

TEST REPORT

Applicant : Shenzhen Gotron Electronic CO.,LTD.

Product Name : Smart Phone

Brand Name : ulefone

Model Name : GQ5012

Series Model : Armor 29 Pro, Armor 29 Ultra, Armor 29, Armor 29T Ultra,
Armor 29T Pro, Armor 29 Lite, Armor 29s, Armor 29s Pro

FCC ID : 2AOWK-5012

Test Standard : 47 CFR 15.247

Date of Receipt : 2025.02.11

Date of Test : 2025.02.11~2025.04.11

Issue Date : 2025.04.29

Report Prepared by :

Jacob Cai

(Jacob Cai)

Report Approved by :

Jason Wu

(Jason Wu)

Authorized Signatory :

Robinson Luo

(Robinson Luo)

Authorized Signature:

Robinson Luo
Laboratory Manager

This results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver

TABLE OF CONTENTS

REVISION HISTORY	4
DECLARATION OF REPORT	5
SUMMARY OF TEST RESULT	6
1. GENERAL DESCRIPTION	7
1.1. Applicant	7
1.2. Manufacturer	7
1.3. Factory	7
1.4. General Information of EUT	8
1.5. Equipment Specification	9
1.6. Modification of EUT	9
1.7. Laboratory Information	9
1.8. Applicable Standards	10
2. TEST CONFIGURATION OF EUT	11
2.1. Carrier Frequency Channel	11
2.2. Test Modes	12
2.3. Block Diagram of Test System	13
2.4. Description of Support Units	13
2.5. Test Software and Power Level	13
2.6. EUT Operating Conditions	13
2.7. Equipment List	14
2.8. Measurement Uncertainty	16
3. TEST RESULT	17
3.1. Maximum Peak Conducted Output Power	17
3.2. Number of Hopping Frequencies	19
3.3. Duty Cycle and Dwell Time	20
3.4. 20dB Bandwidth	21
3.5. Carrier Frequency Separation	22
3.6. Conducted Band Edge	23
3.7. Conducted Spurious Emission	24
3.8. Radiated Spurious Emission and Restricted Band	25
3.9. AC Power-Line Conducted Emission	51
3.10. Antenna Requirement	53
4. Appendix A of data	54
Conducted Output Power	54
99% Bandwidth	55
20dB Bandwidth	57
Carrier Frequencies Separation	59
Conducted Out Of Band Emission	60
Duty Cycle	68
Dwell Time	70
Number Of Hopping Channel	72
AC Power-Line Conducted Emission	74
5. TEST SETUP PHOTOGRAPHS	76

6.EXTERNAL AND INTERNAL PHOTOS OF THE EUT

76

REVISION HISTORY

Rev.	Issue Date	Revisions	Revised by
A0	2025.04.29	Initial Release	N/A

DECLARATION OF REPORT

1. The device has been tested by GTS, and the test results show that the equipment under test (EUT) is in compliance with the requirements of 47 CFR 15.247. And it is applicable only to the tested sample identified in the report.
2. This report shall not be reproduced except in full, without the written approval of GTS, this document only be altered or revised by GTS, personal only, and shall be noted in the revision of the document.
3. The general information of EUT in this report is provided by the customer or manufacture, GTS is only responsible for the test data but not for the information provided by the customer or manufacture.
4. The results in this report is only apply to the sample as tested under conditions. The customer or manufacturer is responsible for ensuring that the additional production units of this model have the same electrical and mechanical components.
5. In this report, '□' indicates that EUT does not support content after '□', and '☑' indicates that it supports content after '☑'

SUMMARY OF TEST RESULT

Report Section	Standard Section	Test Item	Judgment	Remark
3.1	47 CFR 15.247(b)(1)	Maximum Peak Conducted Output Power	PASS	--
3.2	47 CFR 15.247(a)(1)(iii)	Number of Hopping Frequencies	PASS	--
3.3	47 CFR 15.247(a)(1)(iii)	Duty Cycle and Dwell Time	PASS	--
3.4	47 CFR 15.247(a)(1)	20dB Bandwidth	Report only	--
3.5	47 CFR 15.247(a)(1)	Carrier Frequency Separation	PASS	--
3.6	47 CFR 15.247(d)	Conducted Band Edge	PASS	--
3.7	47 CFR 15.247(d)	Conducted Spurious Emission	PASS	--
3.8	47 CFR 15.247(d)/15.209(a)/15.205(a)	Radiated Spurious Emission and Restricted Band	PASS	--
3.9	47 CFR 15.207(a)	AC Power-Line Conducted Emission	PASS	--
3.10	47 CFR 15.203	Antenna Requirements	PASS	--

1. GENERAL DESCRIPTION

1.1. Applicant

Name : Shenzhen Gotron Electronic CO.,LTD.
Address : 7B01, Building A, Block 1, Anhongji Tianyao Plaza, Longhua District, Shenzhen City,
Guangdong Province China

1.2. Manufacturer

Name : Shenzhen Gotron Electronic CO.,LTD.
Address : 7B01, Building A, Block 1, Anhongji Tianyao Plaza, Longhua District, Shenzhen City,
Guangdong Province China

1.3. Factory

Name : Shenzhen Gotron Electronic CO.,LTD.
Address : 7B01, Building A, Block 1, Anhongji Tianyao Plaza, Longhua District, Shenzhen City,
Guangdong Province China

1.4. General Information of EUT

General Information	
Equipment Name	Smart Phone
Brand Name	ulefone
Model Name	GQ5012
Series Model	Armor 29 Pro, Armor 29 Ultra, Armor 29, Armor 29T Ultra, Armor 29T Pro, Armor 29 Lite, Armor 29s, Armor 29s Pro
Model Difference	All the same except for model name
Antenna Type	PIFA Antenna
Antenna 0 Gain	2.6dBi
Sample No:	202502060001001
Adapter:	Input:100-240V~50/60Hz 1.8AOutput:5.0V== 3.0A 15.0W OR 9.0V== 3.0A 27.0W OR 12.0V== 3.0A 36.0W OR 15.0V== 3.0A 45.0W OR 20.0V== 5.0A 100.0W MAX PPS:3.6V-20.0V== 6.0A 120.0W MAX
Battery	Rated Voltage:7.74V Charge Limit Voltage:8.9V Capacity:10600mAh
Hardware version	N/A
Software version	N/A
Connecting I/O Port(s)	Refer to the remark below.

Remark:

The above information of EUT was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.5. Equipment Specification

Equipment Specification		
Frequency Range	2402MHz - 2480MHz	
Number of Channels	79	
Carrier Frequency of Each Channel	2402 + n*1 MHz; n = 0 ~ 78	
Maximum Output Power To Antenna	☑Bluetooth BR(1Mbps):	3.11dBm (0.00205W)
	☑Bluetooth EDR(2Mbps):	2.14dBm (0.00164W)
	☑Bluetooth EDR(3Mbps):	2.60dBm (0.00182W)
Type of Modulation	☑Bluetooth BR(1Mbps):	GFSK
	☑Bluetooth EDR(2Mbps):	$\pi/4$ -DQPSK
	☑Bluetooth EDR(3Mbps):	8-DPSK

1.6. Modification of EUT

No modifications are made to the EUT during all test items.

1.7. Laboratory Information

The test facility is recognized, certified, or accredited by the following organizations:

- **FCC —Registration No.: 381383**

Designation Number: CN5029

Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files.

- **ISED—Registration No.: 9079A**

CAB identifier: CN0091

The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of ISED for radio equipment testing.

- **NVLAP (LAB CODE:600179-0)**

Global United Technology Services Co., Ltd., is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).

All tests were performed at:

Global United Technology Services Co., Ltd.

Address: No. 123-128, Tower A, Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102

Tel: 0755-27798480

Fax: 0755-27798960

1.8. Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

47 CFR Part 15 Subpart C §15.247

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

ANSI C63.10-2013

Remark:

All test items were verified and recorded according to the standards and without any deviation during the test.

2. TEST CONFIGURATION OF EUT

2.1. Carrier Frequency Channel

Frequency Band	Channel	Frequency MHz	Channel	Frequency MHz	Channel	Frequency MHz
2400 - 2483.5 MHz	00	2402	27	2429	54	2456
	01	2403	28	2430	55	2457
	02	2404	29	2431	56	2458
	03	2405	30	2432	57	2459
	04	2406	31	2433	58	2460
	05	2407	32	2434	59	2461
	06	2408	33	2435	60	2462
	07	2409	34	2436	61	2463
	08	2410	35	2437	62	2464
	09	2411	36	2438	63	2465
	10	2412	37	2439	64	2466
	11	2413	38	2440	65	2467
	12	2414	39	2441	66	2468
	13	2415	40	2442	67	2469
	14	2416	41	2443	68	2470
	15	2417	42	2444	69	2471
	16	2418	43	2445	70	2472
	17	2419	44	2446	71	2473
	18	2420	45	2447	72	2474
	19	2421	46	2448	73	2475
	20	2422	47	2449	74	2476
	21	2423	48	2450	75	2477
	22	2424	49	2451	76	2478
	23	2425	50	2452	77	2479
	24	2426	51	2453	78	2480
	25	2427	52	2454	--	--
	26	2428	53	2455	--	--

Remark:

Low Channel: **CH00_2402 MHz**; Middle Channel: **CH39_2441 MHz**; High Channel: **CH78_2480 MHz**.

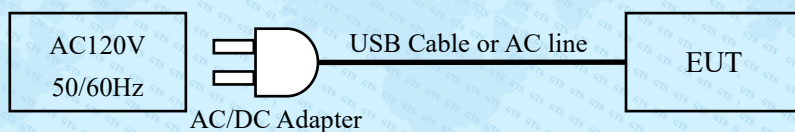
2.2. Test Modes

The table below is showing all test modes to demonstrate in compliance with the standard.

Summary Table of Test Modes			
Test Item	Data Rate / Modulation		
	Bluetooth BR(1Mbps) GFSK	Bluetooth EDR(2Mbps) $\pi/4$ -DQPSK	Bluetooth EDR(3Mbps) 8-DPSK
For Conducted and Radiated Test	Mode 1: CH00_2402 MHz	Mode 2: CH00_2402 MHz	Mode 3: CH00_2402 MHz
	Mode 4: CH39_2441 MHz	Mode 5: CH39_2441 MHz	Mode 6: CH39_2441 MHz
	Mode 7: CH78_2480 MHz	Mode 8: CH78_2480 MHz	Mode 9: CH78_2480 MHz
	Mode 10: Hopping	Mode 11: Hopping	Mode 12: Hopping
For AC Power-line Conducted Emission	Mode 13: TX DH5_2441MHz		

2.3. Block Diagram of Test System

2.3.1. For AC Power-Line Conducted Emission



2.3.2. For Radiated Spurious Emission



2.3.3. For Conducted Test



2.4. Description of Support Units

NO.	Unit	Brand	Model	Description
1	PC	Redmi G	2021Ryzen	N/A

2.5. Test Software and Power Level

During the test, the channel and power control software provided by the customer is used to control the operation channel and output power level.

2.6. EUT Operating Conditions

For AC power-line conducted emission, the engineering test program was provided and make the EUT to continuous transmi.

For radiated spurious emission and conducted test, the engineering test program was provided and make the EUT to continuous transmit/receive.

2.7. Equipment List

2.7.1. For AC Power-Line Conducted Emission

Equipment Name	Manufacturer	Model	Serial No.	Calibration Date	Calibration Due Date
Test Receiver	R&S	ESPI	101679	2024.05.22	2025.05.21
LISN	R&S	ENV216	100300	2024.05.22	2025.05.21
LISN	R&S	ENV216	100333	2024.05.22	2025.05.21
Thermometer	DeLi	N/A	N/A	2024.09.22	2025.09.21
Test Software	FALA	EZ-EMC	N/A	N/A	N/A

2.7.2. For Radiated Spurious Emission

Equipment Name	Manufacturer	Model	Serial No.	Calibration Date	Calibration Due Date
Signal analyzer	Agilent	N9020A	MY50200811	2024.05.22	2025.05.21
Amplifier	JPT	JPA0118-55-303A	1910001800055000	2024.05.22	2025.05.21
Amplifier	JPT	JPA-10M1G32	21010100035001	2024.05.22	2025.05.21
Antenna/Turn table Controller	Brilliant	N/A	N/A	N/A	N/A
Loop Antenna	Daze	ZN30900C	20077	2024.05.22	2025.05.21
Bilog Antenna	SCHWARZBECK	VULB 9168	01174	2024.05.22	2025.05.21
Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120D	02334	2024.05.22	2025.05.21
Horn Antenna	COM-POWER	AH-1840	10100008	2024.05.22	2025.05.21
Thermometer	DeLi	N/A	N/A	2024.09.22	2025.09.21
Test Software	FALA	EMC-RI	N/A	N/A	N/A
Cable	Lyle Microwave	SMAM	RG142	/	/
Vector signal generator	Keysight	N5182B	MY50200811	2025.05.21	2026.05.20
Horn Antenna	Schwarzbeck	BBHA 9120D	2802	2024-08-11	2025-08-10

2.7.3. For Conducted Test

Equipment Name	Manufacturer	Model	Serial No.	Calibration Date	Calibration Due Date
Power meter	Anritsu	ML2496A	1935001	2024.09.29	2025.09.28
Power sensor	Anritsu	MA2411B	1911006	2024.09.29	2025.09.28
Power sensor	DARE	RPR3006W	16I00054SN016	2024.09.29	2025.09.28
Power sensor	DARE	RPR3006W	RPR6W-2001005	2024.09.29	2025.09.28
Power sensor	Rediteq	RPR3006W	RPR6W-2201002	2024.11.15	2025.11.14
Power sensor	Rediteq	RPR3006W	RPR6W-2201003	2024.11.15	2025.11.14
Power sensor	Keysight	U2021XA	MY59120004	2024.08.14	2025.08.13
Adjustable Attenuator	Agilent	8494B	MY42144015	2024.09.29	2025.09.28
Adjustable Attenuator	Agilent	8496B	MY42143776	2024.09.29	2025.09.28
Environmental Test Chamber	KSON	THS-B6C-150	9159K	2024.01.18	2025.01.17
Signal analyzer	Keysight	N9020A	MY50510136	2024.09.29	2025.09.28
Vector signal generator	Keysight	N5182B	MY57300196	2024.09.29	2025.09.28
Vector signal generator	Agilent	N5182A	MY50143555	2024.01.18	2025.07.17
Analog signal generator	Keysight	N5173B	MY60403026	2024.01.18	2025.07.17
Wideband radio communication tester	R&S	CMW500	101331	2024.09.29	2025.09.28
Spectrum analyzer	R&S	FSV40-N	101761	2024.08.23	2025.08.22
Switch Box	N/A	RFSW3003328	RFSW201019	N/A	N/A
Thermometer	DeLi	N/A	N/A	2024.09.22	2025.09.21
Test Software	FALA	LZ-RF	N/A	N/A	N/A

2.8. Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	RF output power, conducted	$\pm 0.958\text{dB}$
2	Conducted spurious emissions(9KHz~30MHz)	$\pm 2.988\text{dB}$
	All emissions, radiated 9KHz~30MHz	$\pm 0.89\text{dB}$
3	All emissions, radiated 30MHz-1GHz	$\pm 2.50\text{dB}$
4	All emissions, radiated 1GHz-18GHz	$\pm 3.51\text{dB}$
5	Occupied bandwidth	$\pm 23.20\text{Hz}$
6	Power spectral density	$\pm 0.886\text{dB}$

3. TEST RESULT

3.1. Maximum Peak Conducted Output Power

3.1.1. Limit

47 CFR 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.

3.1.2. Test Procedure

ANSI C63.10-2013 clause 7.8.5: 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. The hopping shall be disabled for this test:

1. Use the following spectrum analyzer settings:

- ① Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
- ② RBW > 20 dB bandwidth of the emission being measured.
- ③ VBW $\geq$ RBW.
- ④ Sweep: Auto.
- ⑤ Detector function: Peak.
- ⑥ Trace: Max hold.

