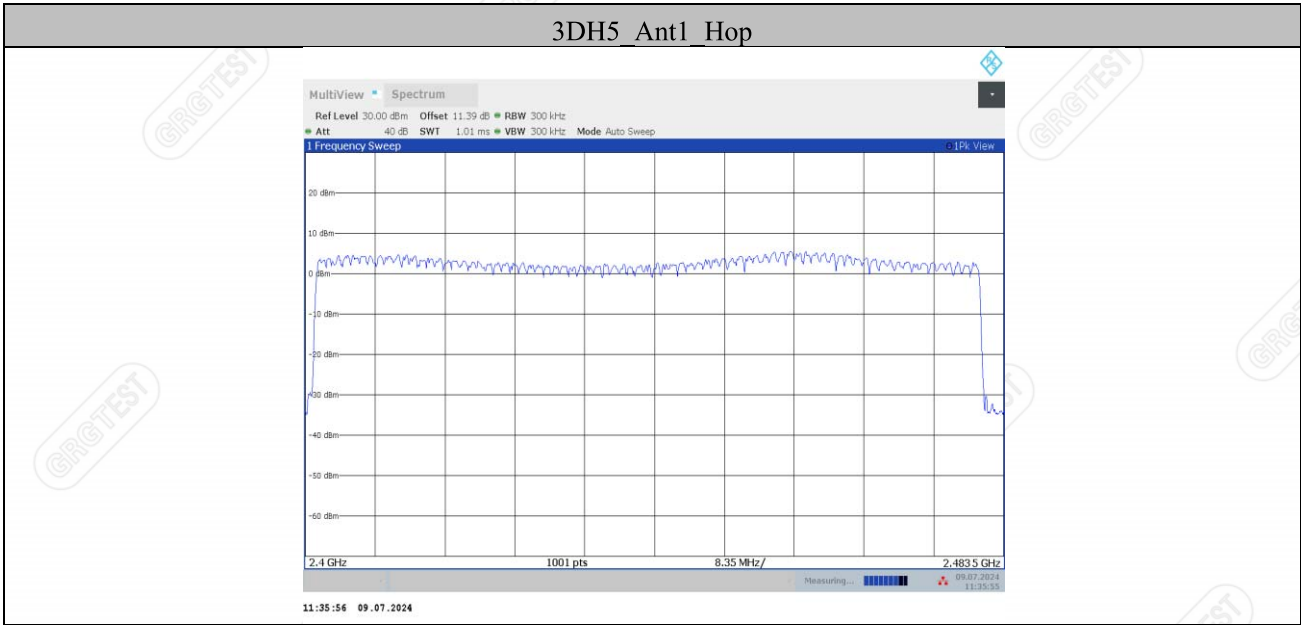
Voltage:DC 12V
Date: 2024-07-09

Test Mode	Antenna	Freq[MHz]	Result[Num]	Limit[Num]	Verdict
DH5	Ant1	Hop	79	≥15	PASS
2DH5	Ant1	Hop	79	≥15	PASS
3DH5	Ant1	Hop	79	≥15	PASS

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Test Graphs





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10. DWELL TIME

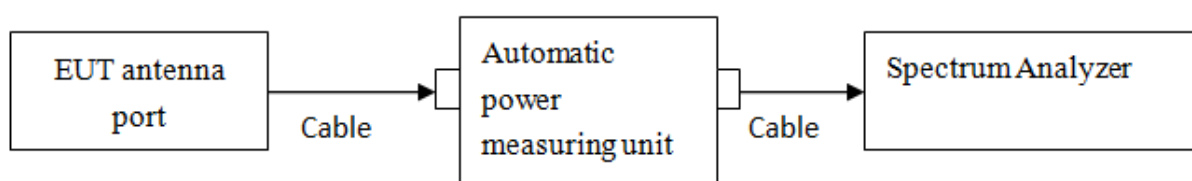
10.1 LIMITS

Regulation 15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

10.2 TEST PROCEDURES

- 1) Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
- 2) Set spectrum analyzer span = 0. centered on a hopping channel;
- 3) Set RBW = 1MHz and VBW = 3MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Detector Function = Peak. Trace = Clear Write;
- 4) Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.). Repeat this test for each variation.
- 5) DH1 Packet permit maximum $1600 / 79 / 2 = 10.12$ hops per second in each channel (1 time slot TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times $10.12 \times 31.6 = 320$ within 31.6 seconds
- 6) DH3 Packet permit maximum $1600 / 79 / 4 = 5.06$ hops per second in each channel (3 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times $5.06 \times 31.6 = 160$ within 31.6 seconds
- 7) DH5 Packet permit maximum $1600 / 79 / 6 = 3.37$ hops per second in each channel (5 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times $3.37 \times 31.6 = 106.6$ within 31.6 seconds

