

Test Report

Verified code: 367537

Report No.: E20211217696105-2

Customer: BYD Auto Industry Company Limited

Address: No. 3001, 3007, Hengping Road, Pingshan, Shenzhen, P. R. China

Sample Name: DiLink

Sample Model: DiLink 3.0F

Receive Sample Date: Feb.10,2022

Test Date: Apr.03,2022 ~ Apr.24,2022

Reference Document: CFR 47, FCC Part 15 Subpart C
RADIO FREQUENCY DEVICES:Subpart C—Intentional Radiators

Test Result: Pass

Prepared by: Yang Zhaoyun

Reviewed by: Zhao Zetian

Approved by: Xiao Liang

GUANGZHOU GRG METROLOGY & TEST CO., LTD

Issued Date: 2022-06-08

GUANGZHOU GRG METROLOGY & TEST CO., LTD.

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5. Without the agreement of the laboratory, the client is not authorized to use the test results for unapproved propaganda.

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REPORT ISSUED HISTORY

Report Version	Report No.	Description	Compile Date
1.0	E20211217696105-2	Original Issue	2022-04-28

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1. TEST RESULT SUMMARY

FCC 47 CFR Part 15 Subpart C 15.247, ANSI C63.10-2013 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)(ii)	PASS
	Dwell Time	Section 15.247(a)(1)(iii)	PASS
	Maximum Peak Output Power	Section 15.247(b)(1)	PASS
	Conducted Emission	Section 15.207	Not Applicable
	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 &15.209	PASS

Note:1) Not Applicable, the EUT is powered by DC 12V.

2)The EUT antenna is External antenna. Max Antenna gain is -1.77dBi .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: BYD Auto Industry Company Limited
Address: No. 3001, 3007, Hengping Road, Pingshan, Shenzhen, P. R. China

2.2 MANUFACTURER

Name: BYD Auto Industry Company Limited
Address: No. 3001, 3007, Hengping Road, Pingshan, Shenzhen, P. R. China

2.3 FACTORY

Name: Huizhou BYD Electronics Co., Ltd.
Address: Xiangshui River, Economic Development Zone, Daya Bay, Huizhou, Guangdong, P. R. China

2.4 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment: DiLink
Model No.: DiLink 3.0F
Adding Model: /
Models discrepancy: /
Trade Name: BYD
FCC ID: SD4-DILINK6125F
Power supply: DC 12V
Frequency Band: 2402MHz~2480MHz
Transmit Power: GFSK:-0.14dBm
 $\pi/4$ -DQPSK:-0.95dBm
8DPSK: -0.61dBm
Type of Modulation: FHSS (GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps, 8DPSK for 3Mbps)
Antenna Specification: External antenna with – 1.77dBi gain (Max)
Temperature Range: -30℃~70℃
Hardware Version: DiLink HW 6125F
Software Version: DiLink SW 4.0F
Sample No: E20211217696105-0001
Note: /

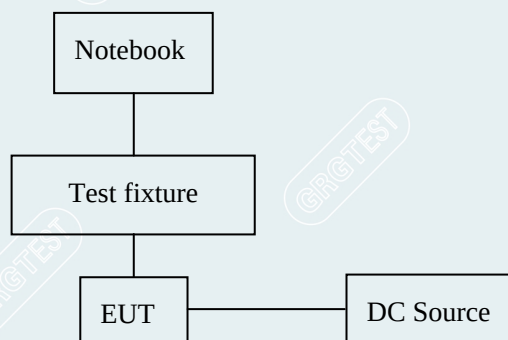
2.5 TEST OPERATION MODE

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	LENOVO	TianYi 310-14ISK	MP18DLC6	/
Adapter(Notebook)	LENOVO	ADLX65NVV3A	SA10M42747	Unshielded, 1m (AC Cable) Shielded, 1.8m (DC Cable)
DC Source	LW	PS-305DM	/	/
Test fixture	/	/	/	/
Cable				
Test fixture cable	/	/	/	Unshielded 0.15m
USB cable	/	/	/	Unshielded 1.0m
DC cable	/	/	/	Unshielded 0.8m

2.7 CONFIGURATION OF SYSTEM UNDER TEST



Test software:

Software version	Test level
QRCT	7

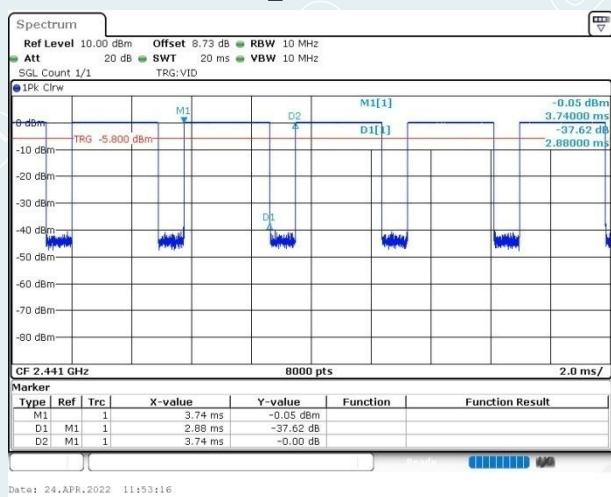
2.8 DUTY CYCLE

Environment: 24.2°C/51%RH
Tested By: Lu Wei

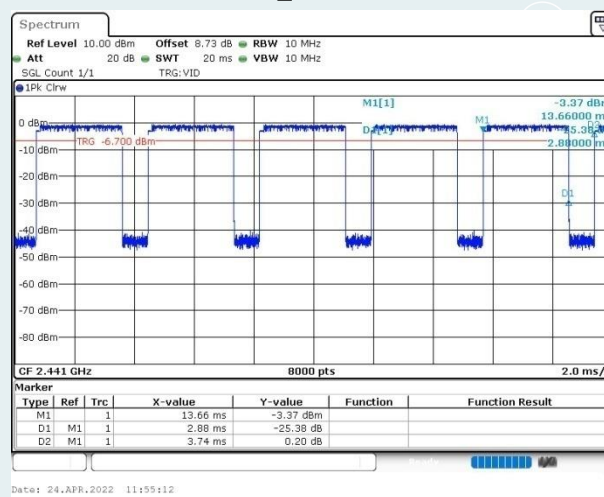
Voltage: DC 12V
Date: 2022-04-24

Test Mode	Antenna	Frequency (MHz)	ON Time [ms]	Period [ms]	DC [%]	T [s]
DH5	Ant1	2441	2.88	3.74	77.01	0.00289
2DH5	Ant1	2441	2.88	3.74	77.01	0.00289
3DH5	Ant1	2441	2.88	3.75	77.01	0.00290

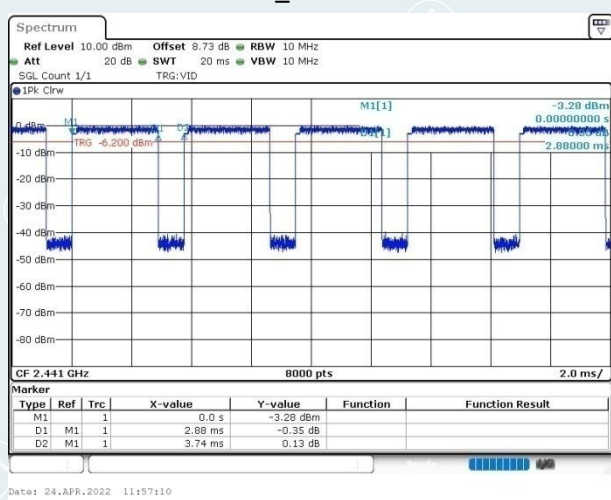
DH5_2441 MHz



2DH5_2441 MHz



3DH5_2441 MHz



3. LABORATORY AND ACCREDITATIONS AND MEASUREMENT UNCERTAINTY

3.1 LABORATORY

The tests & measurements refer to this report were performed by Shenzhen EMC Laboratory of Guangzhou GRG Metrology & Test Co., Ltd.

Add.: No.1301 Guanguang 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 ISO/IEC 17025.

USA	A2LA(Certificate #2861.01)
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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)

Copies of granted accreditation certificates are available for downloading from our web site,
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3.3 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	Horizontal	9kHz~30MHz	4.5dB
		30MHz~1000MHz	4.3dB
		1GHz~18GHz	5.6dB
		18GHz~26.5GHz	3.7dB
	Vertical	9kHz~30MHz	4.5dB
		30MHz~1000MHz	4.3dB
		1GHz~18GHz	5.6dB
		18GHz~26.5GHz	3.7dB

Measurement	Uncertainty
RF frequency	6.0×10^{-6}
RF power conducted	0.8 dB
Occupied channel bandwidth	0.4 dB
Unwanted emission, conducted	0.7 dB
Humidity	6 %
Temperature	2 °C

This uncertainty represents an expanded uncertainty factor of $k=2$.

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4. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Radiated Spurious Emission & Restricted bands of operation				
Test S/W	EZ	CCS-03A1		
Test Receiver	R&S	ESR7	102444	2022-09-21
Preamplifier	EMEC	EM330	I00426	2023-03-05
Bi-log Antenna	Schwarzbeck	VULB9160	VULB9160-3401	2022-10-27
Spectrum Analyzer	Agilent	N9020B	MY57120179	2022-08-08
Loop Antenna	TESEQ	HLA6121	52599	2023-04-02
Horn Antenna	Schwarzbeck	BBHA9120D (1201)	02143	2022-10-22
Board-Band Horn Antenna	Schwarzbeck	BBHA 9170	BBHA 9170-497	2022-10-16
Amplifier	Tonscend	TAP01018048	AP20E8060075	2022-05-09
Amplifier	Tonscend	TAP184050	AP20E806071	2022-05-17
Test S/W	Tonscend	JS36-RE/2.5.1.5		
20 dB Bandwidth & Hopping Channel Number & Dwell Time & Conducted band edges and Spurious Emission & Carrier Frequencies Separated				
Spectrum Analyzer	R&S	FSV30	104381	2022-12-10
Simultaneous sampling DAQ	Tonscend	JS0806-2	186060020	2022-09-04
BT/WIFI System	Tonscend	JS1120-3		
Maximum Peak Output Power				
Pulse power sensor	Anritsu	MA2411B	1126150	2023-03-01
Power meter	Anritsu	ML2495A	1204003	2023-02-28

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

5. EUT TEST CONDITIONS

Type of antenna:

External antenna

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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6. 20dB BANDWIDTH

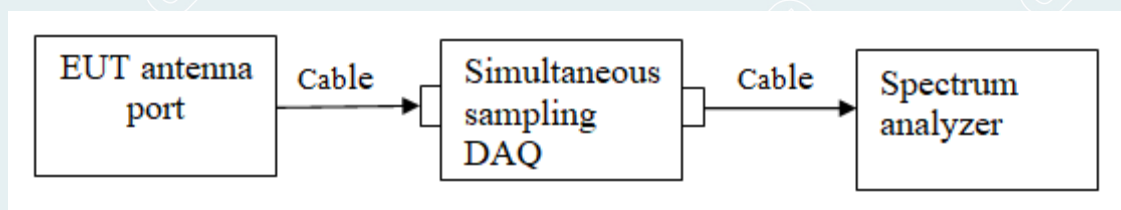
6.1 LIMITS

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.