2. Allow trace to stabilize.

3. Use the marker-to-peak function to set the marker to the peak of the emission.

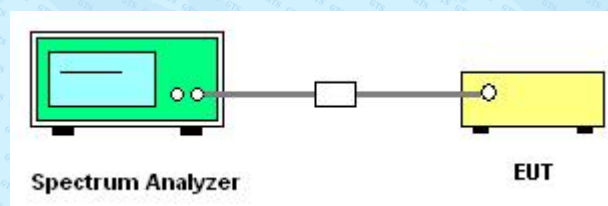
4. The indicated level is the peak output power, after any corrections for external attenuators and cables.

5. A plot of the test results and setup description shall be included in the test report.

Remark:

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.

3.1.3. Test Setup



3.1.4. Test Result of Maximum Peak Conducted Output Power

Please refer to the Appendix A

3.2. Number of Hopping Frequencies

3.2.1. Limit

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

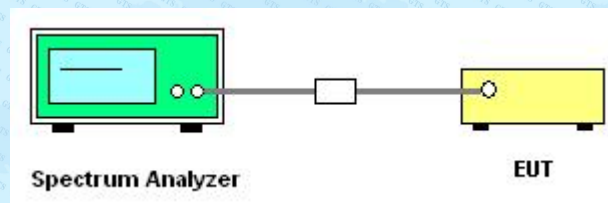
3.2.2. Test Procedure

ANSI C63.10-2013 clause 7.8.3: The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
2. RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3. VBW $\geq$ RBW.
4. Sweep: Auto.
5. Detector function: Peak.
6. Trace: Max hold.
7. Allow the trace to stabilize.

It might prove necessary to break the span up into sub ranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A plot of the data shall be included in the test report.

3.2.3. Test Setup



3.2.4. Test Result of Number of Hopping Frequencies

Please refer to the Appendix A

3.3. Duty Cycle and Dwell Time

3.3.1. Limit

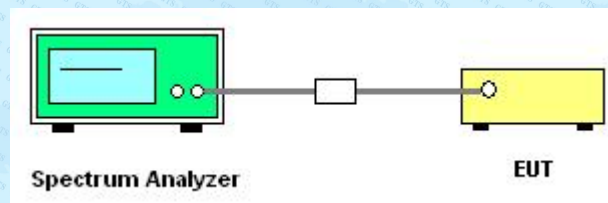
47 CFR 15.247(a)(1)(iii): The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

3.3.2. Test Procedure

ANSI C63.10-2013 clause 7.8.4: The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span: Zero span, centered on a hopping channel.
2. RBW shall be $\leq$ channel spacing and where possible RBW should be set $\gg 1/T$, where T is the expected dwell time per channel.
3. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
4. Detector function: Peak.
5. Trace: Max hold.
6. Use the marker-delta function to determine the transmit time per hop.
7. The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements.

3.3.3. Test Setup



3.3.4. Test Result of Duty Cycle and Dwell Time

Please refer to the Appendix A

3.4. 20dB Bandwidth

3.4.1. Limit

There is no limit requirement for 20dB Bandwidth.

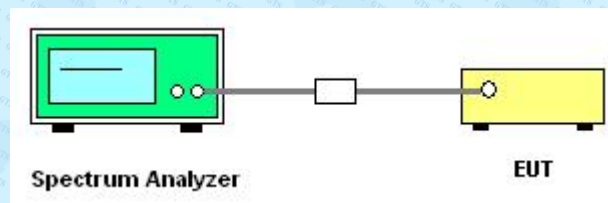
3.4.2. Test Procedure

1. The testing follows ANSI C63.10-2013 clause 6.9.2 and 6.9.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.

The path loss was compensated to the results for each measurement.

3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings for 20dB Bandwidth measurement. Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel; RBW $\geq 1\%$ of the 20 dB bandwidth; VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
5. Measure and record the results in the test report.

3.4.3. Test Setup



3.4.4. Test Result of 20dB Bandwidth

Please refer to the Appendix A

3.5. Carrier Frequency Separation

3.5.1. Limit

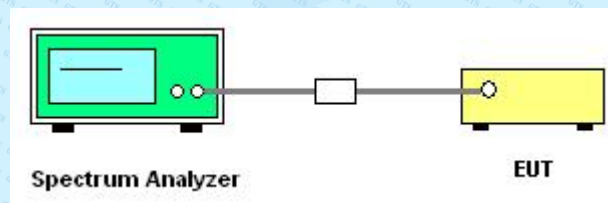
47 CFR 15.247(a)(1): Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

3.5.2. Test Procedure

ANSI C63.10-2013 clause 7.8.2: The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span: Wide enough to capture the peaks of two adjacent channels.
2. RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
3. VBW $\geq$ RBW.
4. Sweep: Auto.
5. Detector function: Peak.
6. Trace: Max hold.
7. Allow the trace to stabilize.
8. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. A plot of the data shall be included in the test report.

3.5.3. Test Setup



3.5.4. Test Result of Carrier Frequency Separation

Please refer to the Appendix A

3.6. Conducted Band Edge

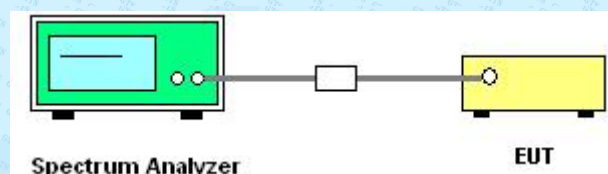
3.6.1. Limit

47 CFR 15.247(d): 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.

3.6.2. Test Procedure

1. The testing follows ANSI C63.10-2013 clause 11.13.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Conducted Band Edge measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the 100 kHz bandwidth within the band that contains the highest level of the desired power when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
4. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.6.3. Test Setup



3.6.4. Test Result of Conducted Band Edge

Please refer to the Appendix A

3.7. Conducted Spurious Emission

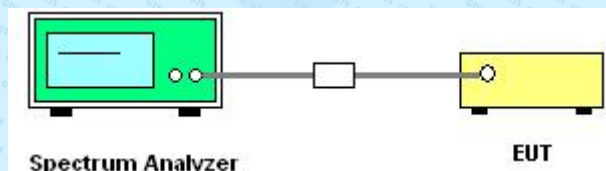
3.7.1. Limit

47 CFR 15.247(d): 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.

3.7.2. Test Procedure

1. The testing follows ANSI C63.10-2013 clause 7.8.8.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.7.3. Test Setup



3.7.4. Test Result of Conducted Spurious Emission

Please refer to the Appendix A

3.8. Radiated Spurious Emission and Restricted Band

3.8.1. Limit

47 CFR 15.247(d): 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.

47 CFR 15.205(a): Only spurious emissions are permitted in any of the frequency bands listed below:

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0.090-0.110	12.29-12.293	149.9-150.05	1660-1710	8.025-8.5
0.495-0.505	12.51975-12.52025	156.52475-156.52525	1718.8-1722.2	9.0-9.2
2.1735-2.1905	12.57675-12.57725	156.7-156.9	2200-2300	9.3-9.5
4.125-4.128	13.36-13.41	162.0125-167.17	2310-2390	10.6-12.7
4.17725-4.17775	16.42-16.423	167.72-173.2	2483.5-2500	13.25-13.4
4.20725-4.20775	16.69475-16.69525	240-285	2690-2900	14.47-14.5
6.215-6.218	16.80425-16.80475	322-335.4	3260-3267	15.35-16.2
6.26775-6.26825	25.5-25.67	399.9-410	3332-3339	17.7-21.4
6.31175-6.31225	37.5-38.25	608-614	3345.8-3358	22.01-23.12
8.291-8.294	73-74.6	960-1240	3600-4400	23.6-24.0
8.362-8.366	74.8-75.2	1300-1427	4500-5150	31.2-31.8
8.37625-8.38675	108-121.94	1435-1626.5	5350-5460	36.43-36.5
8.41425-8.41475	123-138	1645.5-1646.5	7250-7750	Above 38.6

47 CFR 15.209(a): The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3

216-960	200	3
Above 960	500	3

3.8.2. Test Procedure

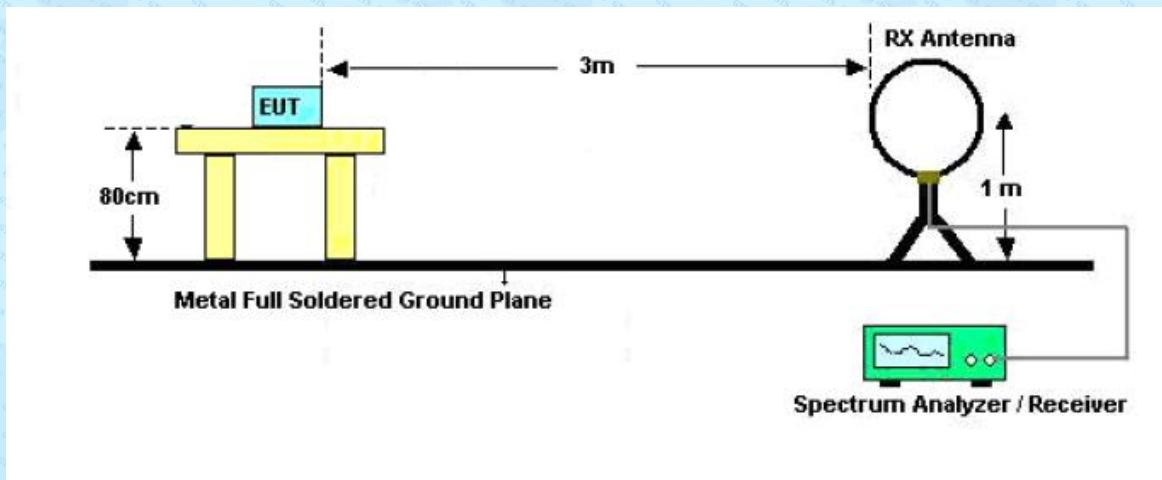
1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
 - ① Span shall wide enough to fully capture the emission being measured;
 - ② Set RBW=100 kHz for $f < 1$ GHz, RBW=1MHz for $f > 1$ GHz ; VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak;
 - ③ For average measurement: use duty cycle correction factor method per 15.35(c).
Duty cycle = On time/100 milliseconds
On time = $N1 \cdot L1 + N2 \cdot L2 + \dots + Nn-1 \cdot L_{Nn-1} + Nn \cdot L_n$
Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.
Average Emission Level = Peak Emission Level + $20 \cdot \log(\text{Duty cycle})$
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Pre-amp Factor = Level
7. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
8. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Remark:

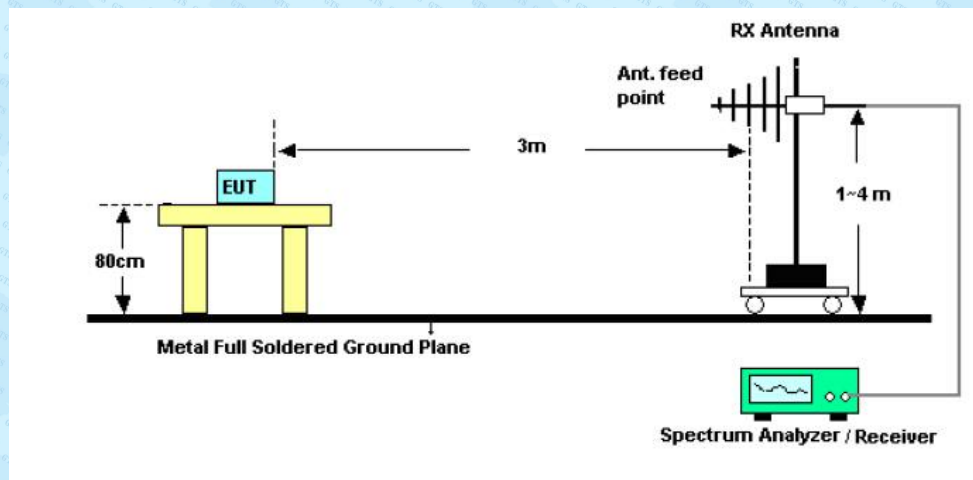
The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.70dB) derived from $20 \log(\text{dwell time}/100\text{ms})$. This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

3.8.3. Test Setup

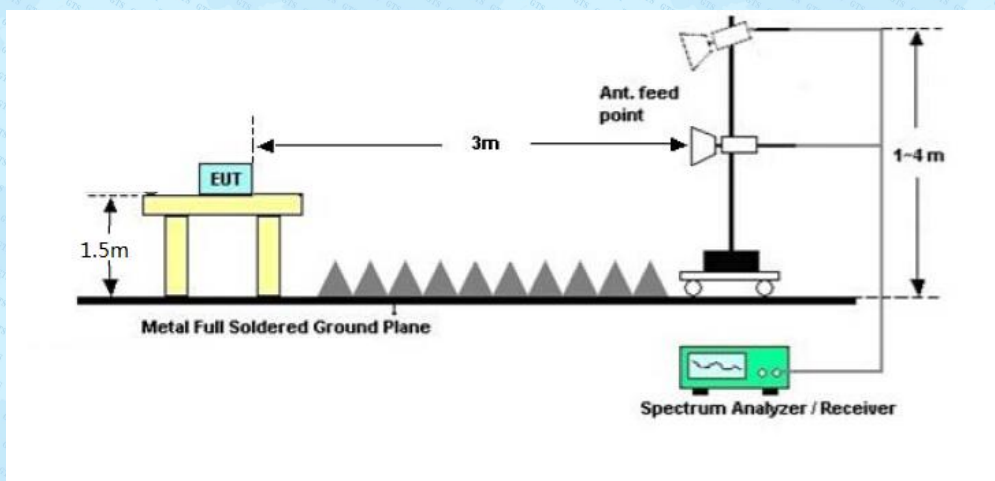
3.8.3.1. For radiated emissions below 30MHz



