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Report No.: SZEM170200080201  
Page: 1 of 86

## **TEST REPORT**

**Application No.:** SZEM1702000802CR  
**Applicant:** BRAGI GMBH  
**Address of Applicant:** Sendlinger Strasse 7 / Angerblock 2. OG, 80331 München, Germany  
**Manufacturer:** BRAGI GMBH  
**Address of Manufacturer:** Sendlinger Strasse 7 / Angerblock 2. OG, 80331 München, Germany  
**Factory:** VTech (Dongguan) Communications Ltd.  
**Address of Factory:** Xia Ling Bei Management Zone, Liaobu Town, Dongguan City, Guangdong Province, China

**Equipment Under Test (EUT):**

**EUT Name:** The Dash Pro  
**Model No.:** B1002-01R  
**Trade mark:** Bragi  
**FCC ID:** 2AF5T-B1002R  
**Standards:** 47 CFR Part 15, Subpart C 15.247  
**Date of Receipt:** 2017-02-13  
**Date of Test:** 2017-02-14 to 2017-03-17  
**Date of Issue:** 2017-04-20

<b>Test Result :</b>	<b>Pass*</b>
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\* In the configuration tested, the EUT complied with the standards specified above.



Jack Zhang  
EMC Laboratory Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.

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Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2017-04-20		Original

Authorized for issue by:				
Tested By				2017-04-20
		Hank Yan /Project Engineer		Date
Checked By				2017-04-20
		Eric Fu /Reviewer		Date



## 2 Test Summary

Radio Spectrum Technical Requirement				
Item	Standard	Method	Requirement	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	Pass
Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)	Pass

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
Conducted Disturbance at AC Power Line(150kHz-30MHz)	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.2	47 CFR Part 15, Subpart C 15.207	N/A
20dB Bandwidth	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.7	47 CFR Part 15, Subpart C 15.247(a)(1)	Pass
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.5	47 CFR Part 15, Subpart C 15.247(b)(1)	Pass
Carrier Frequencies Separation	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.2	47 CFR Part 15, Subpart C 15.247a(1)	Pass
Hopping Channel Number	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.3	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass
Dwell Time	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.4	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.8	47 CFR Part 15, Subpart C 15.247(d)	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.6	47 CFR Part 15, Subpart C 15.247(d)	Pass



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## 4 General Information

### 4.1 Details of E.U.T.

Operation Frequency:	2402MHz~2480MHz
Bluetooth Version:	V4.0 Dual-mode
	This report is for classic mode.
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)
Modulation Type:	GFSK, $\pi/4$ DQPSK, 8DPSK
Number of Channel:	79
Hopping Channel Type:	Adaptive Frequency Hopping systems
Sample Type:	Portable production
Antenna Type:	Integral
Antenna Gain:	-6dBi
Power Supply:	Right headphone: DC 3.7V, 100mAh rechargeable battery Charged by the docking(Charged from Adapter via USB cable)
Cable:	USB charging line: 18.5cm, shielded



Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	20	2422MHz	40	2442MHz	60	2462MHz
1	2403MHz	21	2423MHz	41	2443MHz	61	2463MHz
2	2404MHz	22	2424MHz	42	2444MHz	62	2464MHz
3	2405MHz	23	2425MHz	43	2445MHz	63	2465MHz
4	2406MHz	24	2426MHz	44	2446MHz	64	2466MHz
5	2407MHz	25	2427MHz	45	2447MHz	65	2467MHz
6	2408MHz	26	2428MHz	46	2448MHz	66	2468MHz
7	2409MHz	27	2429MHz	47	2449MHz	67	2469MHz
8	2410MHz	28	2430MHz	48	2450MHz	68	2470MHz
9	2411MHz	29	2431MHz	49	2451MHz	69	2471MHz
10	2412MHz	30	2432MHz	50	2452MHz	70	2472MHz
11	2413MHz	31	2433MHz	51	2453MHz	71	2473MHz
12	2414MHz	32	2434MHz	52	2454MHz	72	2474MHz
13	2415MHz	33	2435MHz	53	2455MHz	73	2475MHz
14	2416MHz	34	2436MHz	54	2456MHz	74	2476MHz
15	2417MHz	35	2437MHz	55	2457MHz	75	2477MHz
16	2418MHz	36	2438MHz	56	2458MHz	76	2478MHz
17	2419MHz	37	2439MHz	57	2459MHz	77	2479MHz
18	2420MHz	38	2440MHz	58	2460MHz	78	2480MHz
19	2421MHz	39	2441MHz	59	2461MHz		

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The Lowest channel	2402MHz
The Middle channel	2441MHz
The Highest channel	2480MHz

## 4.2 Description of Support Units

The EUT has been tested independently.