6.2 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=30kHz, VBW=100kHz, Span=3MHz, Sweep = auto. Allow the trace to stabilize, record 20dB bandwidth value.
- 3) Repeat until all the test channels are investigated.

6.3 TEST SETUP



6.4 TEST RESULTS

Environment: 23.1°C/53%RH
 Tested By: Lu Wei

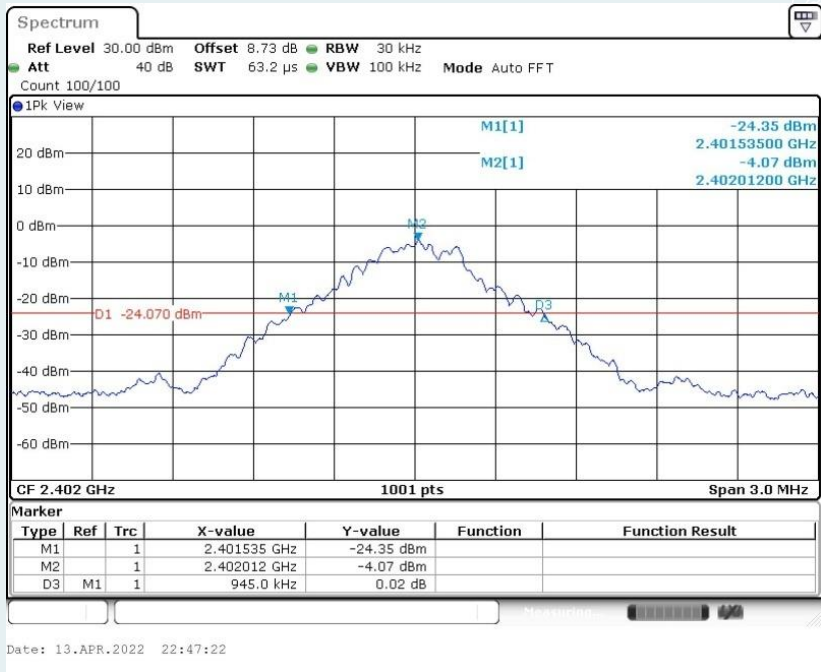
Voltage: DC 12V
 Date: 2022-04-13

Test mode	Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
DH5	Lowest	2402	945
	Middle	2441	942
	Highest	2480	942
2DH5	Lowest	2402	1290
	Middle	2441	1287
	Highest	2480	1284
3DH5	Lowest	2402	1290
	Middle	2441	1290
	Highest	2480	1287

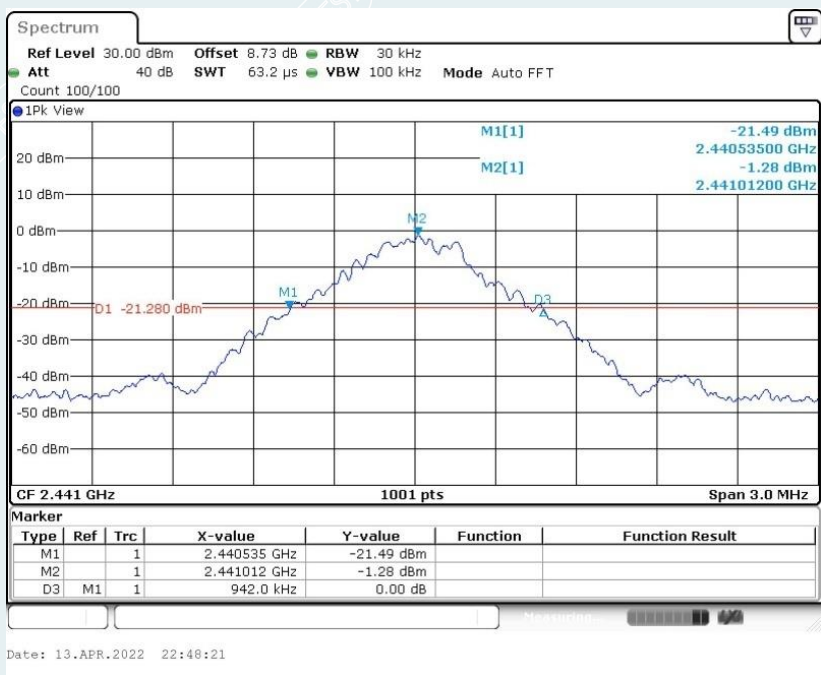
Result plot as follows:

DH5

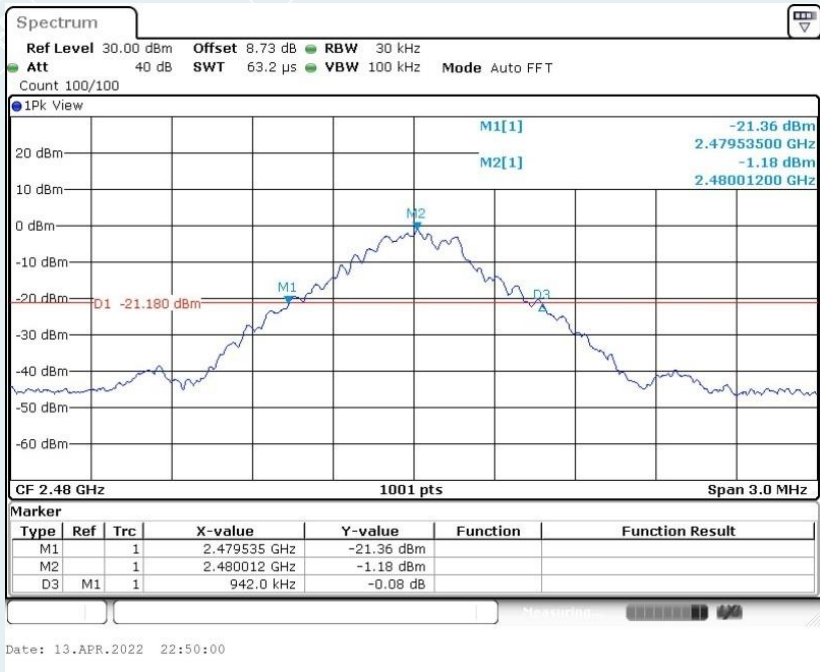
Lowest Channel



Middle Channel

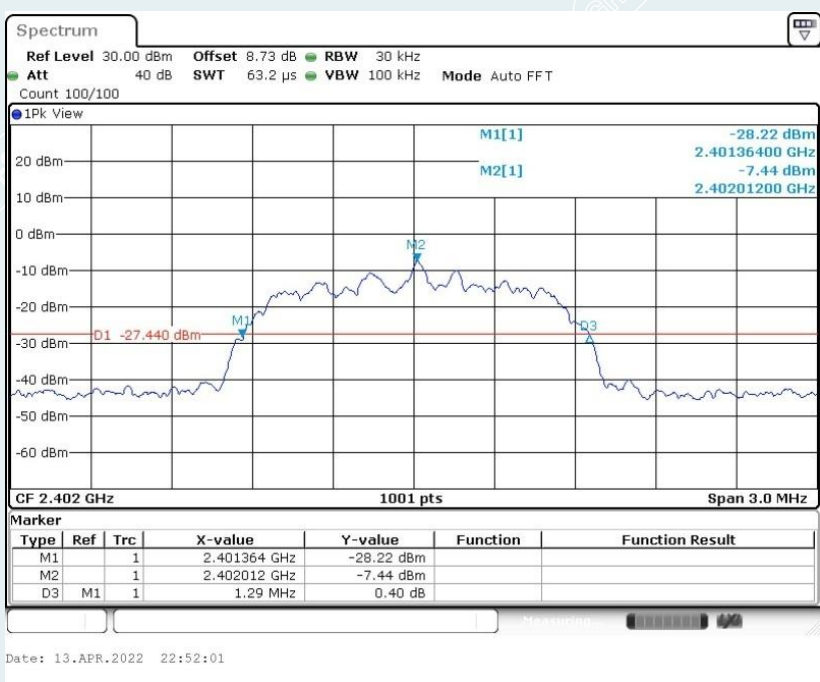


Highest Channel

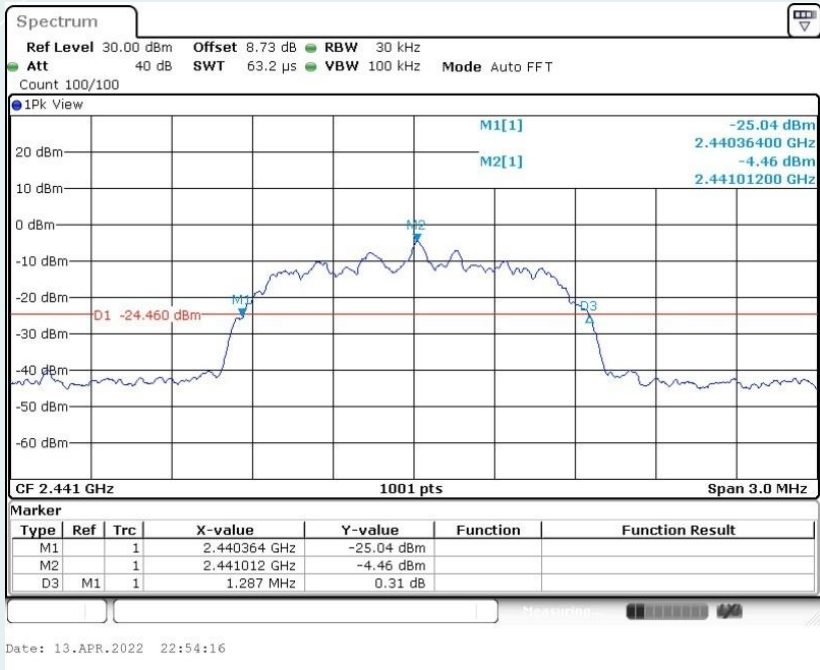


2DH5

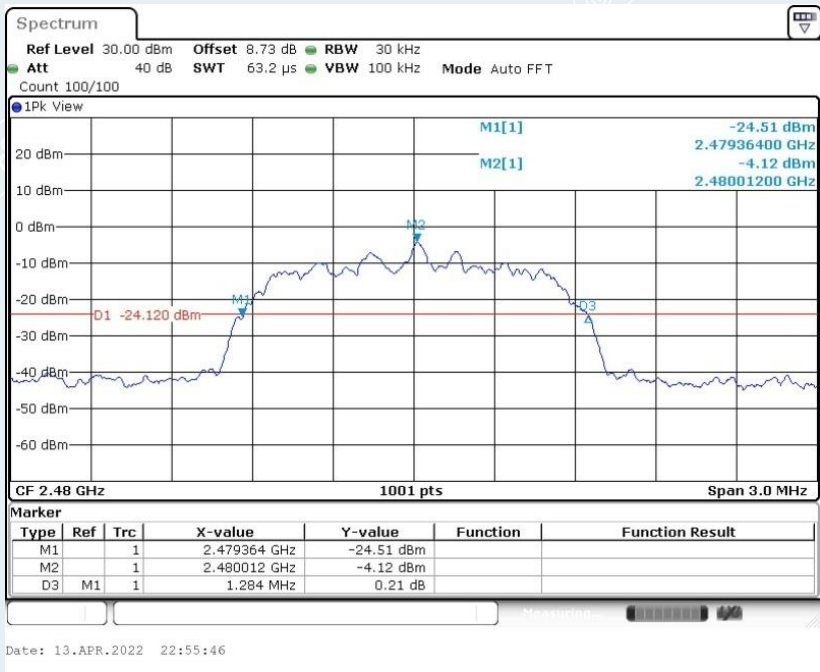
Lowest Channel



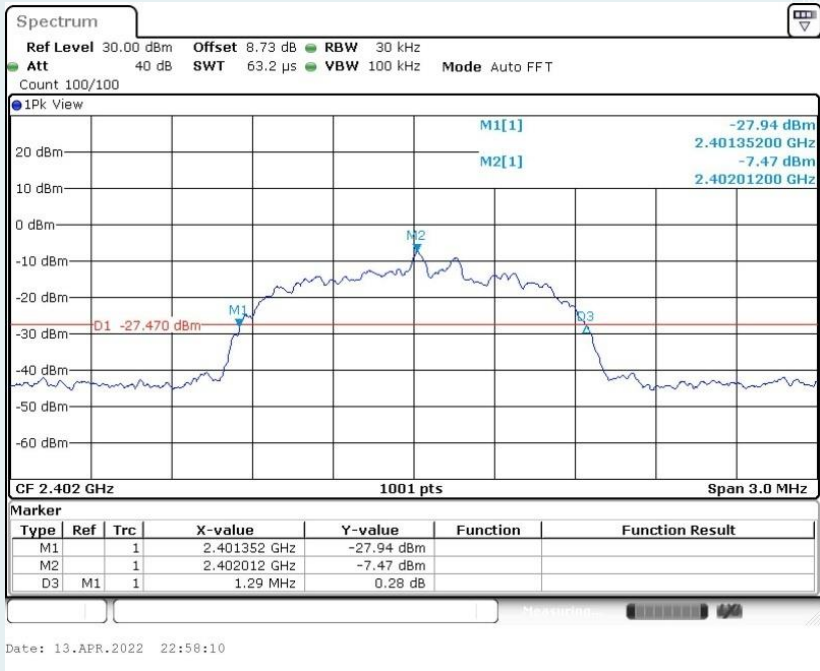
Middle Channel



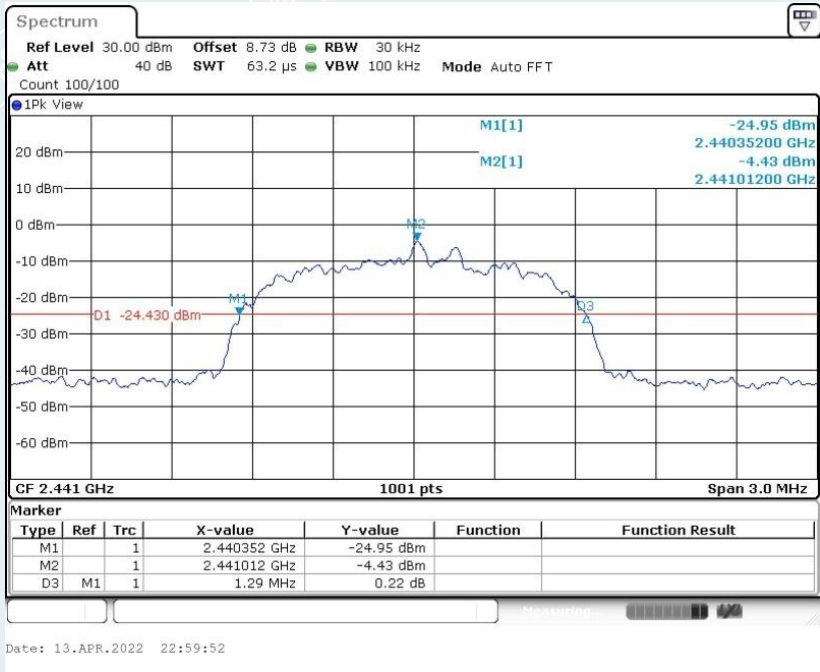
Highest Channel



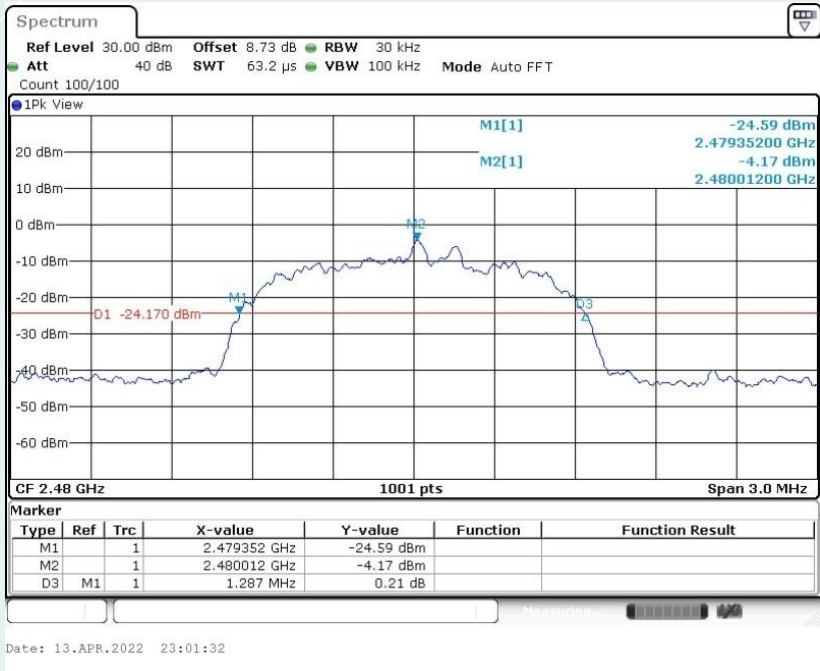
3DH5
Lowest Channel



Middle Channel



Highest Channel



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7. CARRIER FREQUENCIES SEPARATED

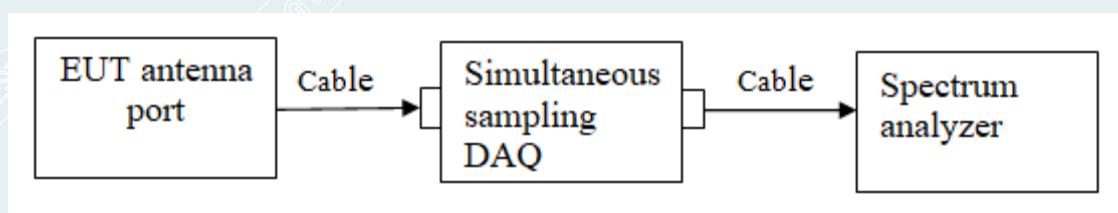
7.1 LIMITS

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.

7.2 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=100kHz, VBW=300kHz, Adjust Span to 2 MHz, Sweep = auto.
- 4) Use the marker-delta function to mark hopping channel carrier frequencies and record the channel separation.

7.3 TEST SETUP



7.4 TEST RESULTS

Environment: 23.1°C/53%RH
 Tested By: Lu Wei

Voltage: DC 12V
 Date: 2022-04-13 to 2022-04-24

DH5

Channel Separation (MHz)	Two-thirds of the 20 dB Bandwidth (kHz)	Channel Separation Limit	Result
1	628	> Two-thirds of the 20 dB Bandwidth	Pass

2DH5

Channel Separation (MHz)	Two-thirds of the 20 dB Bandwidth (kHz)	Channel Separation Limit	Result
1.001	858	> Two-thirds of the 20 dB Bandwidth	Pass

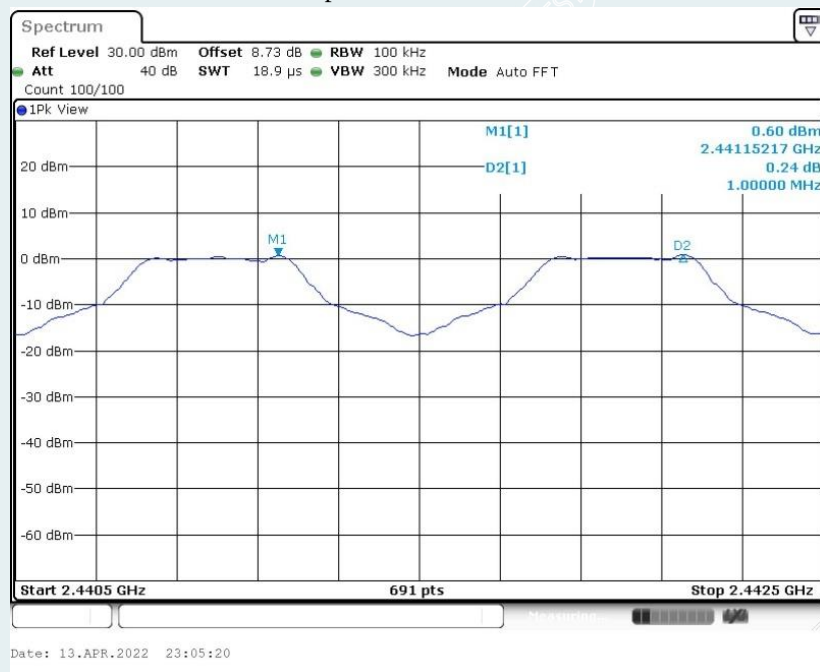
3DH5

Channel Separation (MHz)	Two-thirds of the 20 dB Bandwidth (kHz)	Channel Separation Limit	Result
1.003	860	> Two-thirds of the 20 dB Bandwidth	Pass