3.8.3.2. For radiated emissions from 30MHz to 1GHz



3.8.3.3. For radiated emissions above 1GHz



3.8.4. Test Result of Radiated Spurious Emission

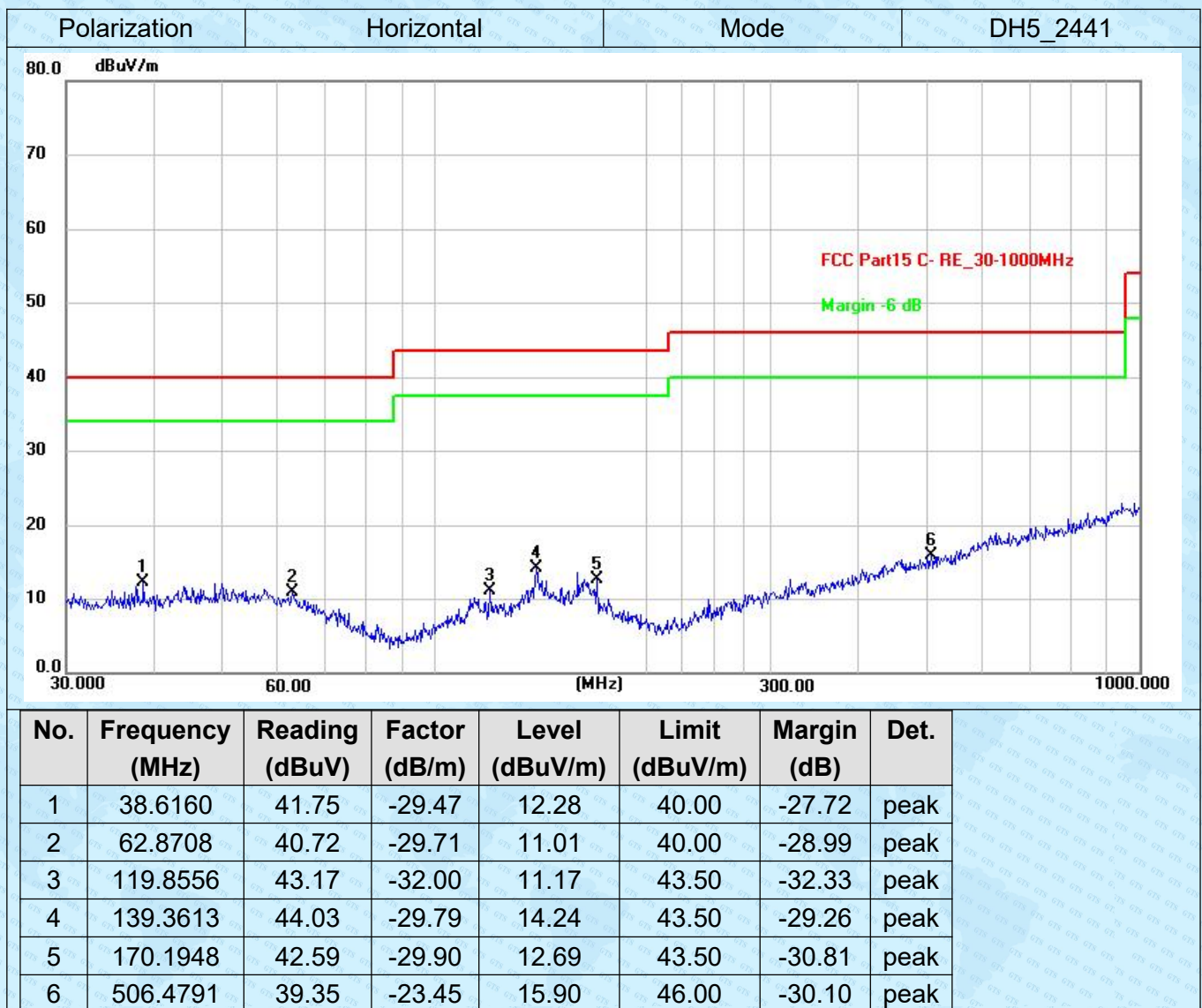
For 9 kHz ~ 30 MHz

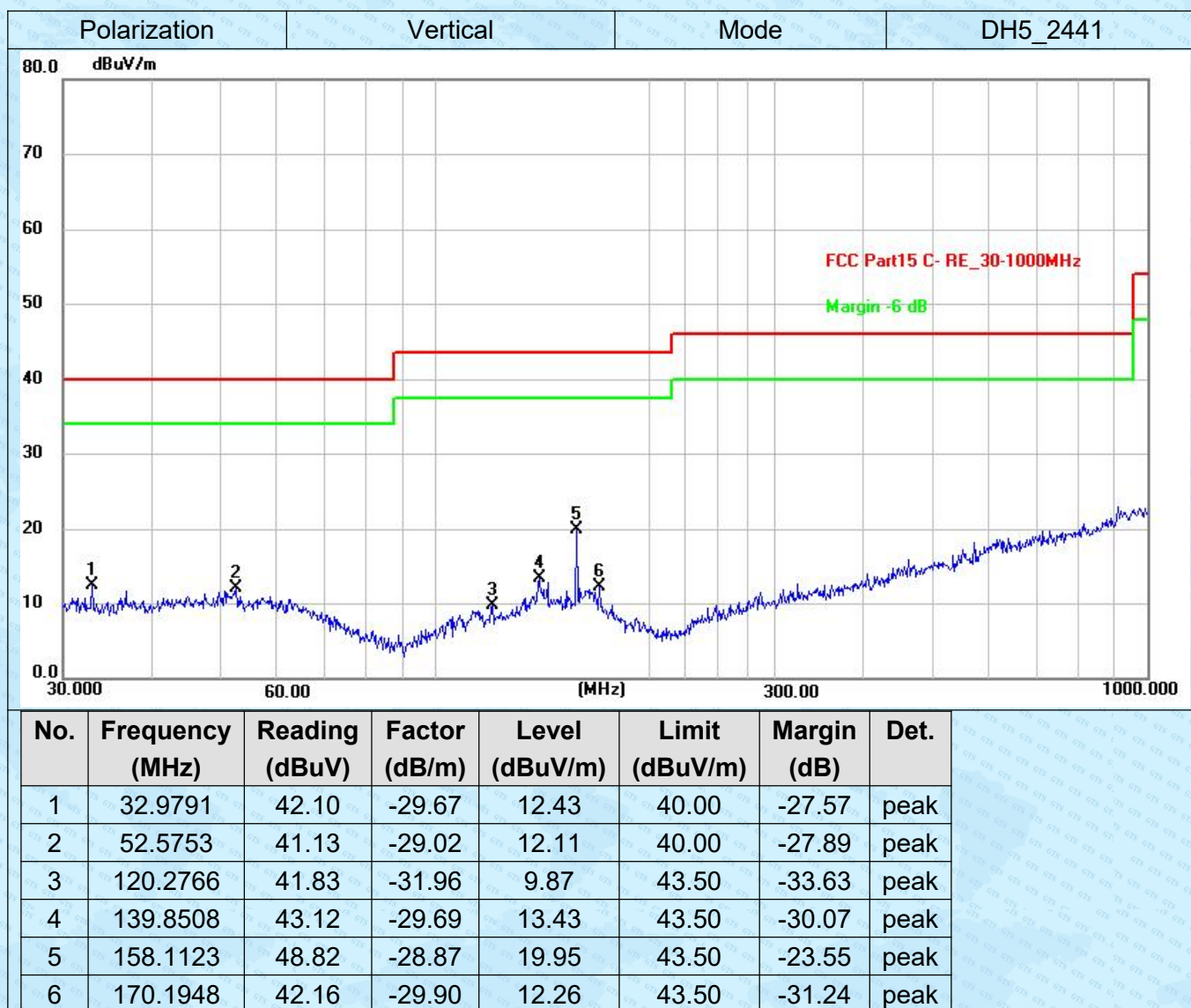
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

For 30 MHz ~ 1 GHz:

Note:

1. All modes have been tested, only worst case(DH5_2441MHz)mode was recorded in the test report.
2. Emission Level (dBUV/m) = Reading Value (dBUV) + Correction Factor (dB/m).
3. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
4. The emission levels of other frequencies were less than 20dB margin against the limit.
5. Margin value = Emission level-Limit value.