10.3 TEST SETUP



10.4 TEST RESULTS

Environment: 25.3℃/49%RH/101.0kPa
Tested By:Qin Tingting

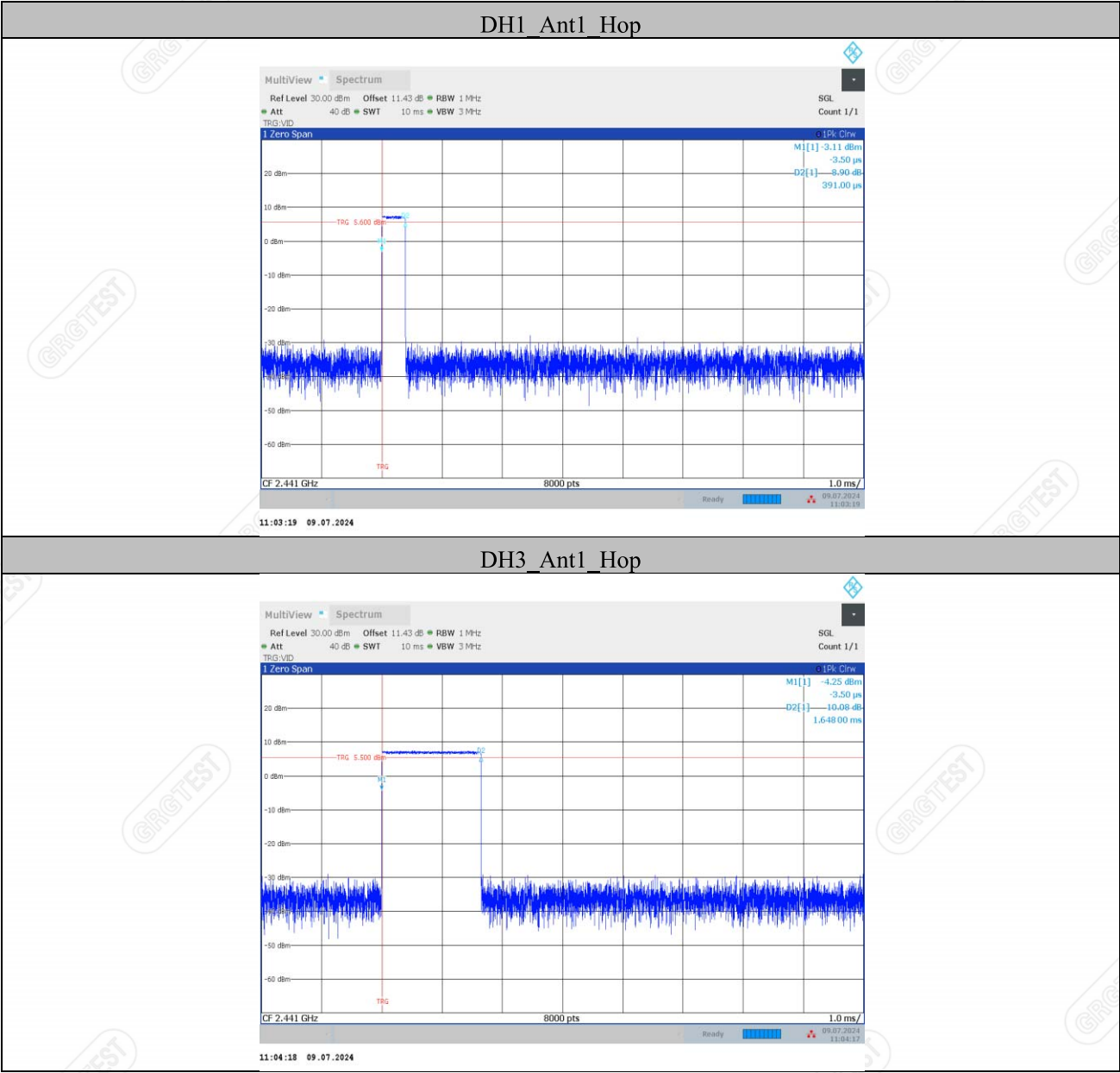