## 4.3 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	7.25 x 10 <sup>-8</sup>
2	Duty cycle	0.37%
3	Occupied Bandwidth	3%
4	RF conducted power	0.75dB
5	RF power density	2.84dB
6	Conducted Spurious emissions	0.75dB
7	RF Radiated power	4.5dB (below 1GHz)
8		4.8dB (above 1GHz)
9	Radiated Spurious emission test	4.5dB (30MHz-1GHz)
		4.8dB (1GHz-18GHz)
	Temperature test	1 °C
10	Humidity test	3%
11	Supply voltages	1.5%
12	Time	3%





#### **4.4 Test Location**

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen Branch

No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China.  
518057.

Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

No tests were sub-contracted.

#### **4.5 Test Facility**

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

- **CNAS (No. CNAS L2929)**

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

- **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

- **VCCI**

The 10m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-823, R-4188, T-1153 and C-2383 respectively.

- **FCC – Registration No.: 556682**

SGS-CSTC Standards Technical 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 our files. Registration No.: 556682.

- **Industry Canada (IC)**

Two 3m Semi-anechoic chambers and the 10m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1, 4620C-2, 4620C-3.

#### **4.6 Deviation from Standards**

None

#### **4.7 Abnormalities from Standard Conditions**

None



## 5 Equipment List

Conducted Disturbance at AC Power Line(150kHz-30MHz)					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Shielding Room	ZhongYu Electron	GB-88	SEM001-06	2016-05-13	2017-05-13
LISN	Rohde & Schwarz	ENV216	SEM007-01	2016-10-09	2017-10-09
LISN	ETS-LINDGREN	3816/2	SEM007-02	2016-04-25	2017-04-25
8 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T8-02	EMC0120	2016-09-28	2017-09-28
4 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T4-02	EMC0121	2016-09-28	2017-09-28
2 Line ISN	Fischer Custom	FCC-TLISN-T2-02	EMC0122	2016-09-28	2017-09-28

20dB Bandwidth					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09

Conducted Peak Output Power					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09

Carrier Frequencies Separation					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09



Hopping Channel Number					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09

Dwell Time					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09

Conducted Spurious Emissions					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09

Conducted Band Edges Measurement					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09

General used equipment					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	ZJ1-2B	SEM002-03	2016-10-12	2017-10-12
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	ZJ1-2B	SEM002-04	2016-10-12	2017-10-12
Humidity/ Temperature Indicator	Mingle	N/A	SEM002-08	2016-10-12	2017-10-12
Barometer	Changchun Meteorological Industry Factory	DYM3	SEM002-01	2016-05-18	2017-05-18

## 6 Radio Spectrum Technical Requirement

### 6.1 Antenna Requirement

#### 6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.247

#### 6.1.2 Conclusion

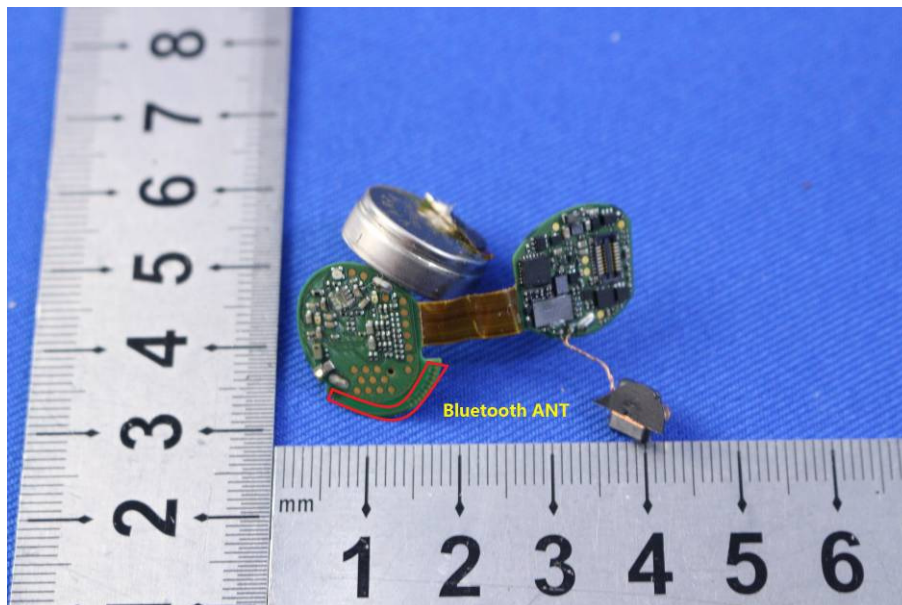
Standard Requirement:

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

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

EUT Antenna:



The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is -6dBi.



## **6.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence**

### **6.2.1 Test Requirement:**

47 CFR Part 15, Subpart C 15.247

### **6.2.2 Conclusion**

Standard Requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1):

According to Technical Specification, the pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones.

> Number of shift register stages: 9

> Length of pseudo-random sequence:  $2^9 - 1 = 511$  bits

> Longest sequence of zeros: 8 (non-inverted signal)

Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:

Each frequency used equally on the average by each transmitter.

According to Technical Specification, the receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any transmitters and shift frequencies in synchronization with the transmitted signals.

Compliance for section 15.247(g):

According to Technical Specification, the system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

Compliance for section 15.247(h):

According to Technical specification, the system incorporates with an adaptive system to detect other user within the spectrum band so that it individ

## 7 Radio Spectrum Matter Test Results

### 7.1 20dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247(a)(1)  
Test Method: ANSI C63.10 (2013) Section 7.8.7

#### 7.1.1 E.U.T. Operation

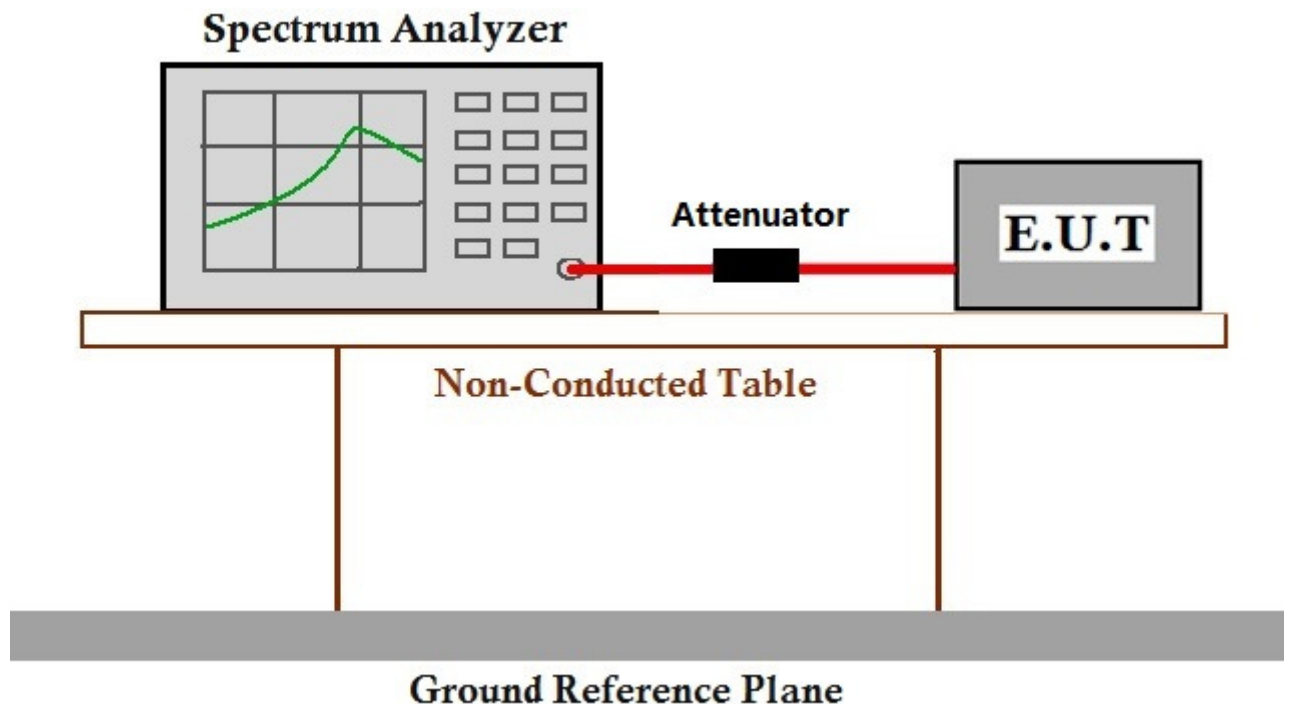
Operating Environment:

Temperature: 23 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar

Exploratory Test Mode: Non-hopping transmitting with all kind of modulation and all kind of data type.