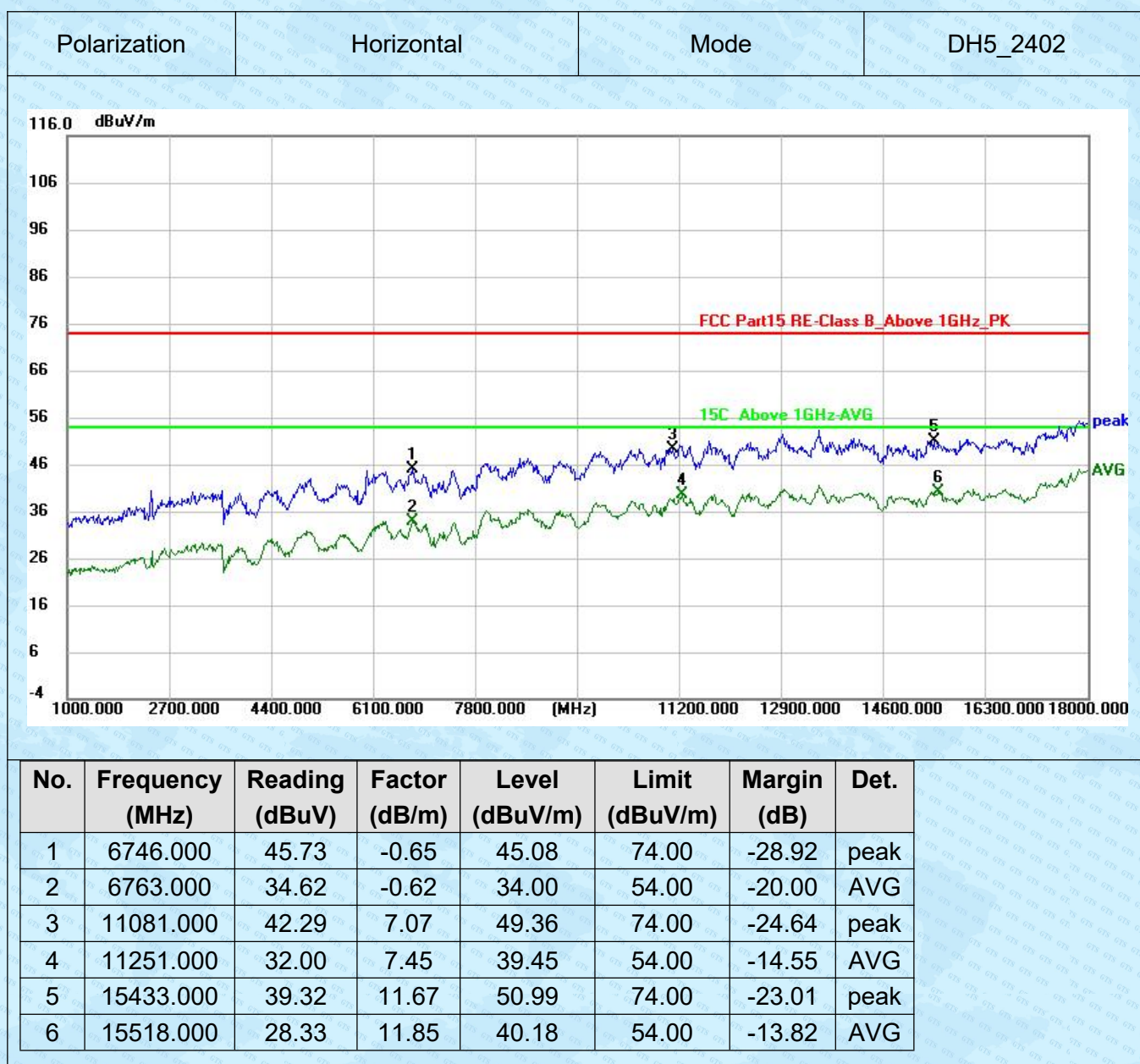


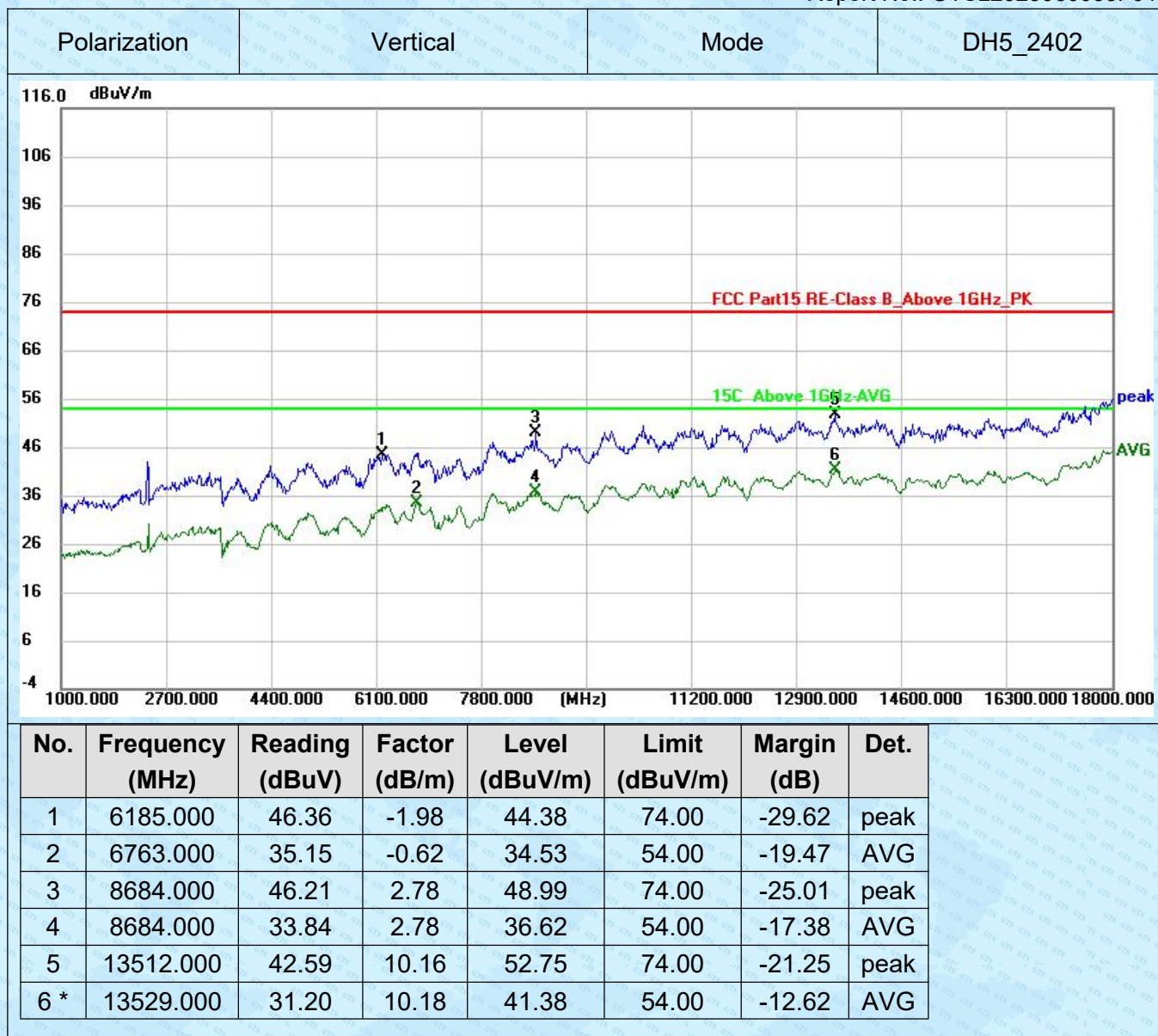


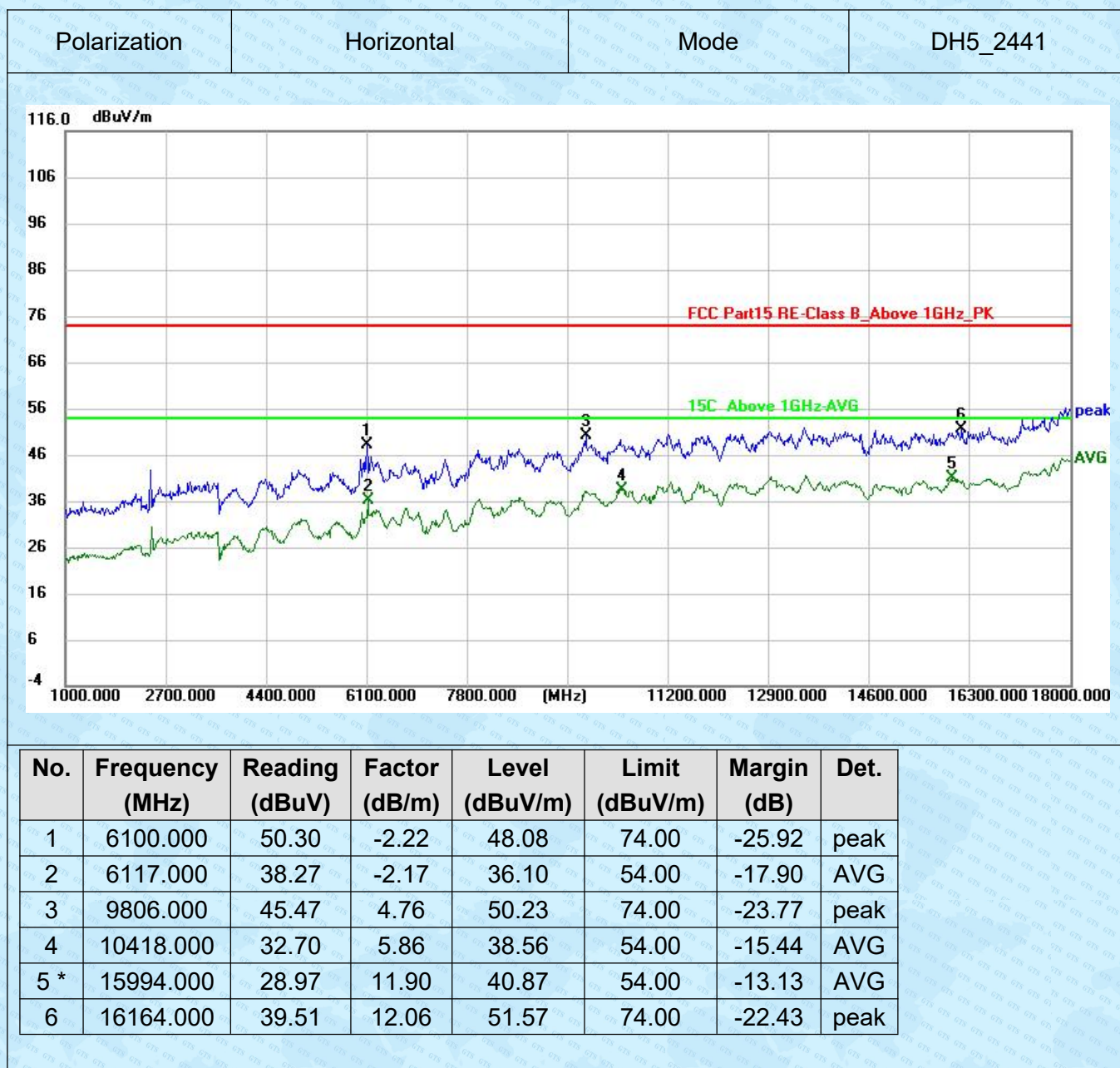
For 1 GHz ~ 18GHz:

Note:

- 1.The all data rate modes had been test, but only worse (DH5 and 3DH5)mode was recorded in the test report.
- 2.In frequency ranges 18 ~25GHz no any other harmonic emissions detected which are tested to compliance with the limit. No recording in the test report. No any other emissions level which are attenuated less than 20dB below the limit. No recording in the test report.
- 3.We used the filter to test and the main frequency was filtered out.
- 4.Emission Level (dBuV/m) = Reading Value (dBuV) + Correction Factor (dB/m).
5. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
6. The emission levels of other frequencies were less than 20dB margin against the limit.
7. Margin value = Emission level-Limit value.







Polarization	Vertical	Mode	DH5_2441
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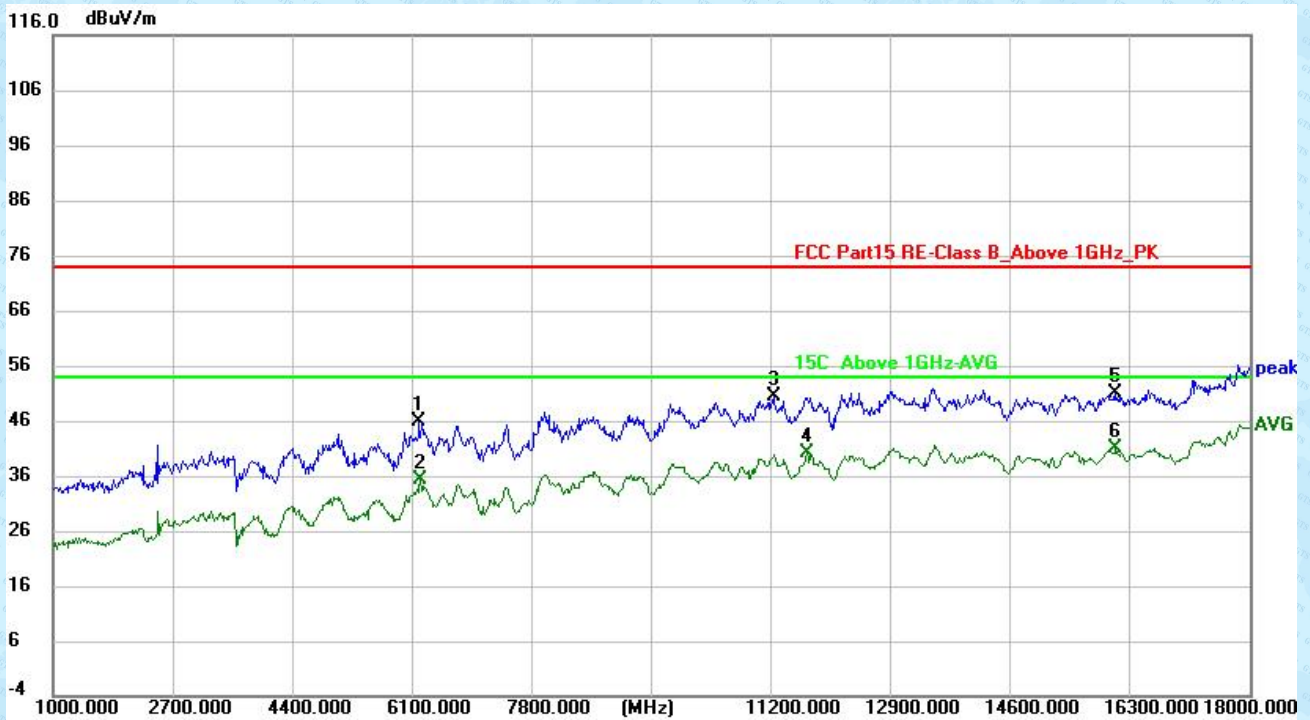
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	6100.000	49.40	-2.22	47.18	74.00	-26.82	peak
2	6117.000	37.32	-2.17	35.15	54.00	-18.85	AVG
3	11234.000	43.55	7.42	50.97	74.00	-23.03	peak
4	11710.000	31.82	8.13	39.95	54.00	-14.05	AVG
5	15977.000	39.04	11.89	50.93	74.00	-23.07	peak
6 *	16572.000	28.49	12.46	40.95	54.00	-13.05	AVG

Polarization	Horizontal	Mode	DH5_2480
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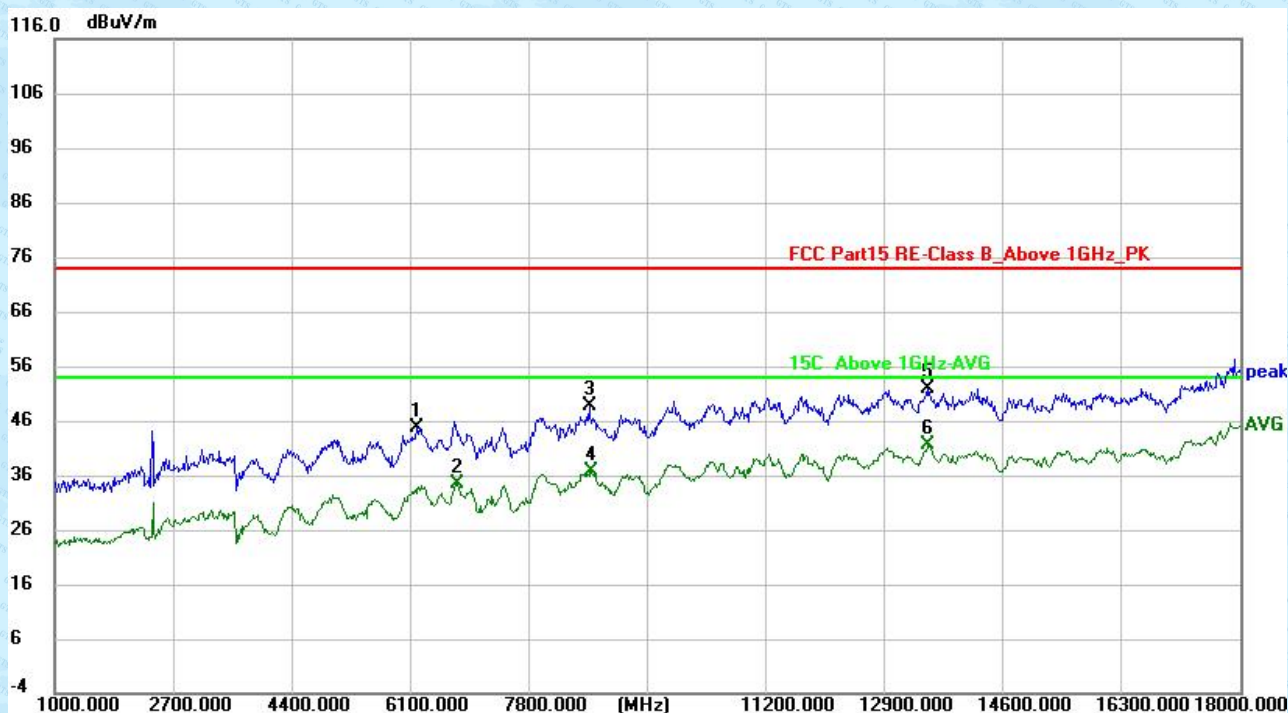
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	6202.000	47.48	-1.94	45.54	74.00	-28.46	peak
2	6763.000	35.38	-0.62	34.76	54.00	-19.24	AVG
3	10401.000	44.15	5.82	49.97	74.00	-24.03	peak
4	11234.000	32.33	7.42	39.75	54.00	-14.25	AVG
5	15382.000	39.99	11.53	51.52	74.00	-22.48	peak
6 *	15994.000	28.98	11.90	40.88	54.00	-13.12	AVG

Polarization	Vertical	Mode	DH5_2480
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No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	6202.000	47.75	-1.94	45.81	74.00	-28.19	peak
2	6219.000	37.12	-1.89	35.23	54.00	-18.77	AVG
3	11234.000	42.99	7.42	50.41	74.00	-23.59	peak
4	11710.000	31.94	8.13	40.07	54.00	-13.93	AVG
5	16079.000	38.97	11.98	50.95	74.00	-23.05	peak
6 *	16096.000	29.03	12.00	41.03	54.00	-12.97	AVG

Polarization	Horizontal	Mode	3DH5_2402
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No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	6185.000	46.62	-1.98	44.64	74.00	-29.36	peak
2	6780.000	35.07	-0.60	34.47	54.00	-19.53	AVG
3	8667.000	46.07	2.73	48.80	74.00	-25.20	peak
4	8701.000	33.96	2.82	36.78	54.00	-17.22	AVG
5	13512.000	41.68	10.16	51.84	74.00	-22.16	peak
6 *	13529.000	31.28	10.18	41.46	54.00	-12.54	AVG

Polarization

Vertical

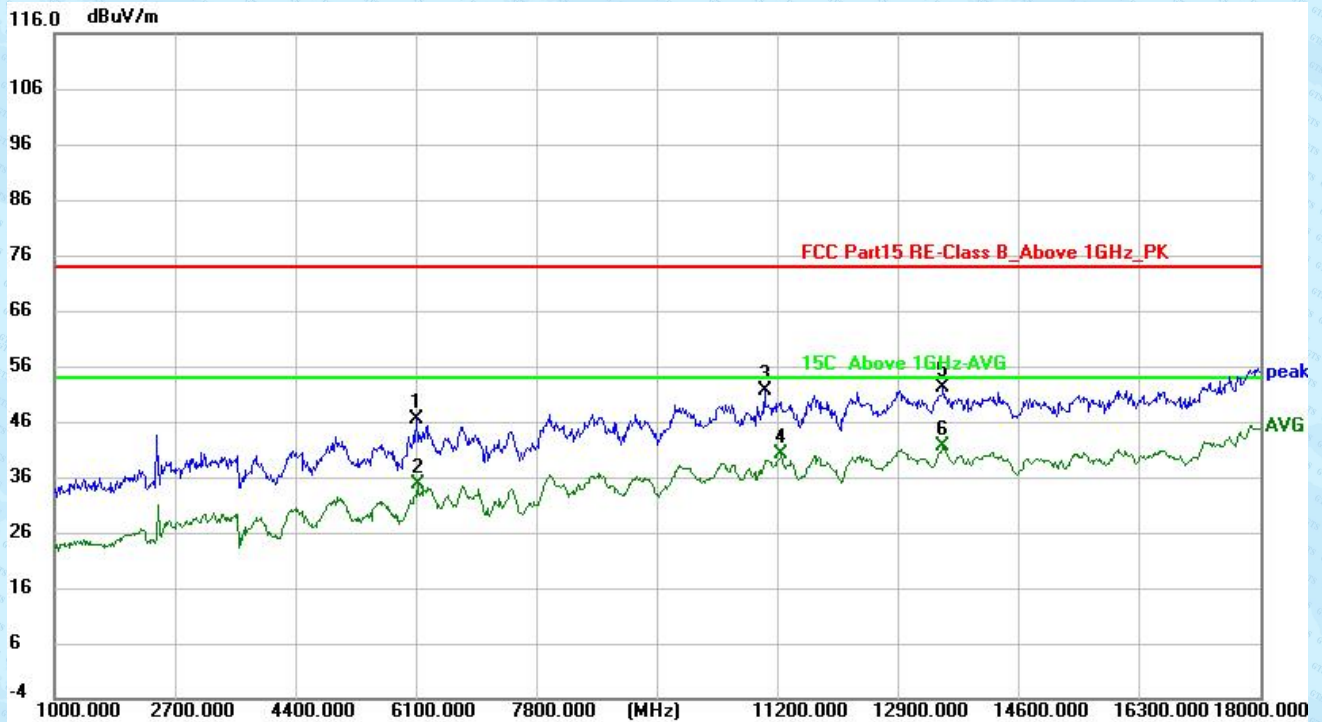
Mode

3DH5_2402



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	5998.000	47.57	-2.50	45.07	74.00	-28.93	peak
2	6763.000	35.29	-0.62	34.67	54.00	-19.33	AVG
3	9908.000	44.27	4.93	49.20	74.00	-24.80	peak
4	10401.000	32.72	5.82	38.54	54.00	-15.46	AVG
5	13512.000	42.20	10.16	52.36	74.00	-21.64	peak
6 *	13529.000	31.29	10.18	41.47	54.00	-12.53	AVG