Voltage:DC 12V
Date: 2024-07-09

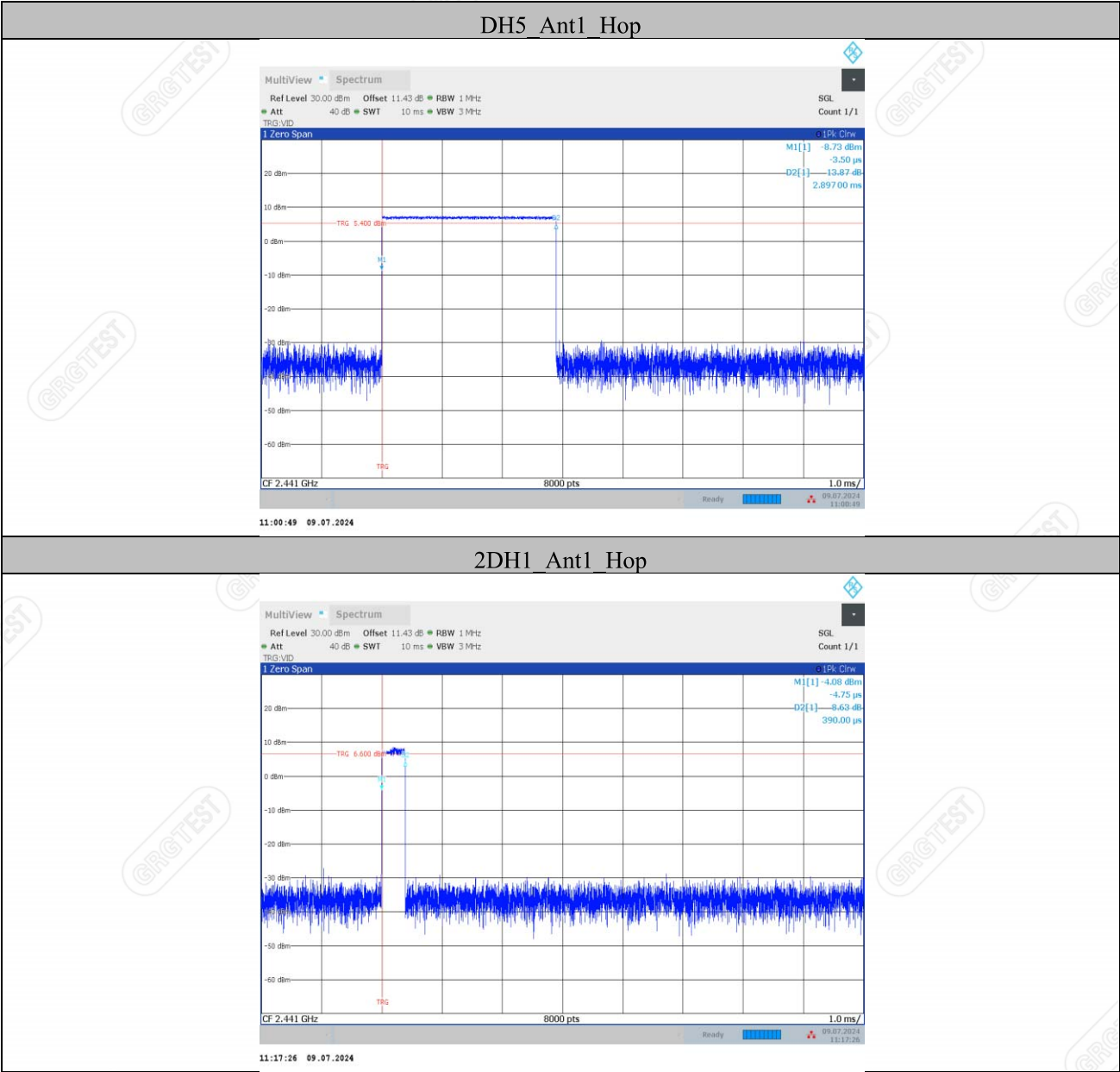
The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