Result plot as follows:

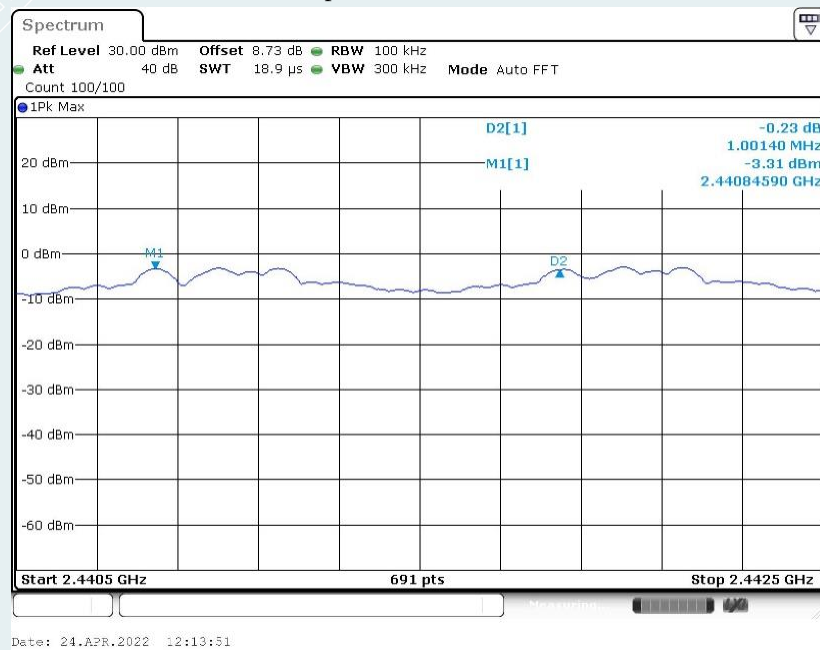
DH5

Measurement of Channel Separation



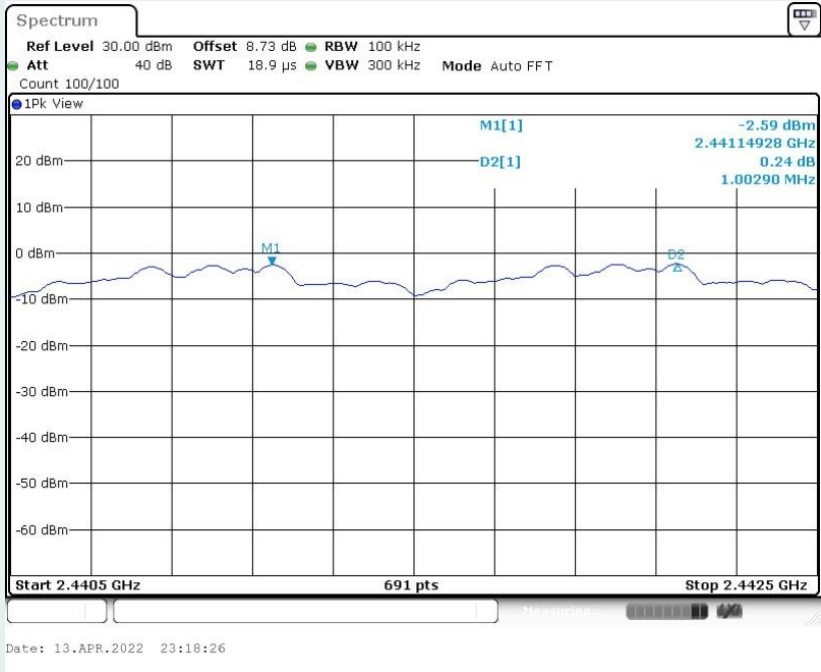
2DH5

Measurement of Channel Separation



3DH5

Measurement of Channel Separation



Test result: The unit does meet the FCC requirements.

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8. HOPPING CHANNEL NUMBER

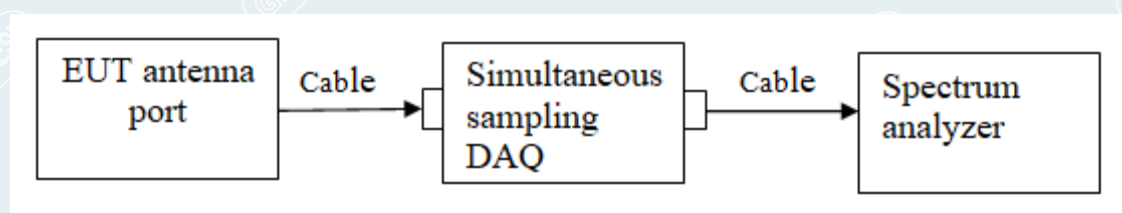
8.1 LIMITS

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

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 the spectrum analyzer as RBW=100kHz, VBW=300kHz.
- 3) Set the spectrum analyzer: start frequency = 2400MHz. stop frequency = 2483.5MHz. Submit the test result graph.

8.3 TEST SETUP



8.4 TEST RESULTS

Environment: 23.1°C/53%RH

Tested By: Lu Wei

Voltage: DC 12V

Date: 2022-04-13

GFSK

Result (No. of CH)	Limit (No. of CH)	Result
79	≥ 15	PASS

$\pi/4$ -DQPSK

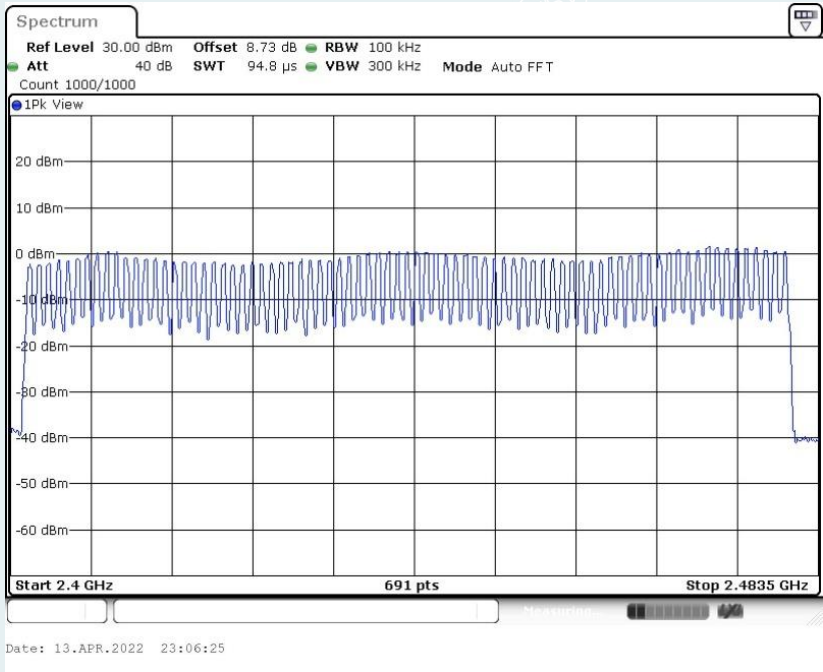
Result (No. of CH)	Limit (No. of CH)	Result
79	≥ 15	PASS

8DPSK

Result (No. of CH)	Limit (No. of CH)	Result
79	≥ 15	PASS

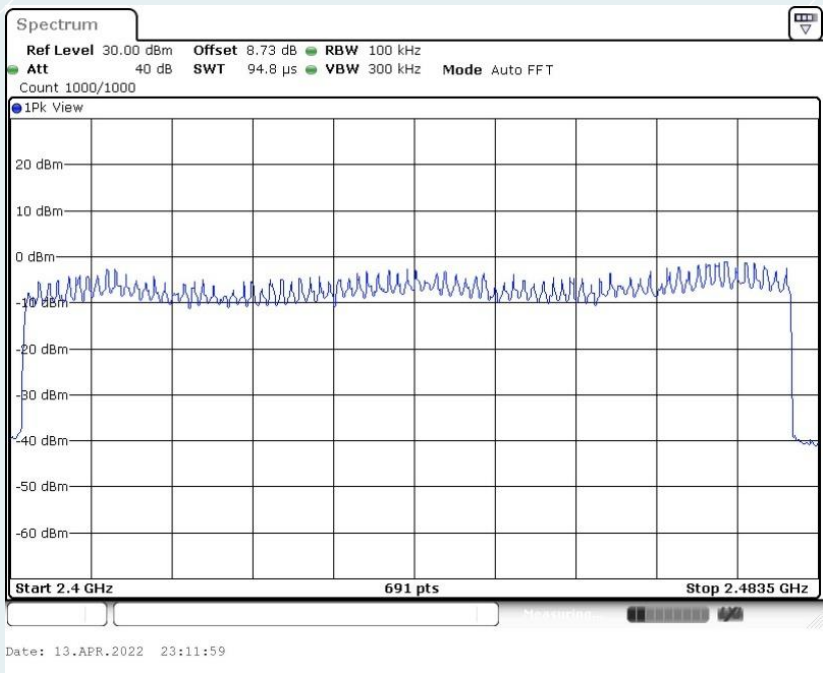
GFSK

2.400 GHz – 2.4835 GHz

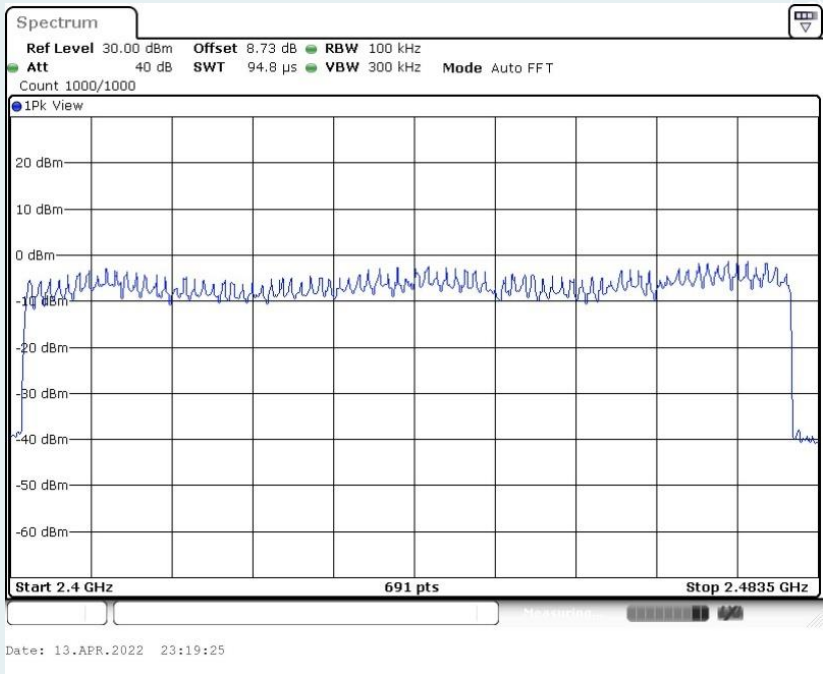


$\pi/4$ -DQPSK

2.400 GHz – 2.4835 GHz



8DPSK
2.400 GHz – 2.4835 GHz



Test result: The unit does meet the FCC requirements.