Polarization	Horizontal	Mode	3DH5_2441
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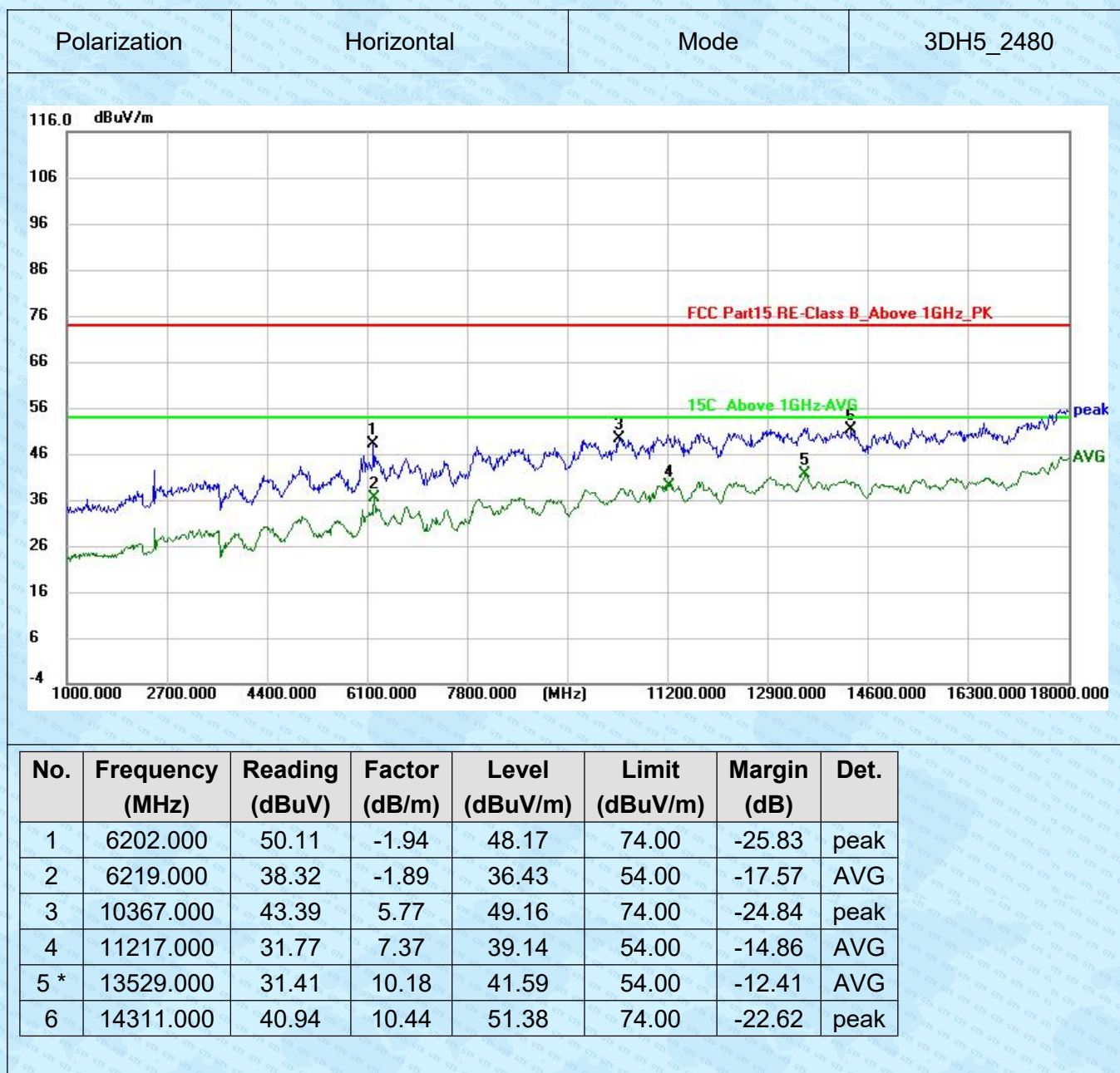


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	6100.000	48.53	-2.22	46.31	74.00	-27.69	peak
2	6117.000	36.83	-2.17	34.66	54.00	-19.34	AVG
3	11013.000	44.51	6.93	51.44	74.00	-22.56	peak
4	11251.000	32.56	7.45	40.01	54.00	-13.99	AVG
5	13529.000	41.92	10.18	52.10	74.00	-21.90	peak
6 *	13529.000	31.32	10.18	41.50	54.00	-12.50	AVG

Polarization	Vertical	Mode	3DH5_2441
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No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	6100.000	49.33	-2.22	47.11	74.00	-26.89	peak
2	6117.000	37.86	-2.17	35.69	54.00	-18.31	AVG
3	11081.000	42.78	7.07	49.85	74.00	-24.15	peak
4	11710.000	31.89	8.13	40.02	54.00	-13.98	AVG
5 *	13512.000	31.29	10.16	41.45	54.00	-12.55	AVG
6	14192.000	41.19	10.51	51.70	74.00	-22.30	peak



Polarization	Vertical	Mode	3DH5_2480
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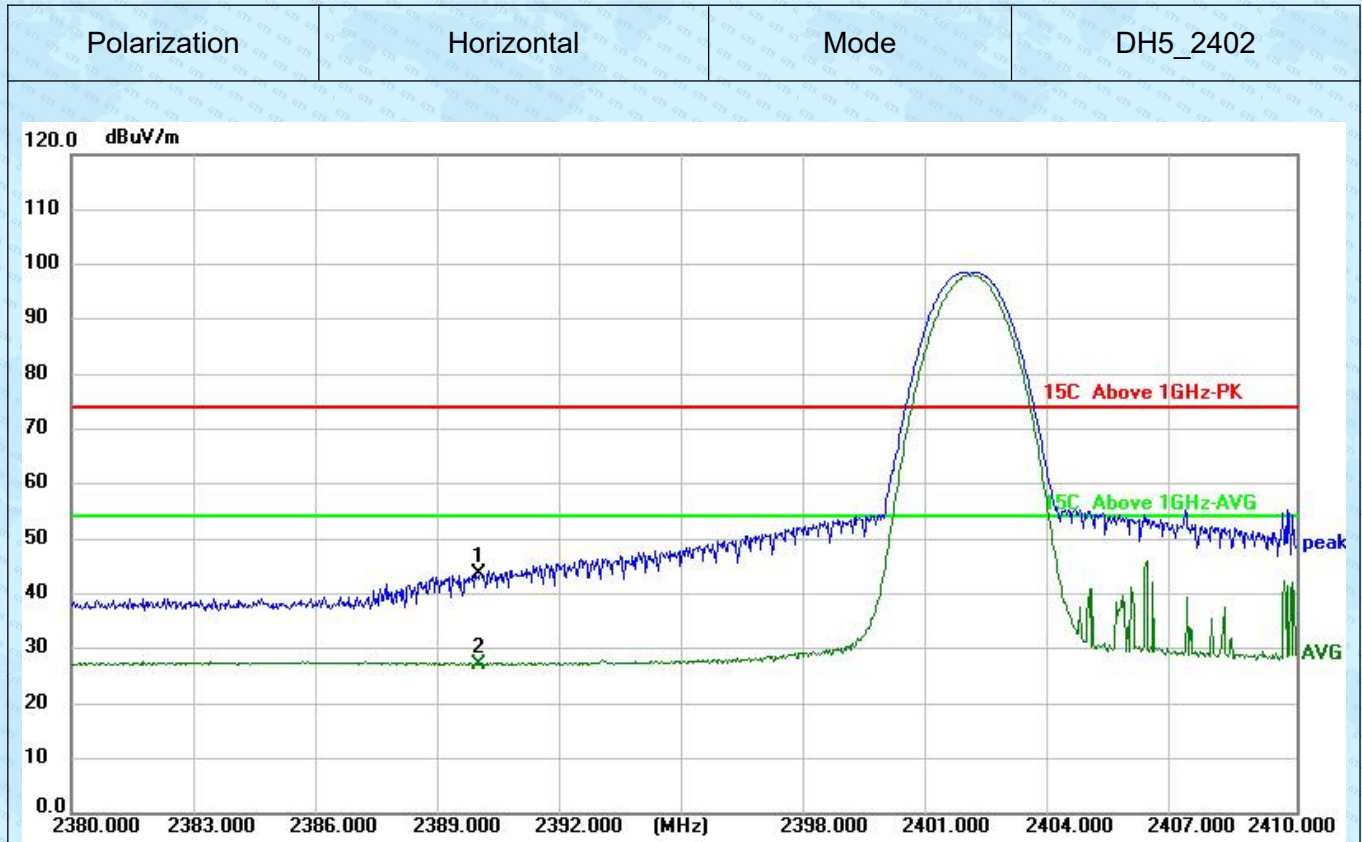


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	6202.000	48.37	-1.94	46.43	74.00	-27.57	peak
2	6219.000	36.64	-1.89	34.75	54.00	-19.25	AVG
3	11234.000	42.89	7.42	50.31	74.00	-23.69	peak
4	11710.000	32.02	8.13	40.15	54.00	-13.85	AVG
5	15399.000	40.43	11.58	52.01	74.00	-21.99	peak
6 *	16096.000	28.90	12.00	40.90	54.00	-13.10	AVG

3.8.5. Test Result of Restricted Band

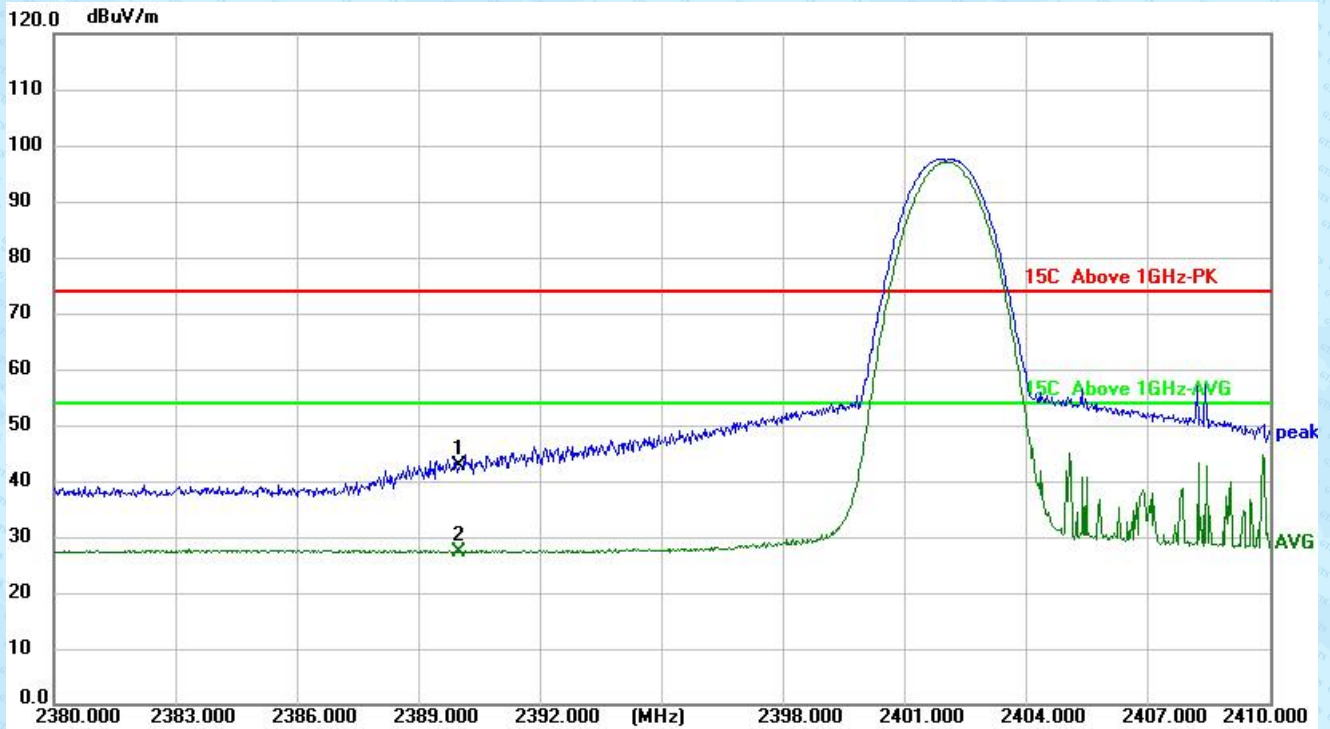
Note:

All modes have been tested, only worst case(DH5 and 3DH5)mode was recorded in the test report.