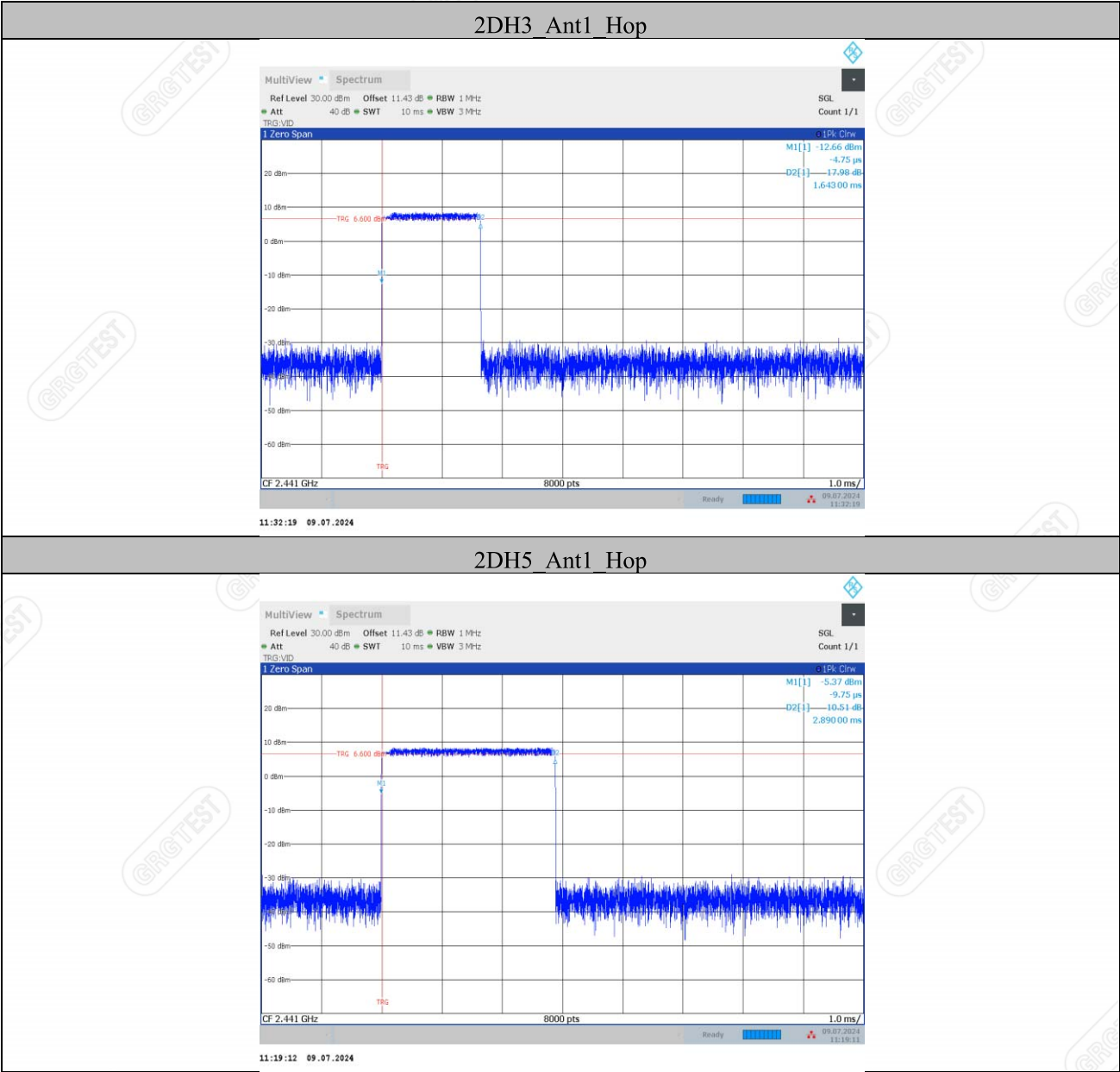
Test Mode	Antenna	Freq[MHz]	Burst Width [ms]	Total Hops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.391	320	0.125	≤0.4	PASS
DH3	Ant1	Hop	1.648	160	0.264	≤0.4	PASS
DH5	Ant1	Hop	2.897	106.67	0.309	≤0.4	PASS
2DH1	Ant1	Hop	0.390	320	0.125	≤0.4	PASS
2DH3	Ant1	Hop	1.643	160	0.263	≤0.4	PASS
2DH5	Ant1	Hop	2.890	106.67	0.308	≤0.4	PASS
3DH1	Ant1	Hop	0.390	320	0.125	≤0.4	PASS
3DH3	Ant1	Hop	1.640	160	0.262	≤0.4	PASS
3DH5	Ant1	Hop	2.892	106.67	0.308	≤0.4	PASS