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9. DWELL TIME

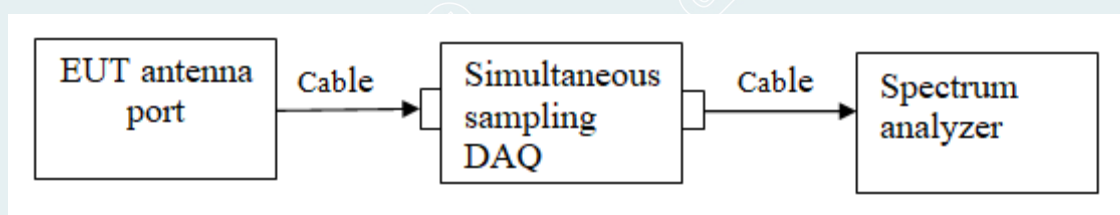
9.1 LIMITS

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

9.2 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 = Max hold.
- 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.

9.3 TEST SETUP



9.4 TEST RESULTS

Environment: 23.1°C/53%RH
Tested By: Lu Wei

Voltage: DC 12V
Date: 2022-04-13 to 2022-04-24

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

GFSK: Middle Channel (2.441GHz)

DH1 time slot= 0.38 (ms)* (1600/(2*79)) * 31.6 = 121.60 ms

DH3 time slot= 1.63 (ms)* (1600/(4*79)) * 31.6 = 260.80 ms

DH5 time slot= 2.87 (ms)* (1600/(6*79)) * 31.6 = 306.13 ms

$\pi/4$ -DQPSK: Middle Channel (2.441GHz)

2DH1 time slot= 0.38 (ms)* (1600/(2*79)) * 31.6 = 121.60 ms

2DH3 time slot= 1.63 (ms)* (1600/(4*79)) * 31.6 = 260.80 ms

2DH5 time slot= 2.87 (ms)* (1600/(6*79)) * 31.6 = 306.13 ms

8DPSK: Middle Channel (2.441GHz)

3DH1 time slot= 0.38 (ms)* (1600/(2*79)) * 31.6 = 121.60 ms

3DH3 time slot= 1.63 (ms)* (1600/(4*79)) * 31.6 = 260.80 ms

3DH5 time slot= 2.87 (ms)* (1600/(6*79)) * 31.6 = 306.13 ms

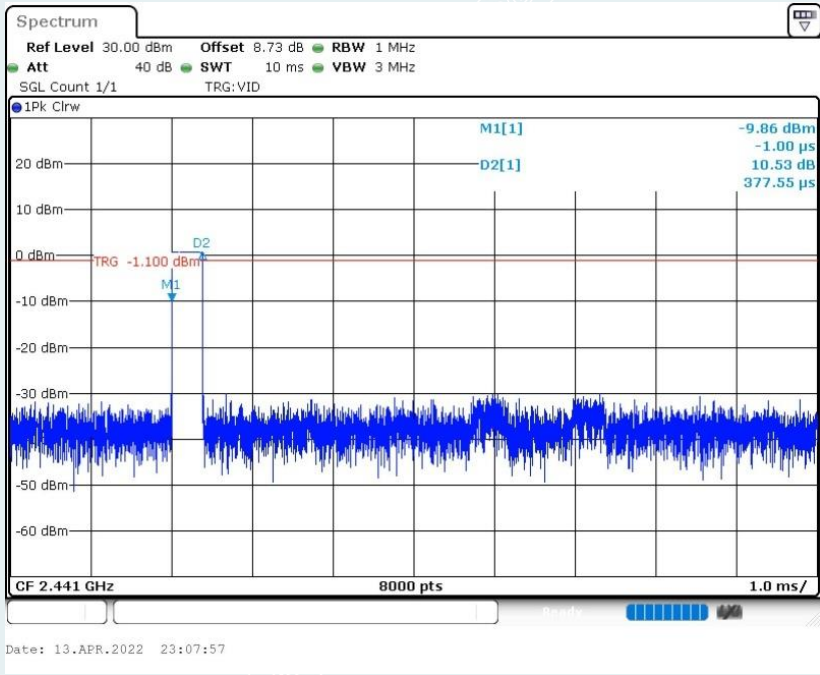
The results are not greater than 0.4 seconds.

The unit does meet the requirements.

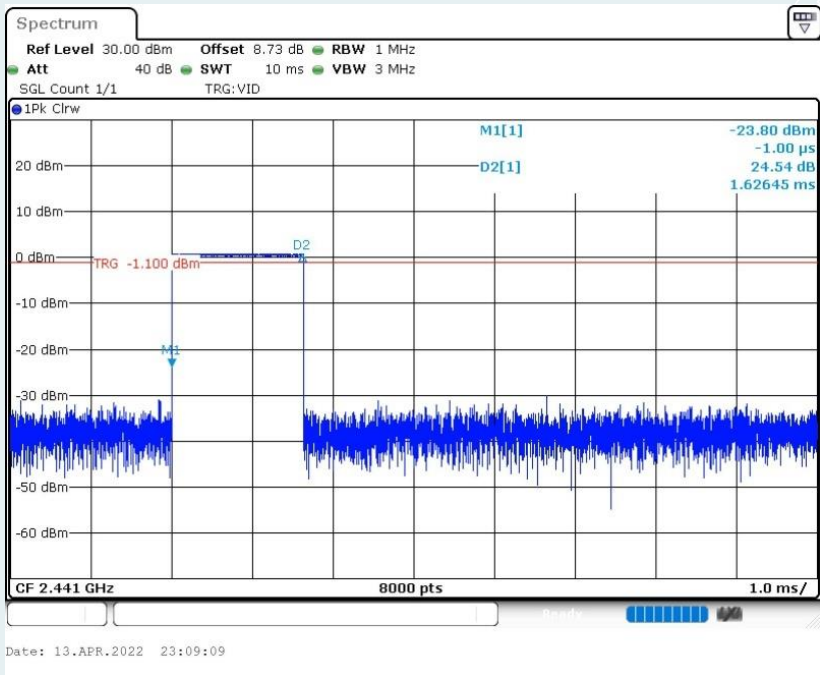
----- The following blanks -----

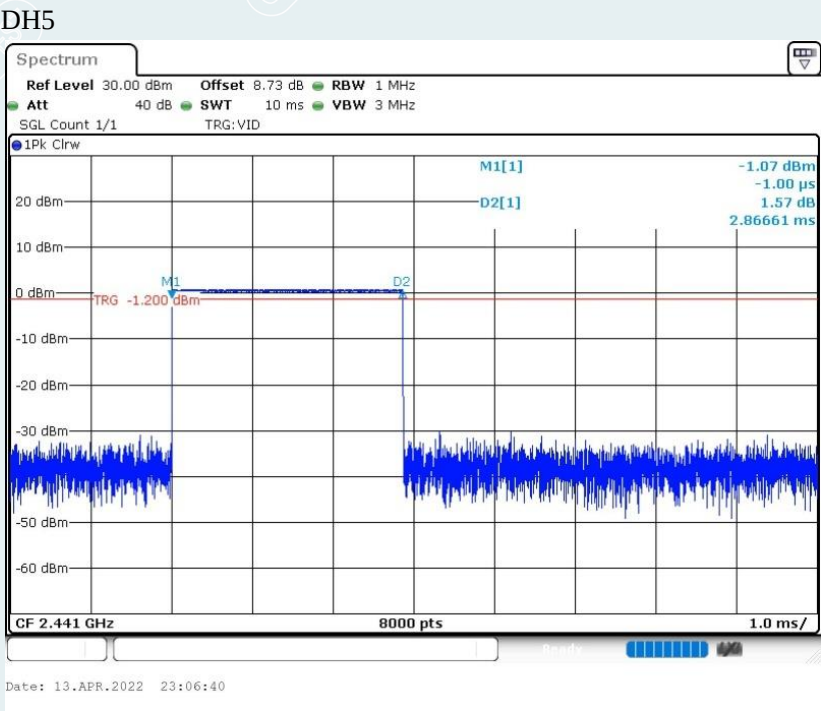
Please refer the graph as below:

GFSK
Middle Frequency (2.441GHz)
DH1



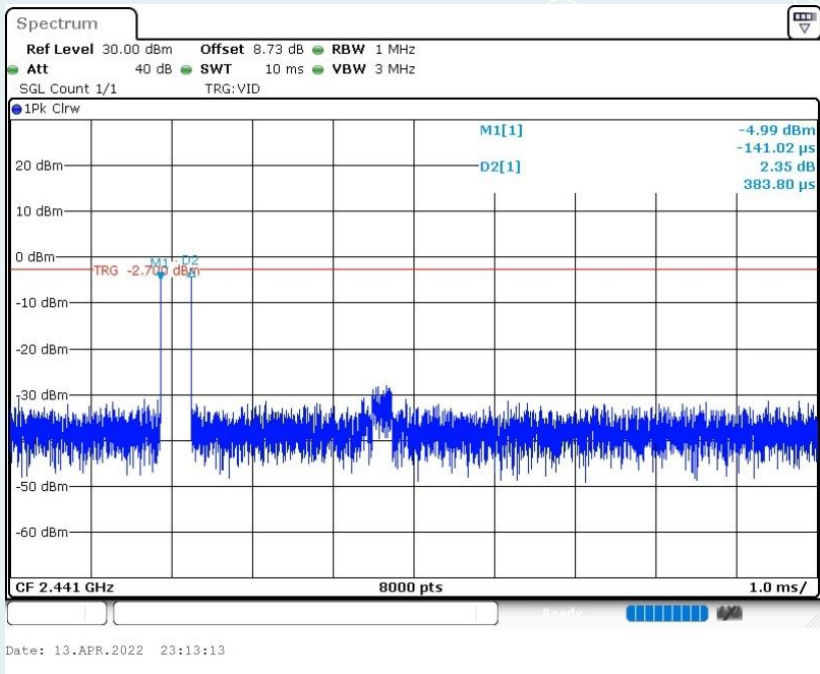
DH3



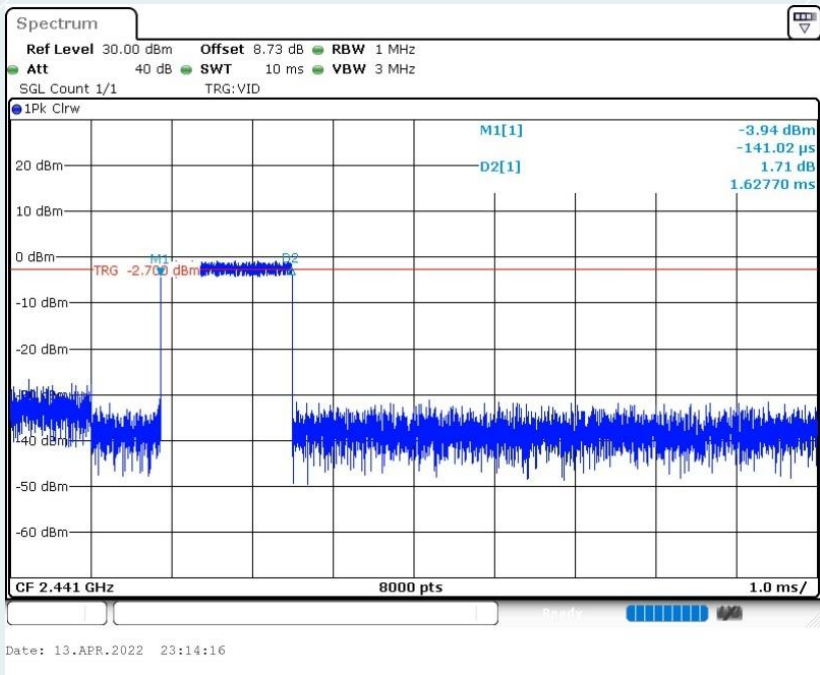


----- The following blanks -----

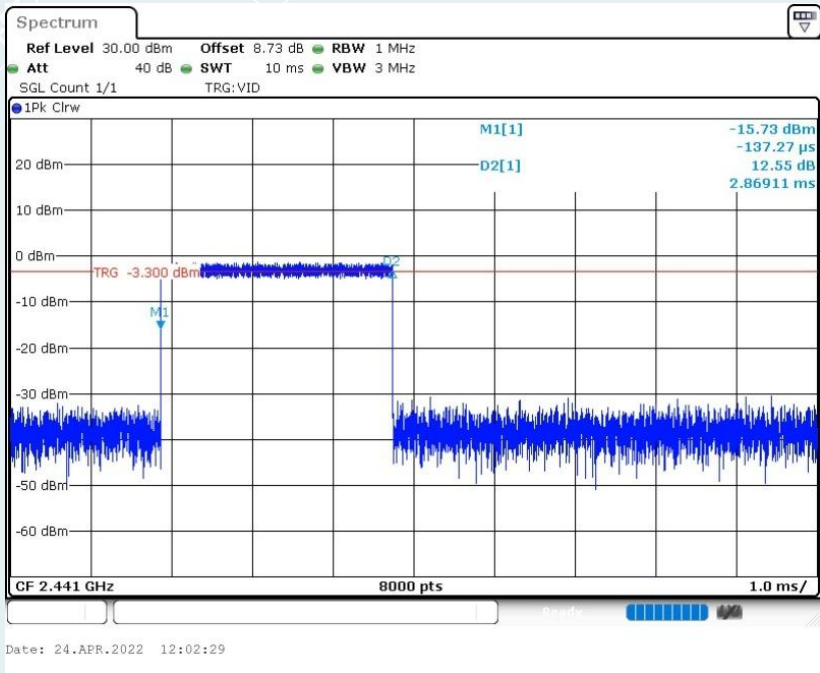
$\pi/4$ -DQPSK
Middle Frequency (2.441GHz)
2DH1



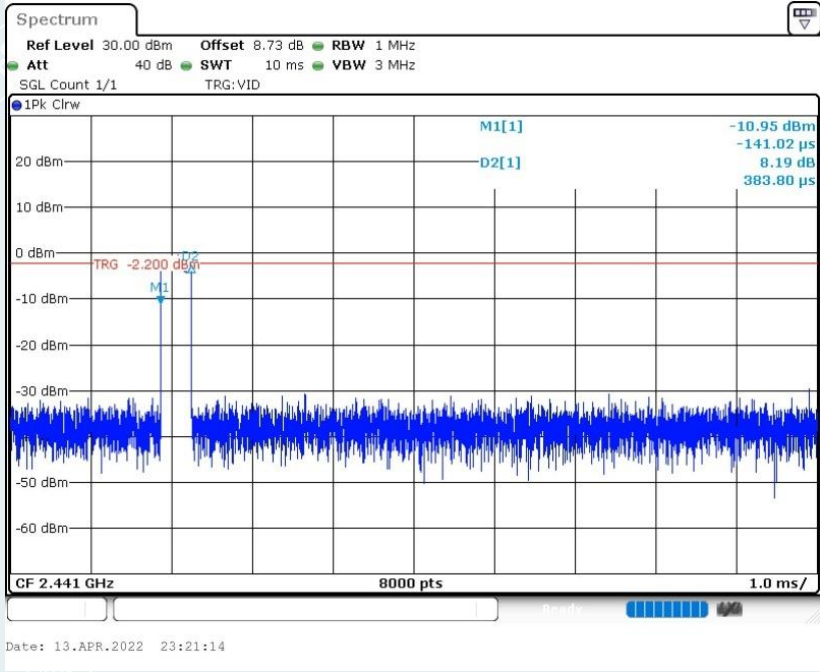
Mid Frequency (2.441GHz)
2DH3



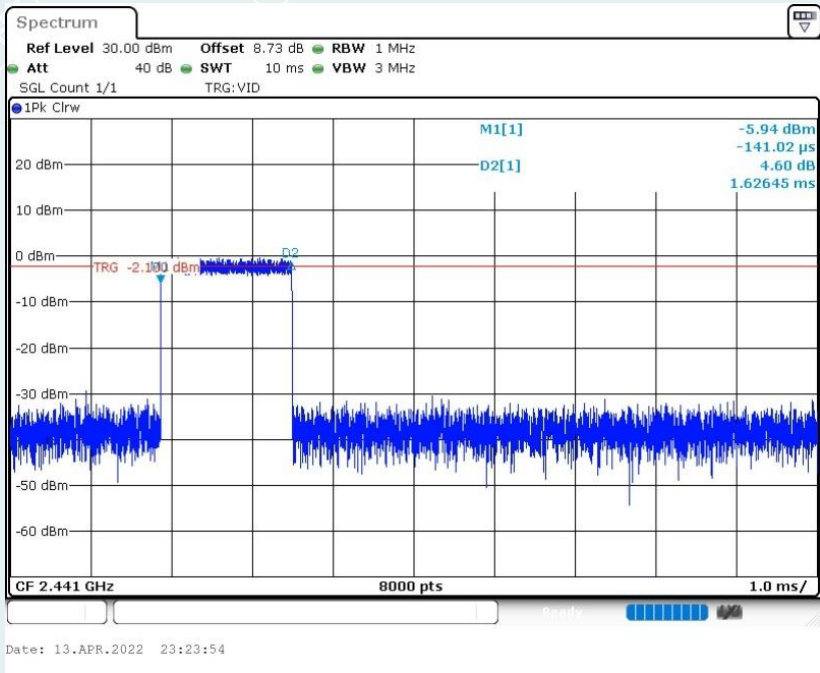
2DH5



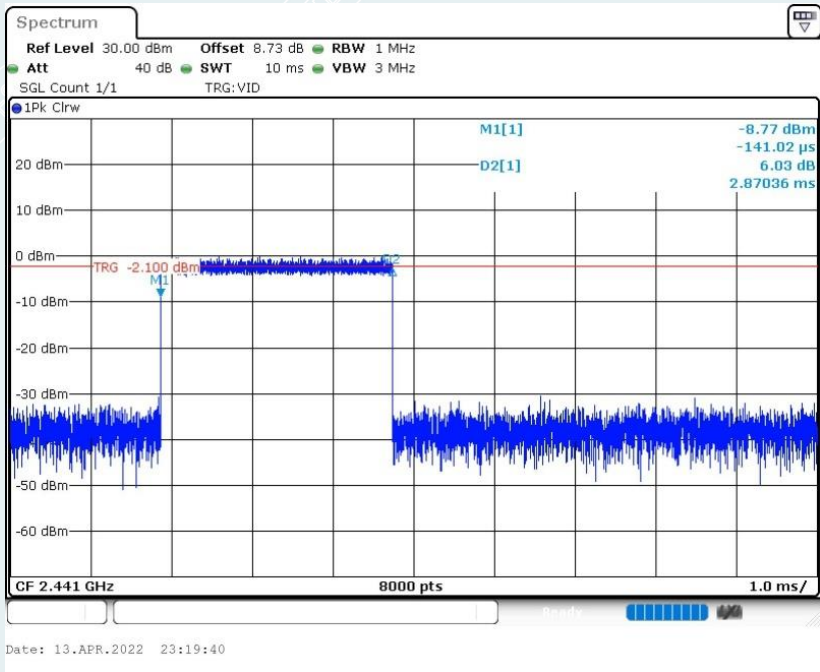
8DPSK
Middle Frequency (2.441GHz)
3DH1



3DH3



3DH5



10. MAXIMUM PEAK OUTPUT POWER

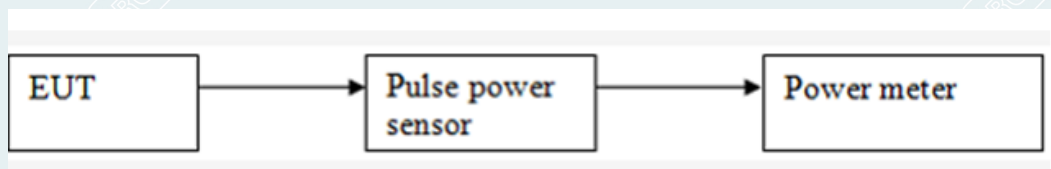
10.1 LIMITS

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.

10.2 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.