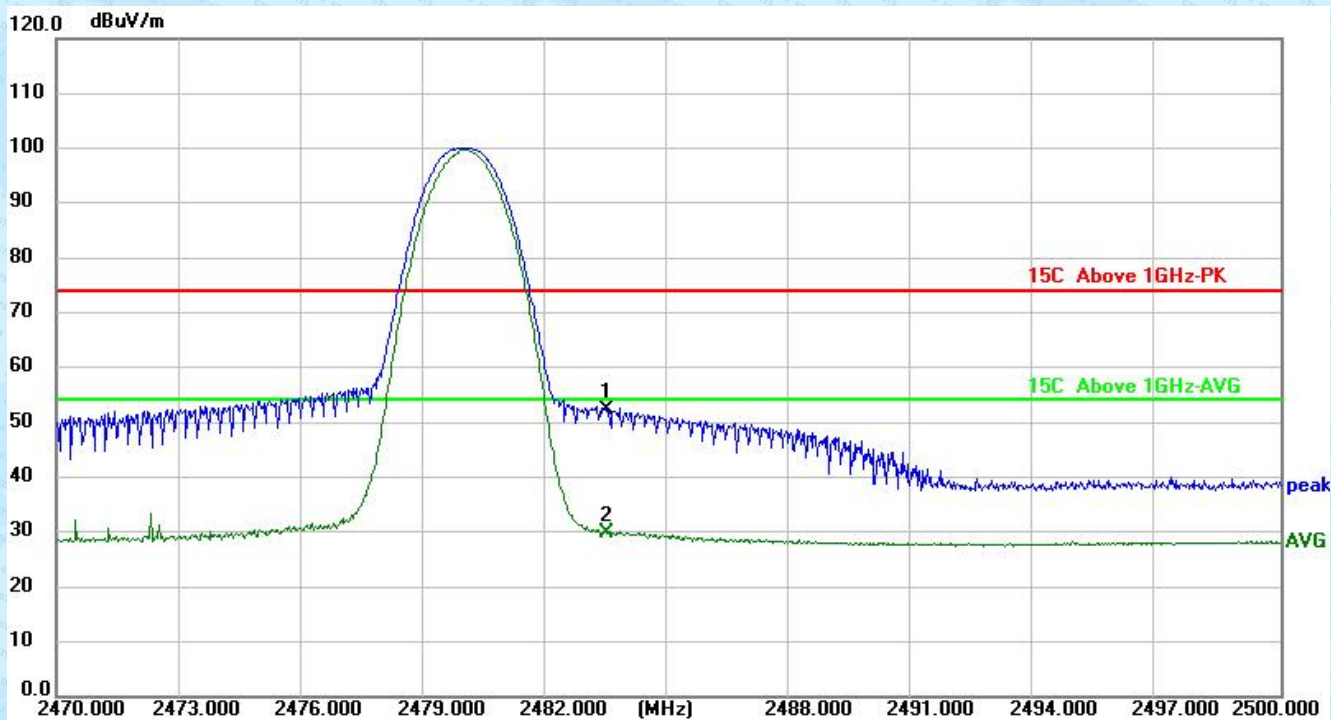
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	2390.000	59.61	-15.88	43.73	74.00	-30.27	peak
2 *	2390.000	43.13	-15.88	27.25	54.00	-26.75	AVG

Polarization	Vertical	Mode	DH5_2402
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No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	2390.000	58.63	-15.88	42.75	74.00	-31.25	peak
2 *	2390.000	43.24	-15.88	27.36	54.00	-26.64	AVG

Polarization	Horizontal	Mode	DH5_2480
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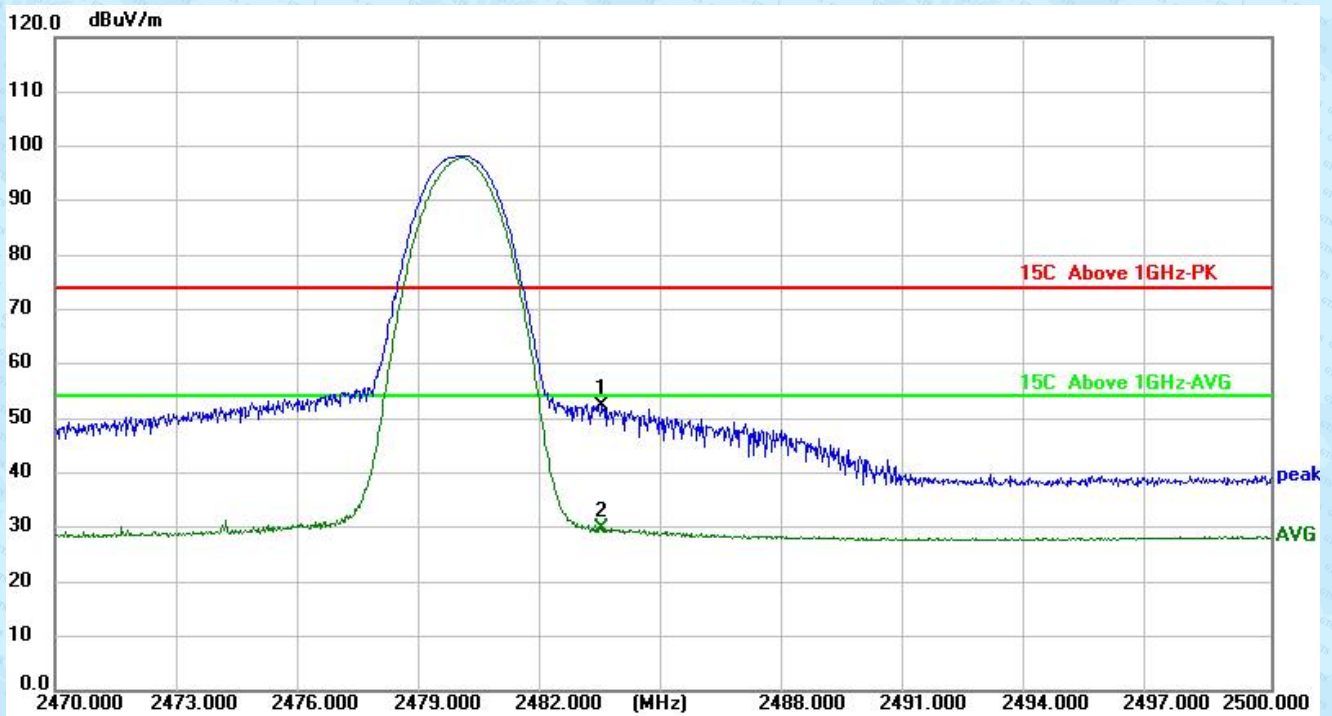
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1 *	2483.500	67.72	-15.30	52.42	74.00	-21.58	peak
2	2483.500	45.06	-15.30	29.76	54.00	-24.24	AVG

Polarization

Vertical

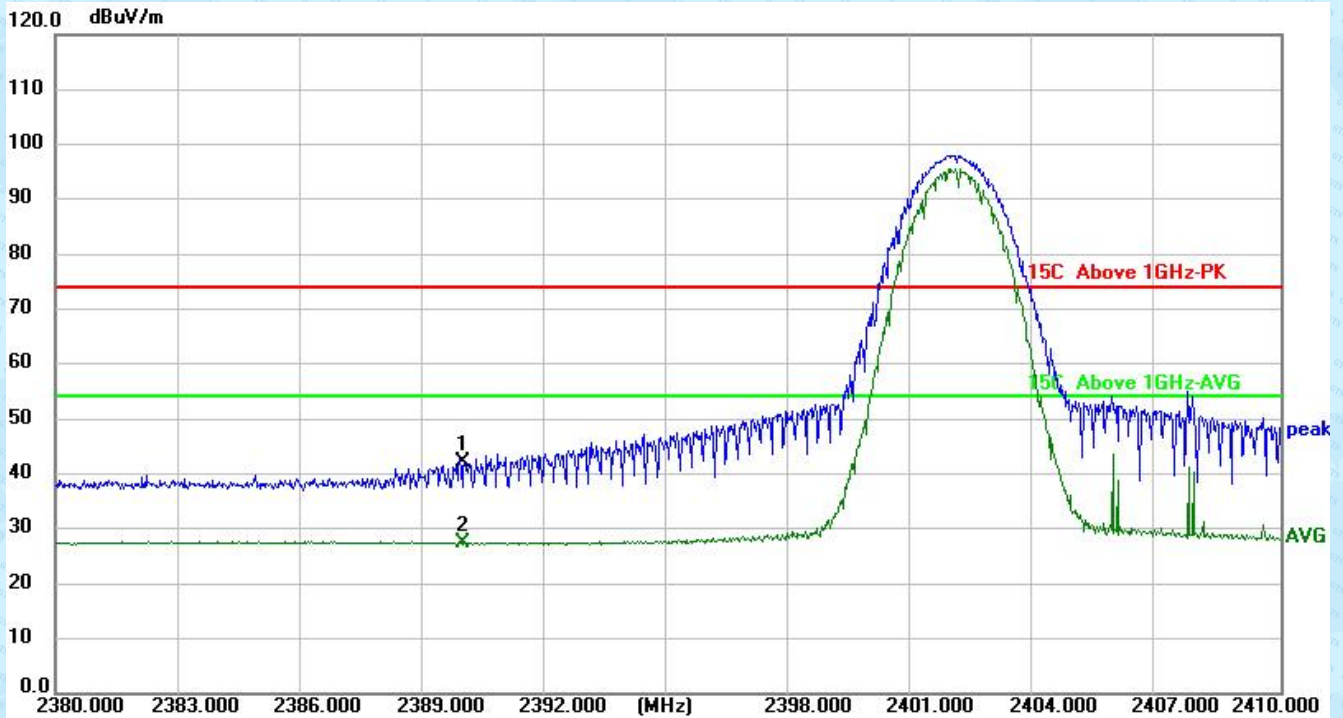
Mode

DH5_2480



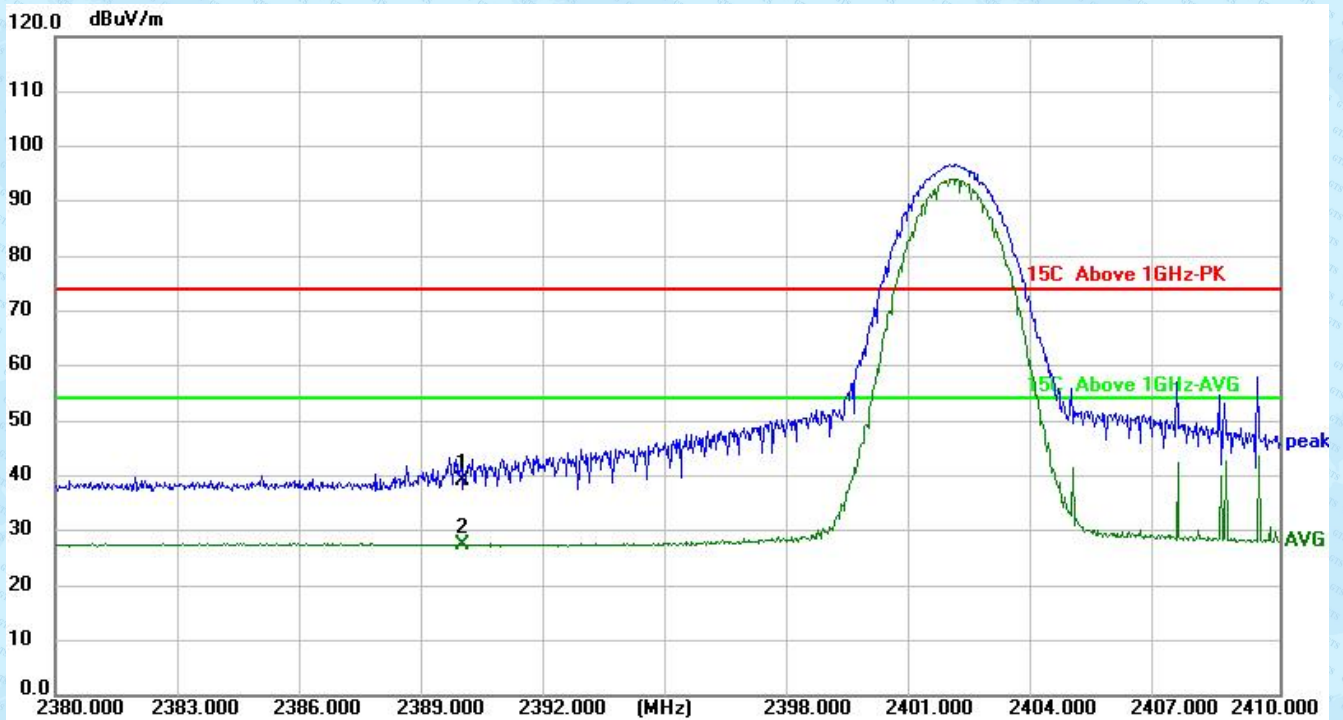
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1 *	2483.500	67.51	-15.30	52.21	74.00	-21.79	peak
2	2483.500	45.02	-15.30	29.72	54.00	-24.28	AVG

Polarization	Horizontal	Mode	3DH5_2402
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No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	2390.000	57.99	-15.88	42.11	74.00	-31.89	peak
2 *	2390.000	43.31	-15.88	27.43	54.00	-26.57	AVG

Polarization	Vertical	Mode	3DH5_2402
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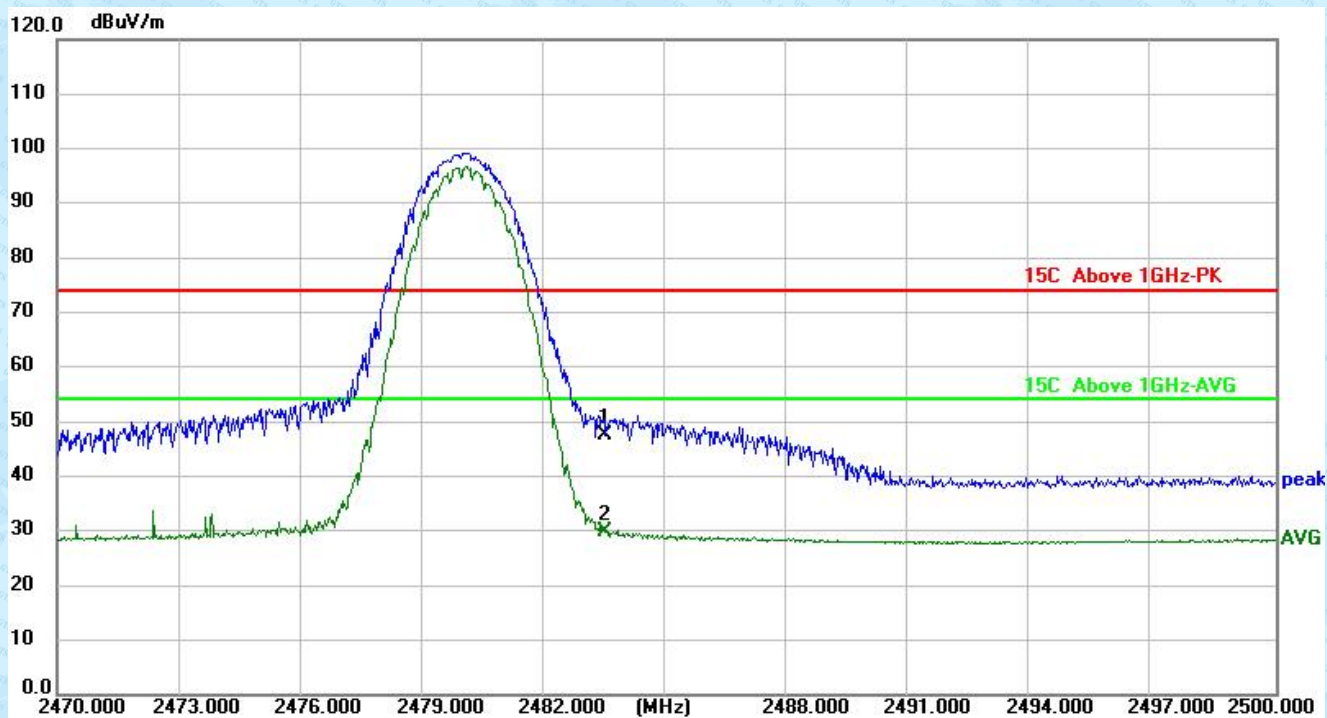
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	2390.000	54.96	-15.88	39.08	74.00	-34.92	peak
2 *	2390.000	43.25	-15.88	27.37	54.00	-26.63	AVG