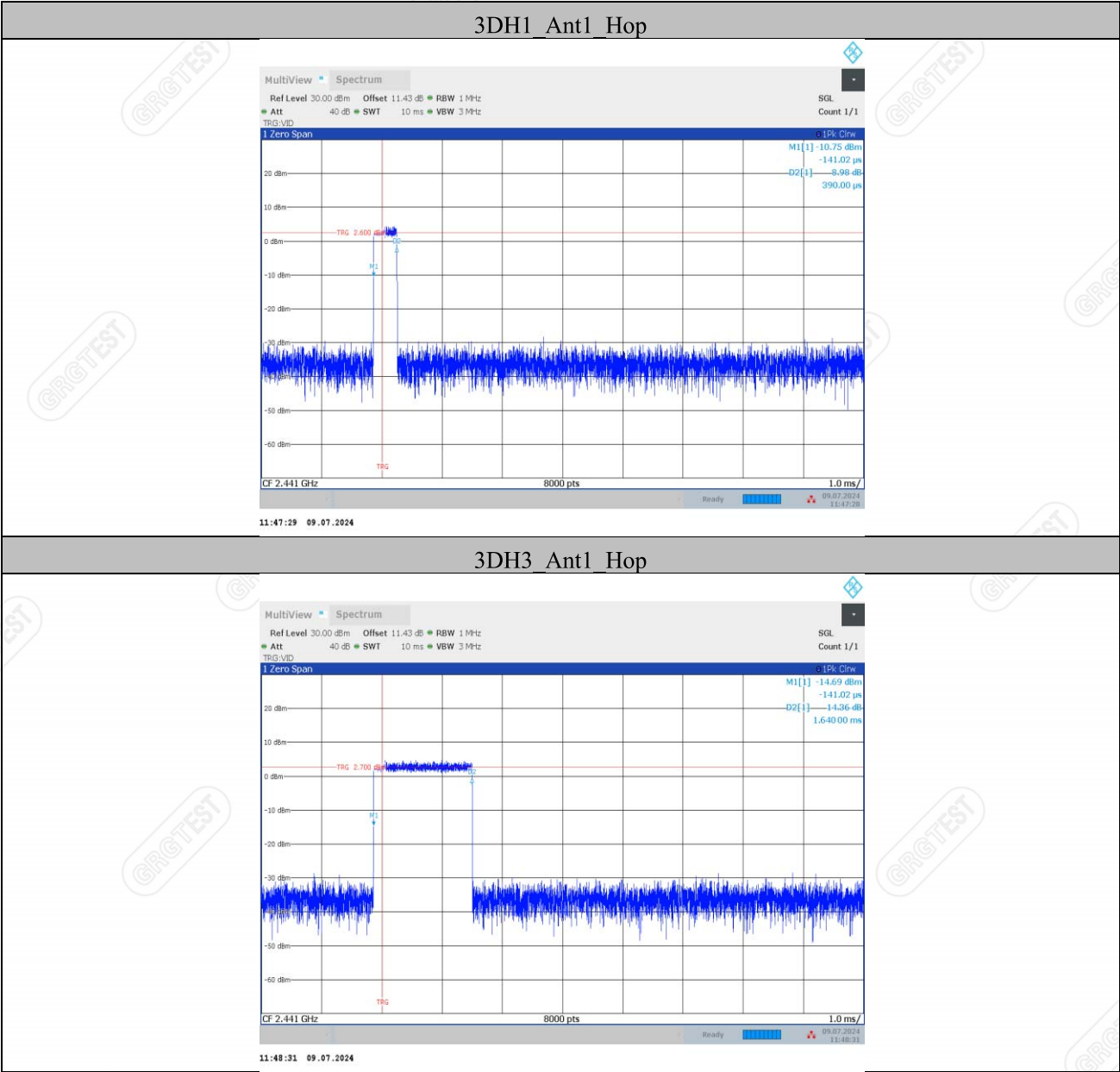
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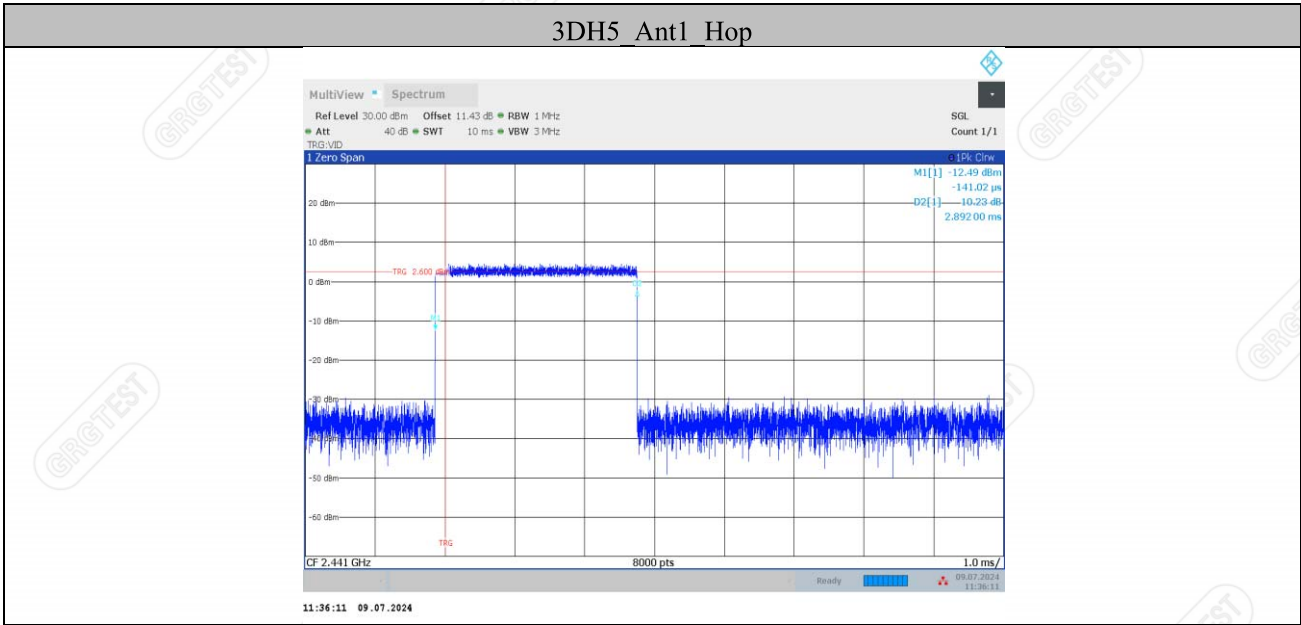
Test Graphs