10.3 TEST SETUP



----- The following blanks -----

10.4 TEST RESULTS

Environment: 24.2°C/51%RH
Tested By: Lu Wei

Voltage: DC 12V
Date: 2022-04-03

DH5

Test Channel	Fundamental Frequency (GHz)	Max Output Power(dBm)	Limit (dBm)	Peak/Average	Pass/Fail
Lowest	2.402	-3.37	20.97	Peak	Pass
Middle	2.441	-0.42			Pass
Highest	2.480	-0.14			Pass

2DH5

Test Channel	Fundamental Frequency (GHz)	Max Output Power(dBm)	Limit (dBm)	Peak/Average	Pass/Fail
Lowest	2.402	-4.35	20.97	Peak	Pass
Middle	2.441	-1.3			Pass
Highest	2.480	-0.95			Pass

3DH5

Test Channel	Fundamental Frequency (GHz)	Max Output Power(dBm)	Limit (dBm)	Peak/Average	Pass/Fail
Lowest	2.402	-3.91	20.97	Peak	Pass
Middle	2.441	-0.8			Pass
Highest	2.480	-0.61			Pass

Test result: The unit does meet the FCC requirements.

11. CONDUCTED BAND EDGES AND SPURIOUS EMISSIONS

11.1 LIMITS

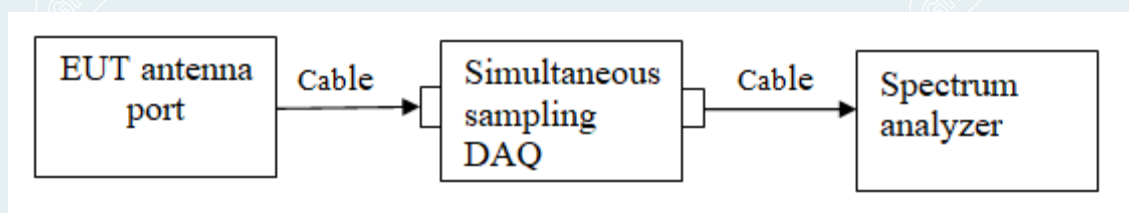
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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 30 dB instead of 20 dB.

11.2 TEST PROCEDURES

Test procedures follow KDB 558074 D01 15.247 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.

11.3 TEST SETUP



11.4 TEST RESULTS

Environment: 23.1°C/53%RH
Tested By: Lu Wei

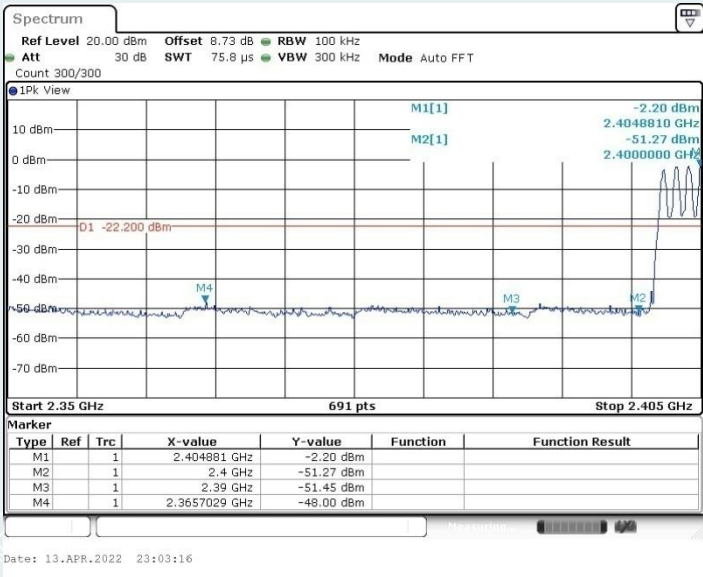
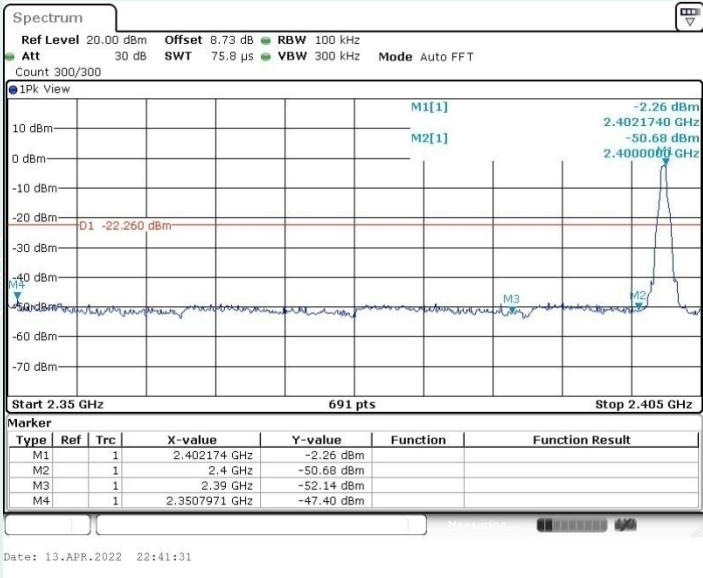
Voltage: DC 12V
Date: 2022-04-13

Test result plot as follows:

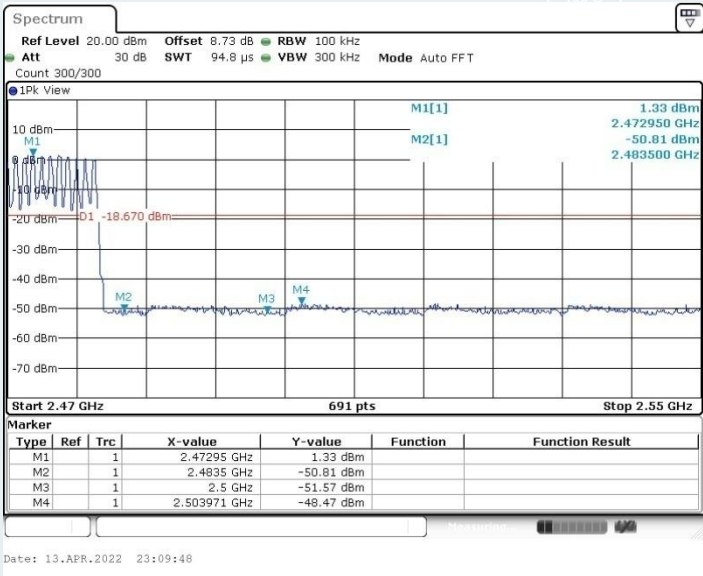
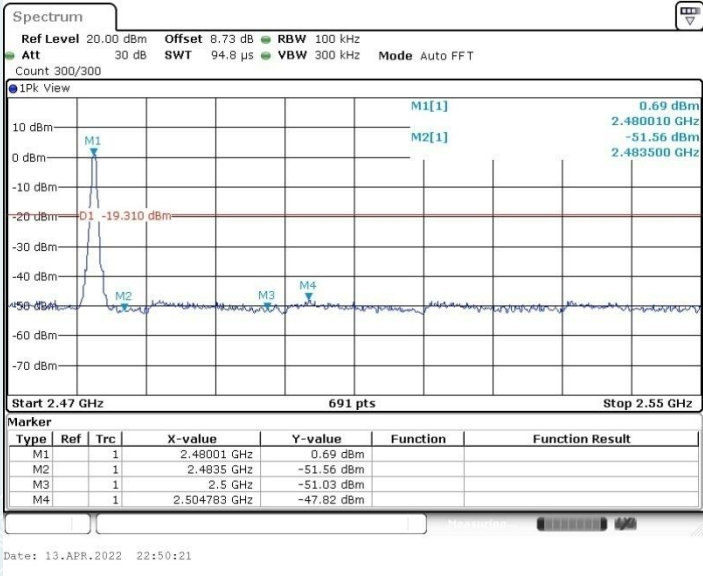
Band Edges

DH5

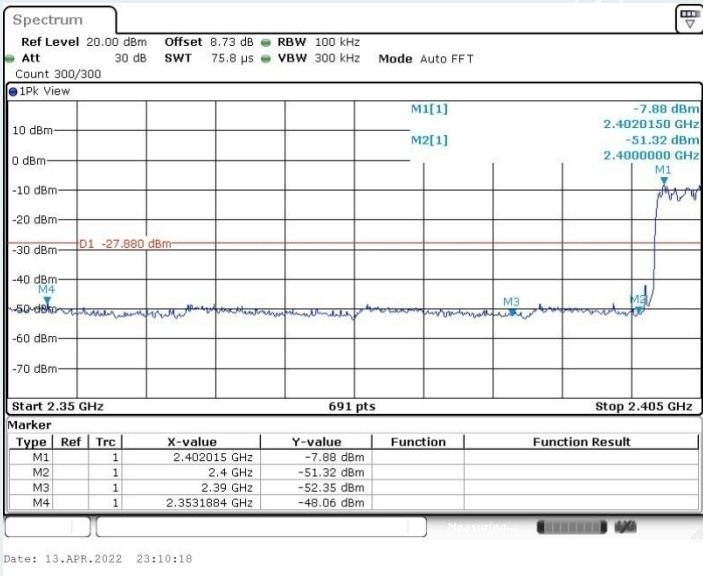
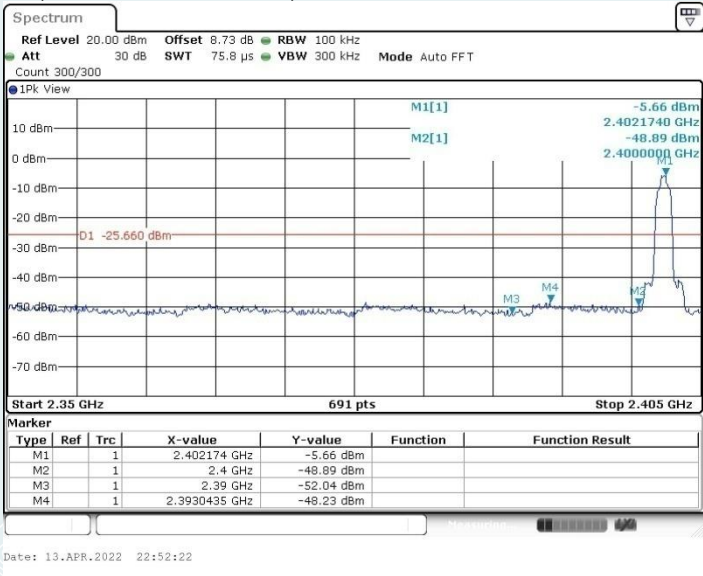
CH Low (2.35GHz ~2.405GHz)