Polarization

Horizontal

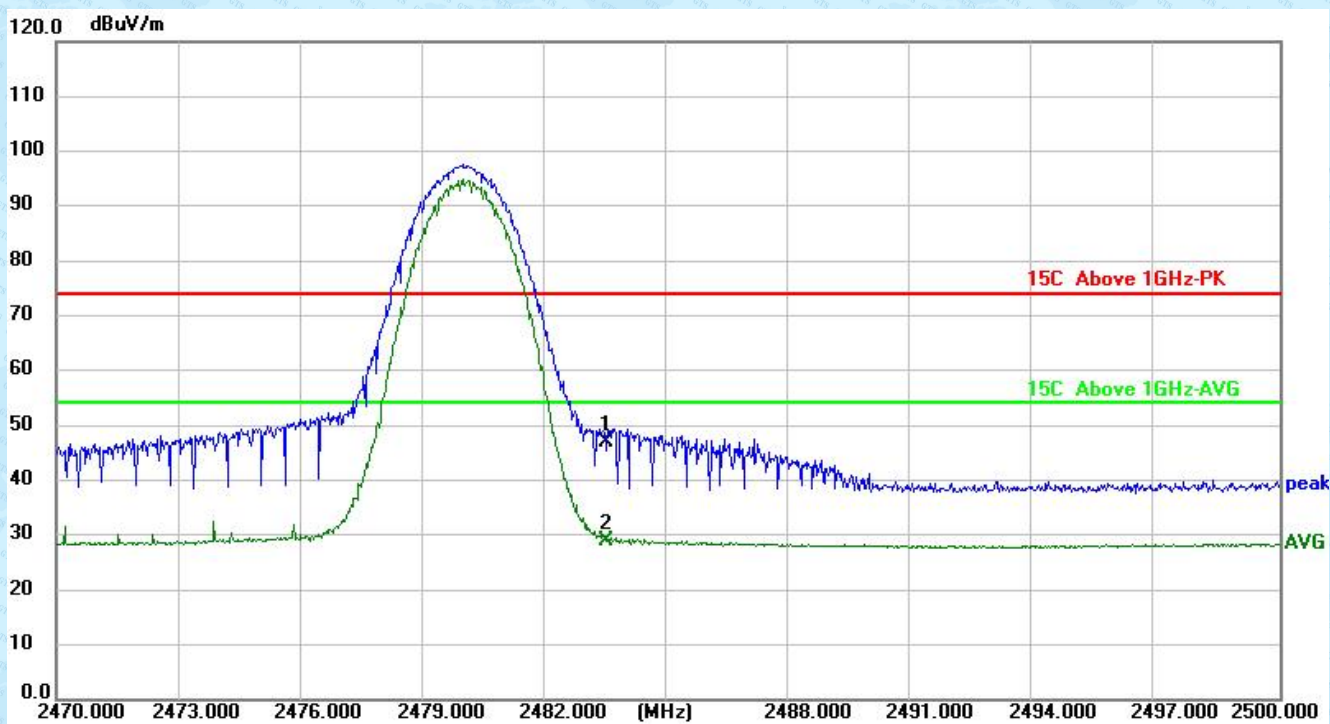
Mode

3DH5_2480



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1 *	2483.500	62.90	-15.30	47.60	74.00	-26.40	peak
2	2483.500	45.24	-15.30	29.94	54.00	-24.06	AVG

Polarization	Vertical	Mode	3DH5_2480
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No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	2483.500	62.25	-15.30	46.95	74.00	-27.05	peak
2 *	2483.500	44.36	-15.30	29.06	54.00	-24.94	AVG

3.9. AC Power-Line Conducted Emission

3.9.1. Limit

47 CFR 15.207(a): For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table:

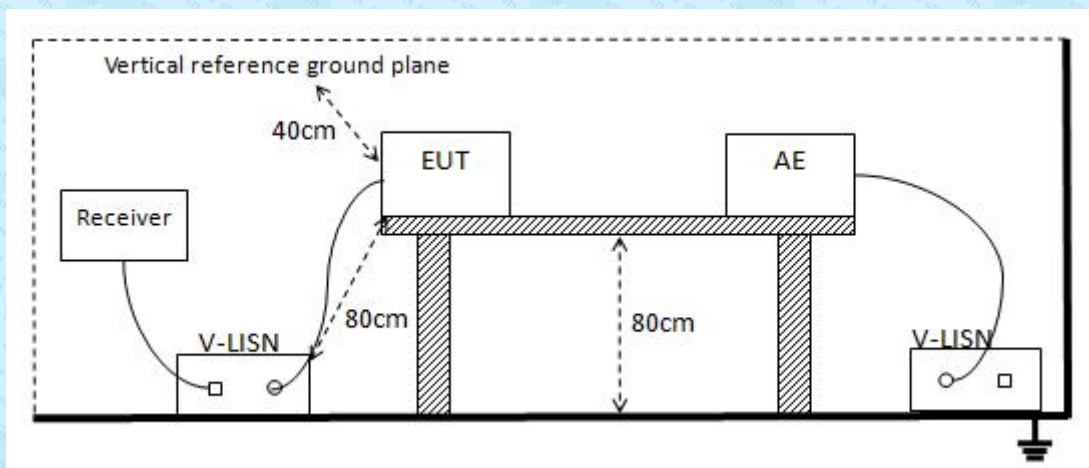
Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

3.9.2. Test Procedure

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9 kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.9.3. Test Setup



3.9.4. Test Result of AC Power-Line Conducted Emission

Note:

Please refer to the Appendix A

3.10. Antenna Requirement

3.10.1. Standard Requirement

According to 47 CFR 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

3.10.2. EUT Antenna

The antenna used for the EUT is PIFA Antenna, which meets the antenna requirements.

4. Appendix A of data

Conducted Output Power

Test Result

Peak power

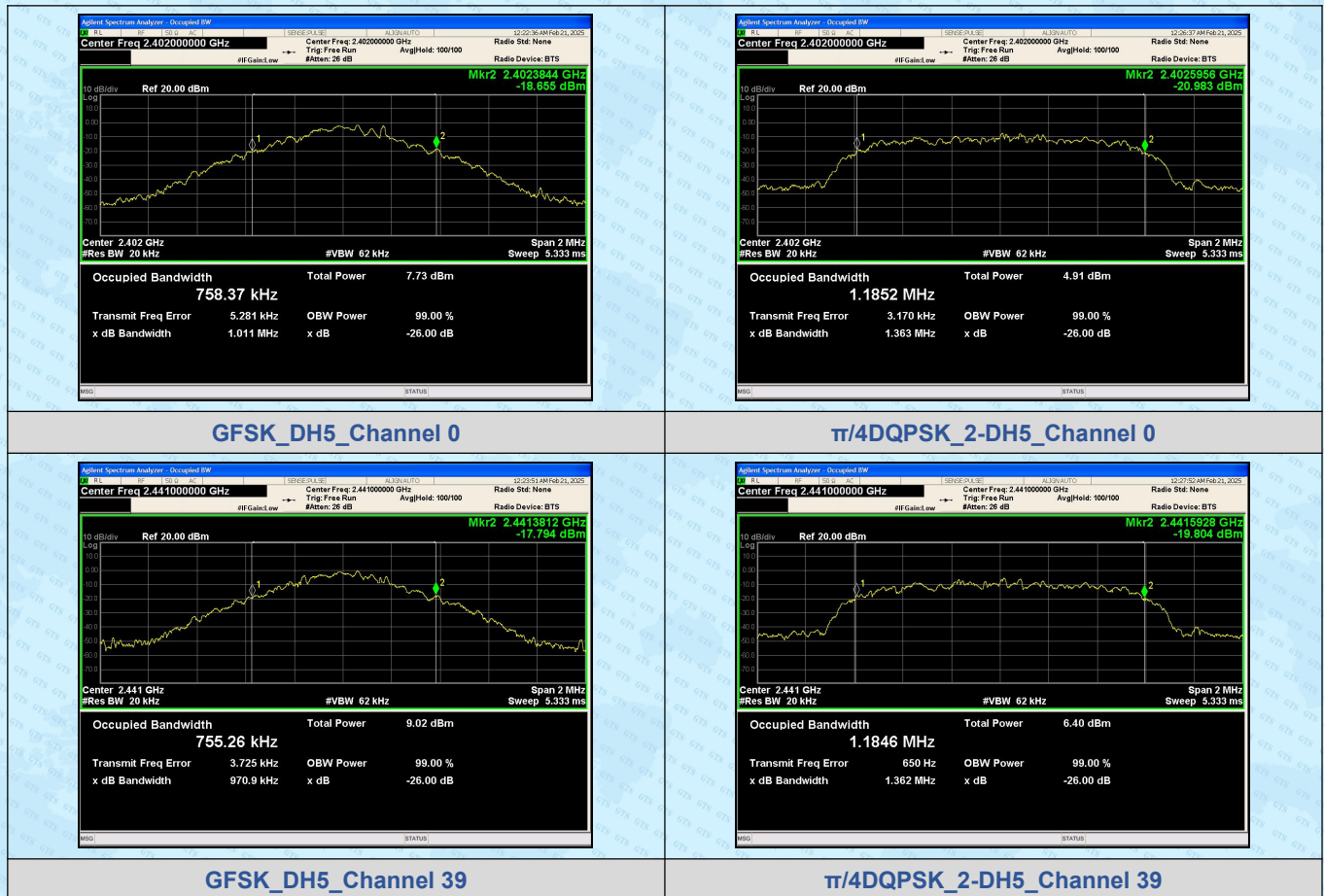
Modulation	Packet Type	Channel	Peak Output Power (dBm)	Peak Output Power (mW)	Limit (dBm)	Result
GFSK	DH5	0	1.80	1.52	20.97	PASS
		39	3.11	2.05		PASS
		78	2.24	1.68		PASS
$\pi/4$ DQPSK	2-DH5	0	0.90	1.23		PASS
		39	2.14	1.64		PASS
		78	1.18	1.31		PASS
8DPSK	3-DH5	0	1.08	1.28		PASS
		39	2.60	1.82		PASS
		78	1.73	1.49		PASS

99% Bandwidth

Test Result

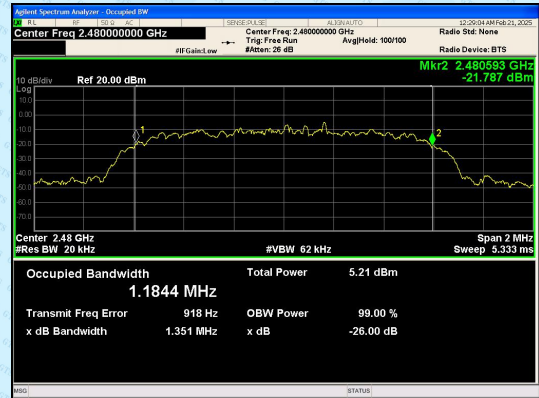
Modulation	Channel	Center Frequency (MHz)	99% BW (MHz)
GFSK	0	2402	0.75837
	39	2441	0.75526
	78	2480	0.75637
$\pi/4$ DQPSK	0	2402	1.1852
	39	2441	1.1846
	78	2480	1.1844
8DPSK	0	2402	1.1948
	39	2441	1.1910
	78	2480	1.1983

Test Graphs





GFSK_DH5_Channel 78

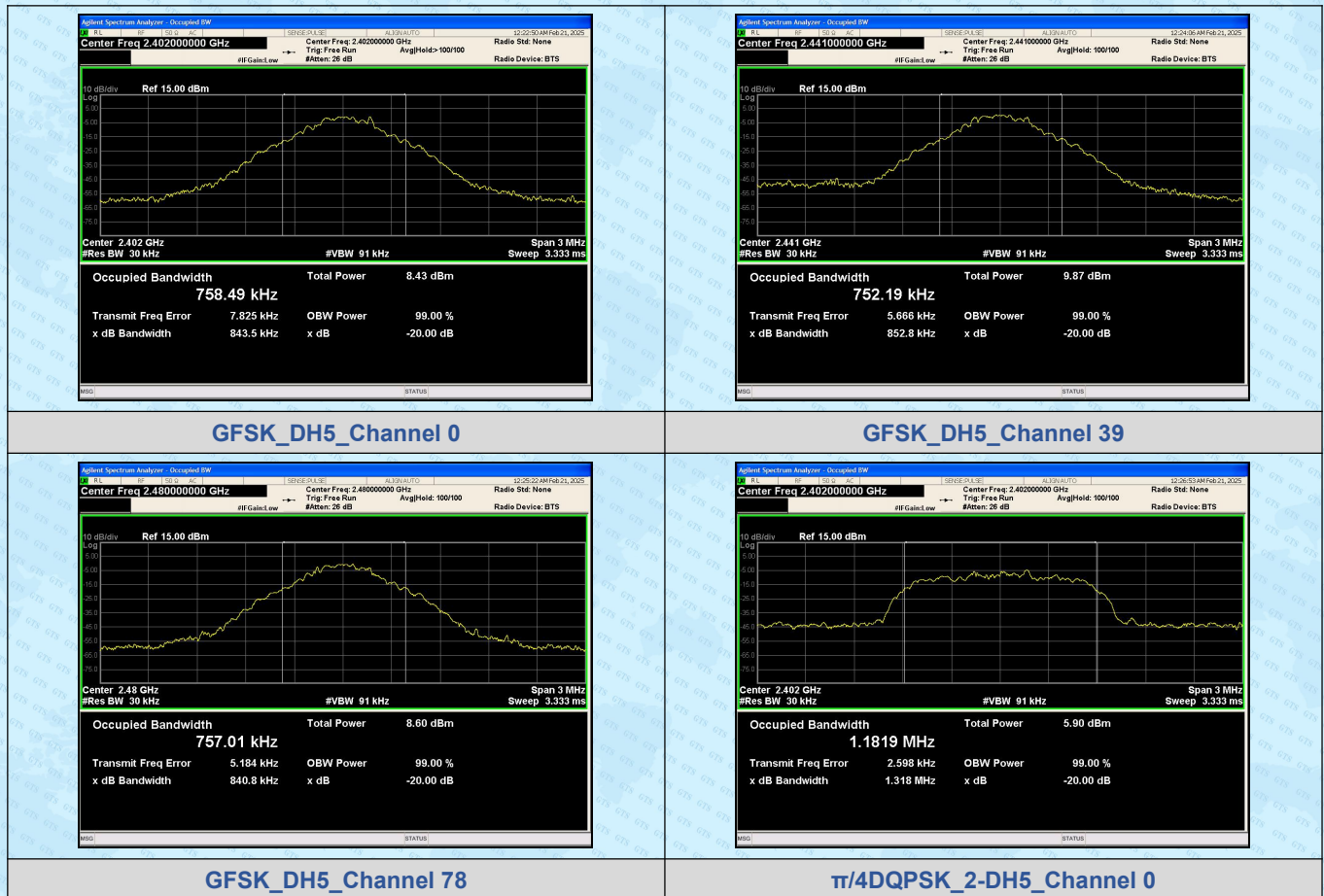
 $\pi/4$ DQPSK_2-DH5_Channel 78

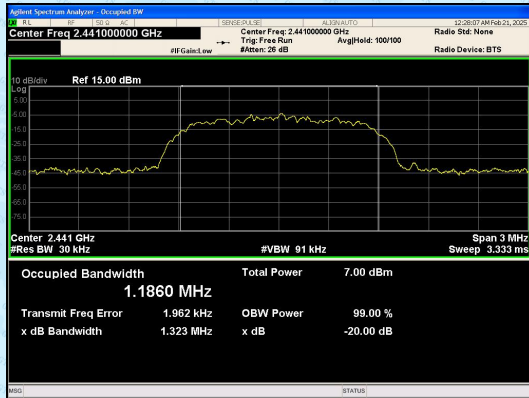
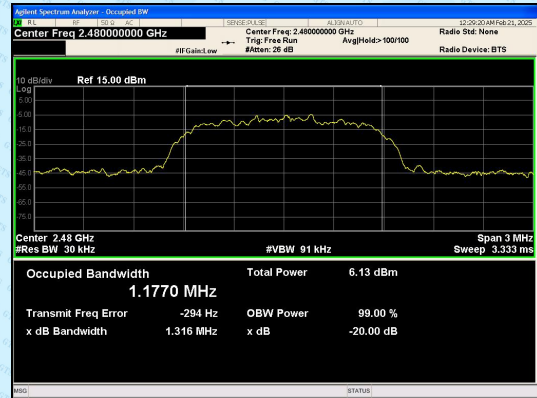
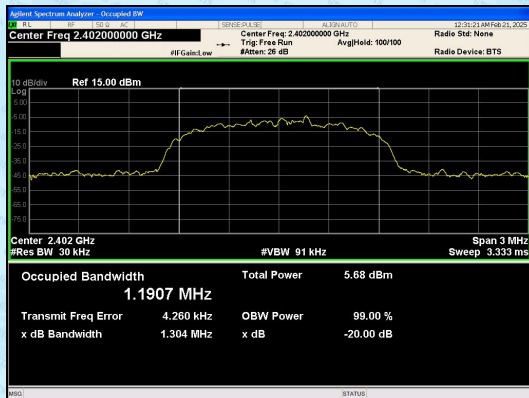
20dB Bandwidth