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11. MAXIMUM PEAK OUTPUT POWER

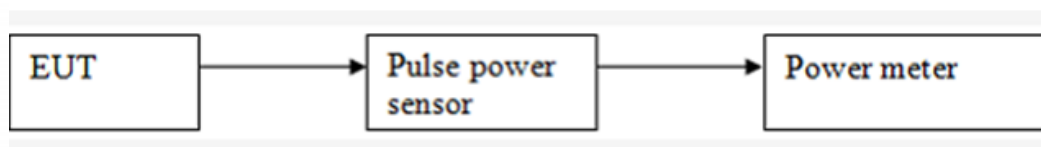
11.1 LIMITS

Regulation 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.

11.2 TEST PROCEDURES

- 1) Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the power meter and enable the EUT transmit continuously.
- 2) Keep the EUT in transmitting at lowest, middle and highest channel individually. Record the max value.

11.3 TEST SETUP



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11.4 TEST RESULTS

Environment: 25.3°C/49%RH/101.0kPa
Tested By:Qin Tingting

Voltage:DC 12V
Date: 2024-07-09 ~ 2024-09-18

DH5

Test Channel	Fundamental Frequency (GHz)	Max Output Power(dBm)	Limit (dBm)	Peak/ Average	Pass/Fail
Lowest	2.402	1.62	20.97	Peak	Pass
Middle	2.441	1.52			Pass
Highest	2.480	3.13			Pass

2DH5

Test Channel	Fundamental Frequency (GHz)	Max Output Power(dBm)	Limit (dBm)	Peak/ Average	Pass/Fail
Lowest	2.402	6.24	20.97	Peak	Pass
Middle	2.441	6.45			Pass
Highest	2.480	6.93			Pass

3DH5

Test Channel	Fundamental Frequency (GHz)	Max Output Power(dBm)	Limit (dBm)	Peak/ Average	Pass/Fail
Lowest	2.402	3.21	20.97	Peak	Pass
Middle	2.441	3.27			Pass
Highest	2.480	4.79			Pass

12. CONDUCTED BAND EDGES AND SPURIOUS EMISSIONS

12.1 LIMITS

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB.

12.2 TEST PROCEDURES

Test procedures follow KDB 558074 D01 DTS Measurement Guidance v05r02.

- 1) Remove the antenna from the EUT and then connect a low attenuation cable from the antenna port to the spectrum.
- 2) Set the spectrum analyzer: RBW = 100kHz; VBW = 300kHz, Frequency range = 30MHz to 26.5GHz; Sweep = auto; Detector Function = Peak. Trace = Max, hold.
- 3) Measure and record the results in the test report.
- 4) The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

12.3 TEST SETUP