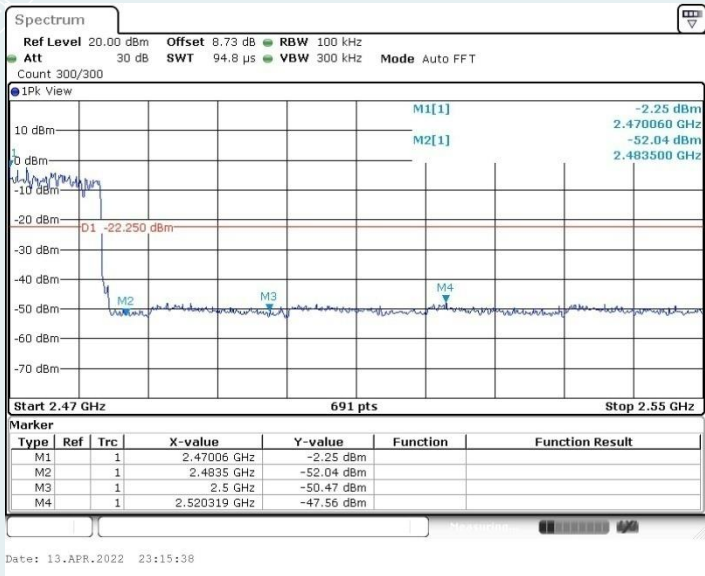
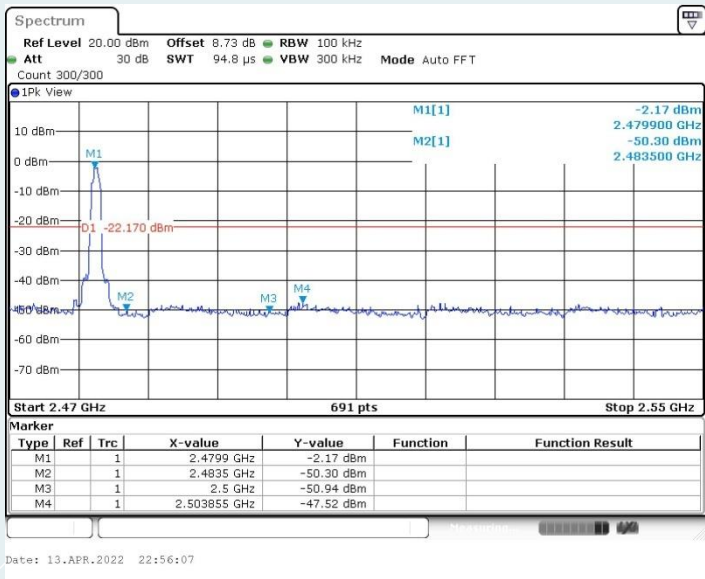
CH High (2.47GHz ~ 2.55GHz)



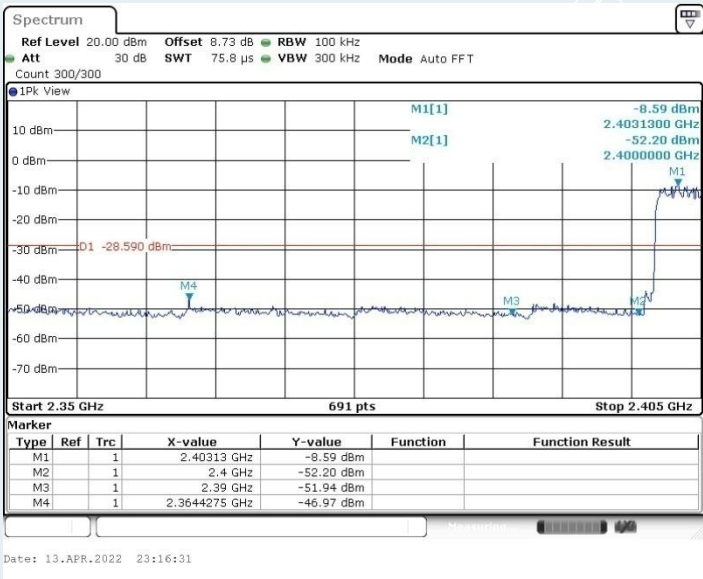
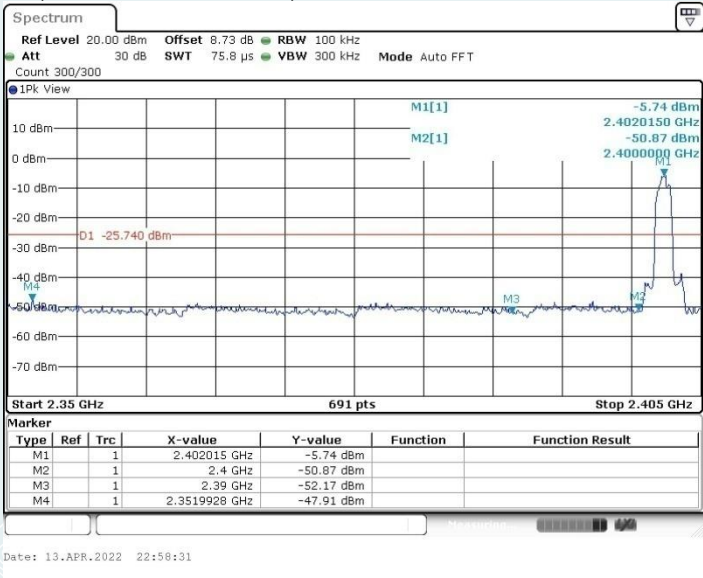
2DH5
CH Low (2.35GHz ~2.405GHz)



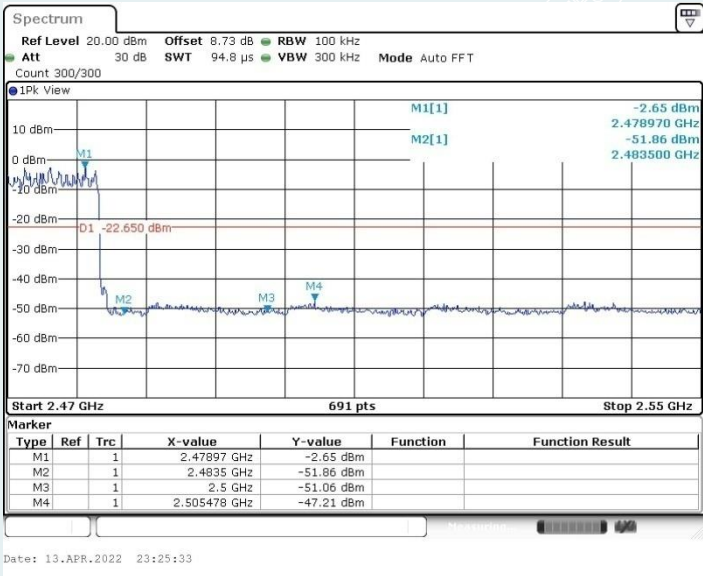
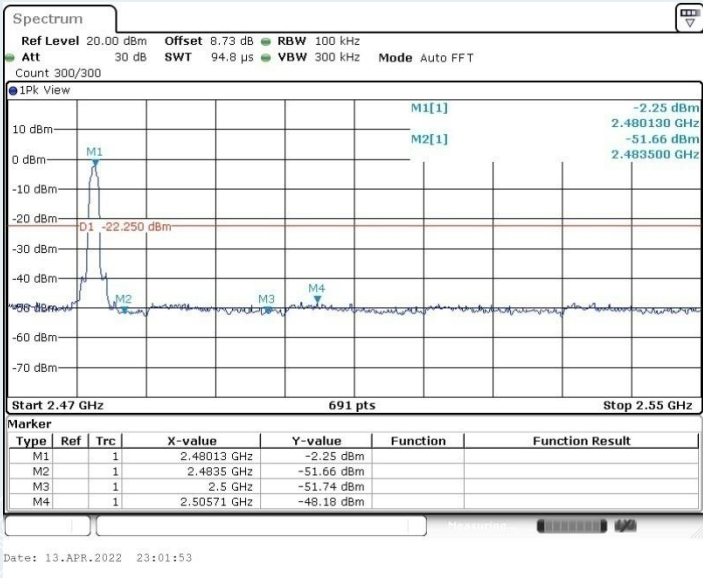
CH High (2.47GHz ~ 2.55GHz)



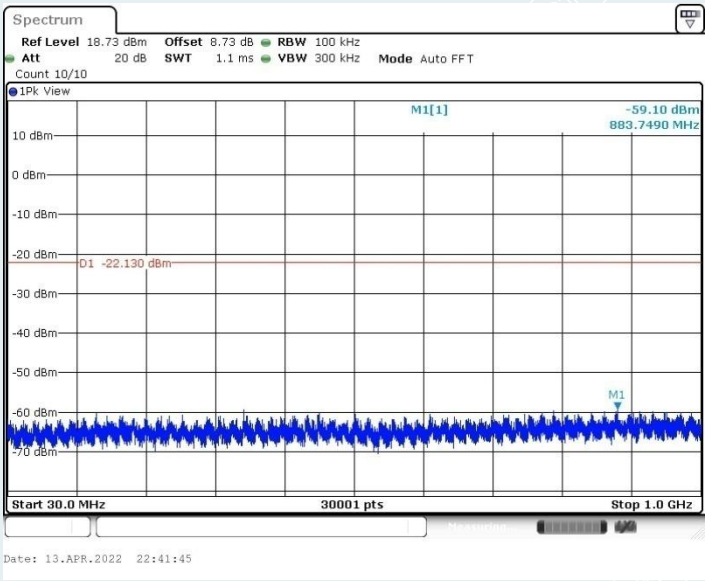
3DH5
CH Low (2.35GHz ~2.405GHz)

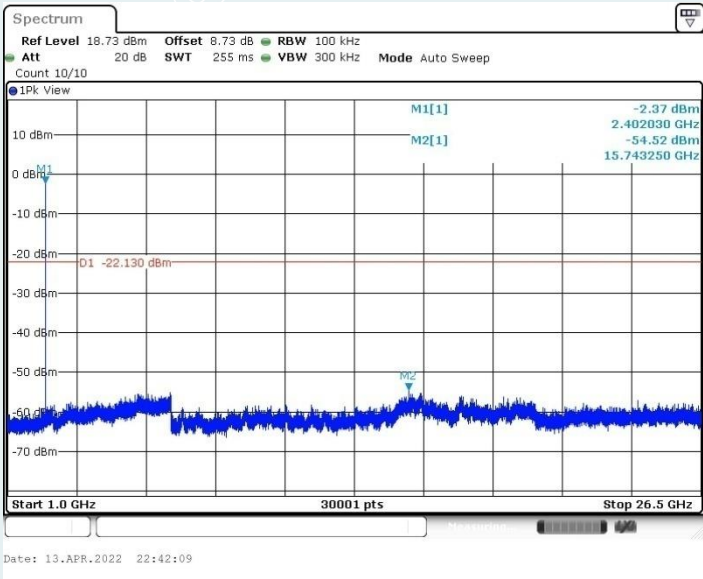


CH High (2.47GHz ~ 2.55GHz)



Spurious Emissions
DH5
CH Low





CH Mid