Test Result

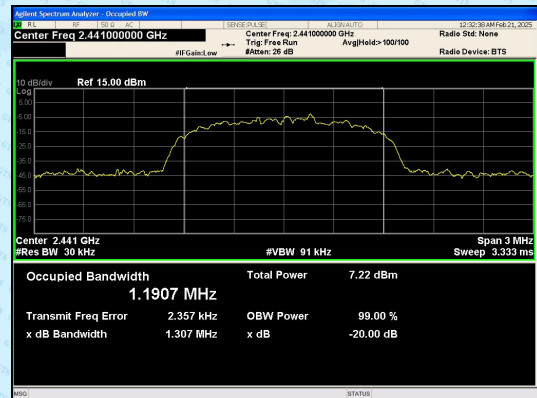
Modulation	Channel	Center Frequency (MHz)	20 dB Bandwidth (MHz)
GFSK	0	2402 MHz	0.8435
	39	2441 MHz	0.8528
	78	2480 MHz	0.8408
$\pi/4$ DQPSK	0	2402 MHz	1.318
	39	2441 MHz	1.323
	78	2480 MHz	1.316
8DPSK	0	2402 MHz	1.304
	39	2441 MHz	1.307
	78	2480 MHz	1.319

Test Graphs

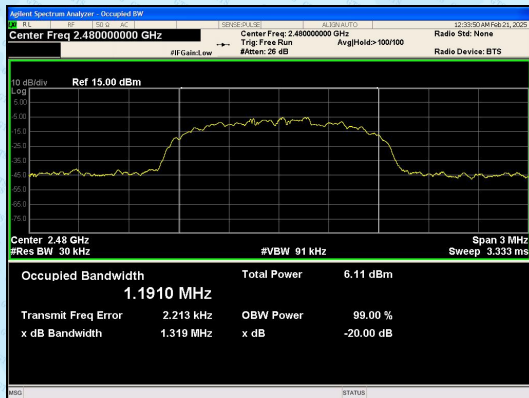


 $\pi/4$ DQPSK_2-DH5_Channel 39 $\pi/4$ DQPSK_2-DH5_Channel 78

8DPSK_3-DH5_Channel 0



8DPSK_3-DH5_Channel 39



8DPSK_3-DH5_Channel 78

Carrier Frequencies Separation

Test Result

Modulation	Packet	Left Center frequency (MHz)	Right Center frequency (MHz)	Hopping Frequency Separation (MHz)	Limit (MHz)	Result
GFSK	DH5	2439.9898	2440.9859	0.9961	0.57	PASS
$\pi/4$ DQPSK	2-DH5	2439.9823	2440.9784	0.9961	0.88	PASS
8DPSK	3-DH5	2439.9256	2441.1497	1.2241	0.88	PASS

Note: The minimum limit is two-third 20 dB bandwidth.

Test Graphs



Conducted Out Of Band Emission

Test Result

Non-Hopping

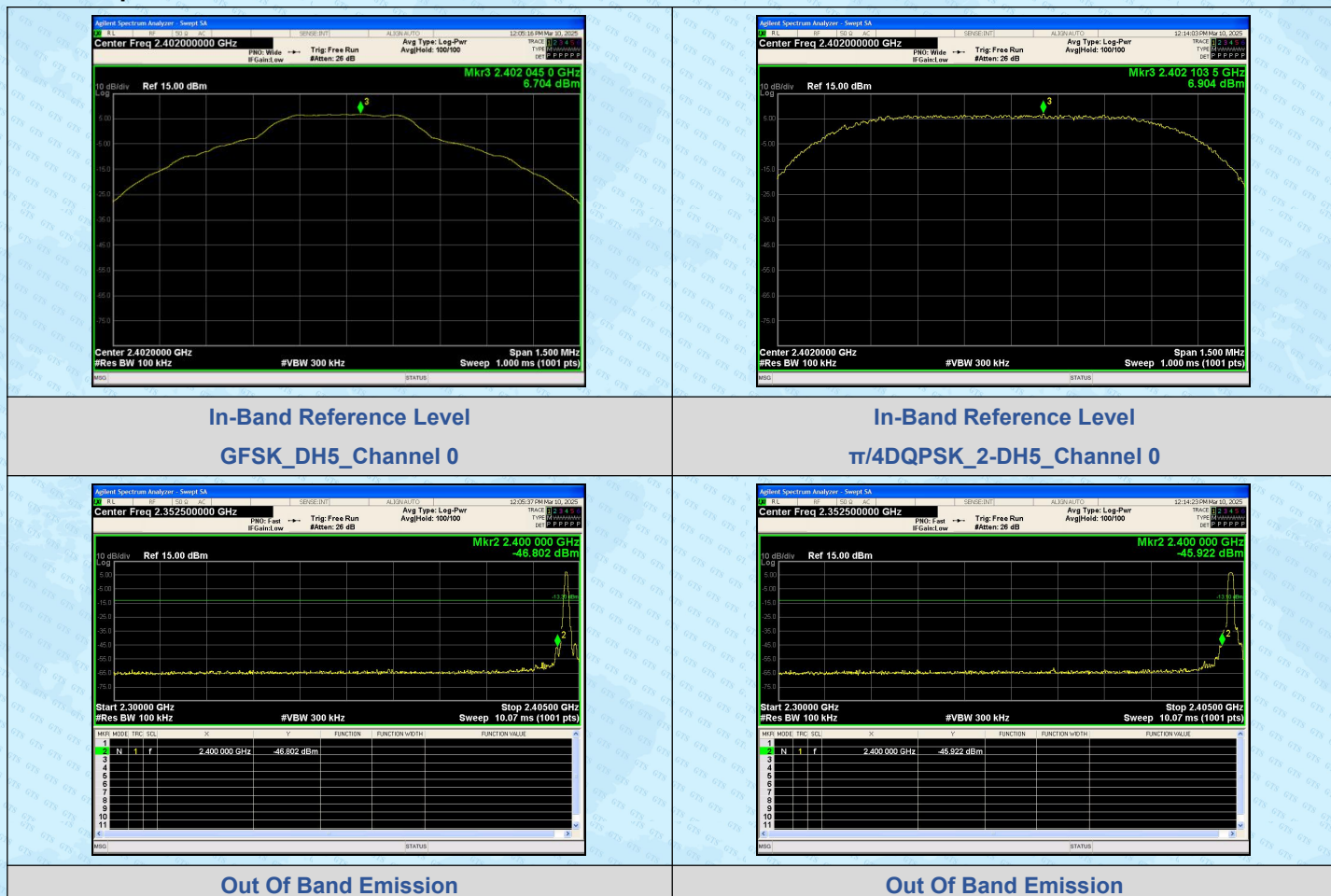
Modulation	Packet	Channel	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result
GFSK	DH5	0	2400.00	-46.802	-13.3	-33.502	PASS
			4803.64	-63.836	-13.3	-50.535	PASS
			7205.75	-63.866	-13.3	-50.566	PASS
			9607.24	-65.473	-13.3	-52.173	PASS
			24754.7	-48.274	-13.3	-34.974	PASS
		39	4881.67	-63.606	-14.27	-49.336	PASS
			7323.11	-65.326	-14.27	-51.056	PASS
			9763.93	-65.109	-14.27	-50.839	PASS
			24740.3	-48.495	-14.27	-34.225	PASS
		78	2483.50	-61.122	-14.99	-46.132	PASS
			4959.70	-62.124	-14.99	-47.134	PASS
			7440.47	-62.690	-14.99	-47.700	PASS
			9919.99	-64.592	-14.99	-49.602	PASS
			24807.1	-47.851	-14.99	-32.861	PASS
$\pi/4$ DQPSK	2-DH5	0	2400.00	-45.922	-13.1	-32.822	PASS
			4803.64	-61.738	-13.1	-48.638	PASS
			7205.75	-64.695	-13.1	-51.595	PASS
			9608.49	-65.403	-13.1	-52.303	PASS
			24772.2	-49.305	-13.1	-36.205	PASS
		39	4882.30	-63.862	-14.11	-49.752	PASS
			7323.74	-63.695	-14.11	-49.585	PASS
			9763.31	-66.111	-14.11	-52.001	PASS
			24847.7	-49.003	-14.11	-34.893	PASS
		78	2483.50	-59.532	-14.97	-44.562	PASS
			4960.33	-62.381	-14.97	-47.411	PASS
			7440.47	-62.965	-14.97	-47.995	PASS
8DPSK	3-DH5	0	9919.37	-65.406	-14.97	-50.436	PASS
			24712.2	-48.790	-14.97	-33.820	PASS
		39	2400.00	-45.656	-13.47	-32.186	PASS
			4804.26	-61.814	-13.47	-48.344	PASS
			7206.38	-63.071	-13.47	-49.601	PASS
		39	9607.24	-65.518	-13.47	-52.048	PASS
			24908.9	-49.449	-13.47	-35.979	PASS
		39	4882.30	-62.324	-13.87	-48.454	PASS
			7323.74	-62.518	-13.87	-48.648	PASS

78	9763.93	-64.298	-13.87	-50.428	PASS
	24790.2	-48.604	-13.87	-34.734	PASS
	2483.50	-57.977	-14.68	-43.297	PASS
	4959.08	-64.359	-14.68	-49.679	PASS
	7439.85	-63.904	-14.68	-49.224	PASS
	9919.99	-65.517	-14.68	-50.837	PASS
	24814.6	-48.949	-14.68	-34.269	PASS

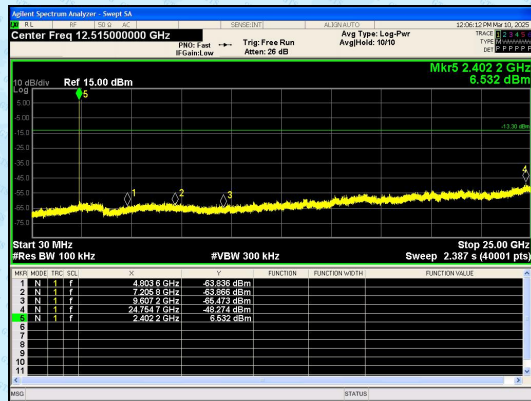
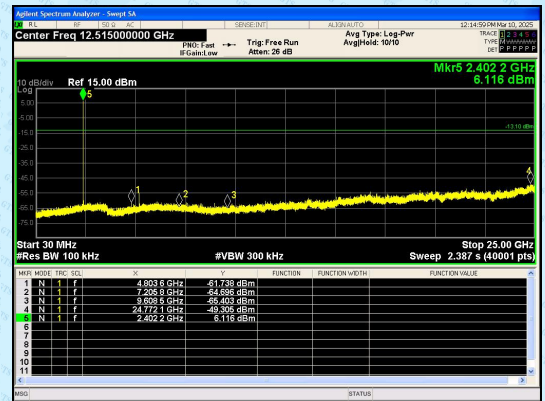
Hopping

Modulation	Packet	Channel	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result
GFSK	DH5	Hopping	2400.00	-46.167	-11.22	-34.947	PASS
			2483.50	-58.428	-12.82	-45.608	PASS
π/4DQPSK	2-DH5		2400.00	-45.249	-9.58	-35.669	PASS
			2483.50	-56.619	-11.16	-45.459	PASS
8DPSK	3-DH5		2400.00	-45.367	-10.03	-35.337	PASS
			2483.50	-57.720	-11.29	-46.430	PASS

Test Graphs



GFSK_DH5_Channel 0

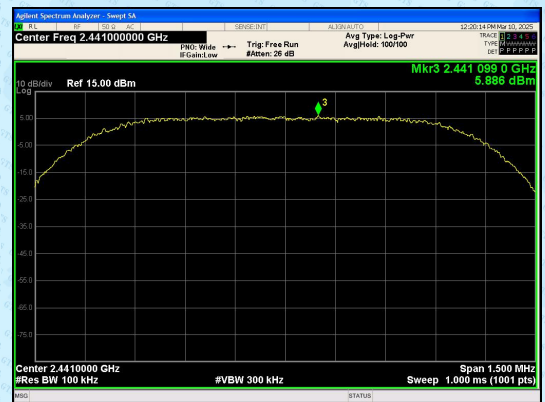
 $\pi/4$ DQPSK_2-DH5_Channel 0

30.0 MHz - 25000.0 MHz

GFSK_DH5_Channel 0

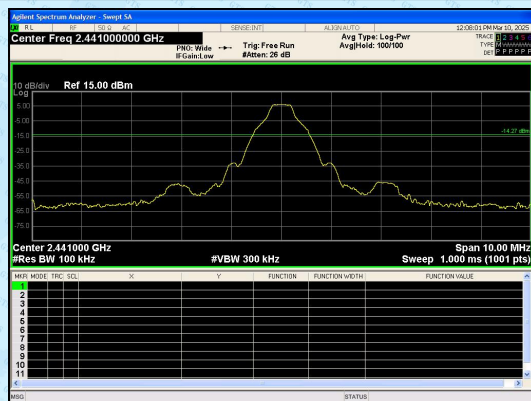


30.0 MHz - 25000.0 MHz

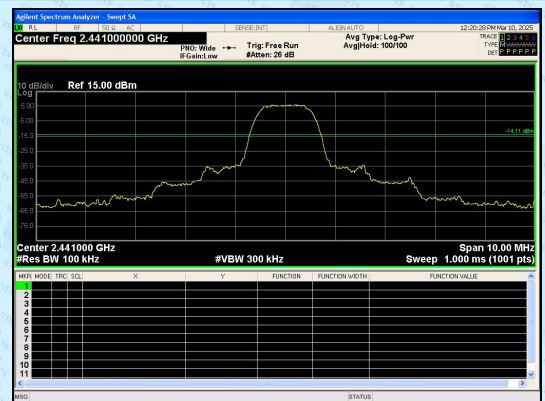
 $\pi/4$ DQPSK_2-DH5_Channel 0

In-Band Reference Level

GFSK_DH5_Channel 39



In-Band Reference Level

 $\pi/4$ DQPSK_2-DH5_Channel 39

Out Of Band Emission

GFSK_DH5_Channel 39

Out Of Band Emission

 $\pi/4$ DQPSK_2-DH5_Channel 39