Final Test Mode: Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type, 2-DH1 of data type is the worst case of  $\pi/4$ DQPSK modulation type, 3-DH1 of data type is the worst case of 8DPSK modulation type.

#### 7.1.2 Test Setup Diagram



#### 7.1.3 Measurement Data

The detailed test data see: Appendix 15.247





## 7.2 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(1)  
Test Method: ANSI C63.10 (2013) Section 7.8.5  
Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for $\geq 50$ hopping channels
	0.25 for $25 \leq$ hopping channels $< 50$
	1 for digital modulation
2400-2483.5	1 for $\geq 75$ non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

### 7.2.1 E.U.T. Operation

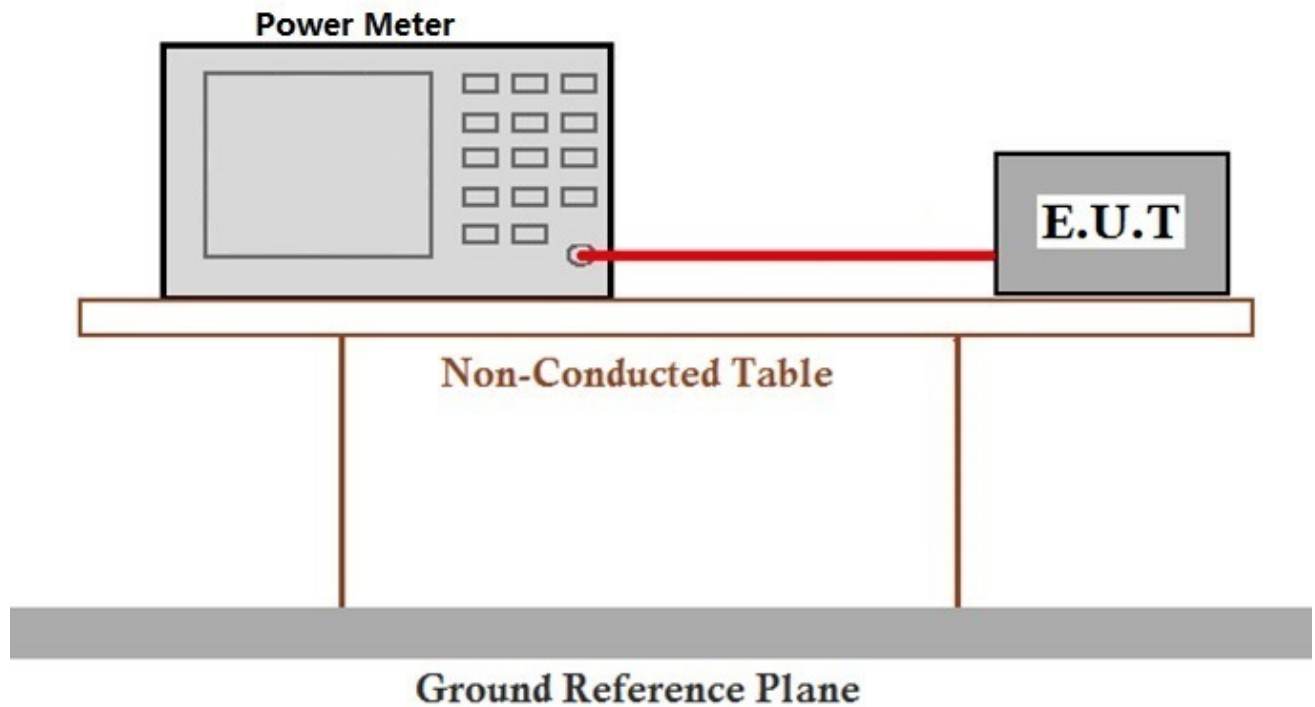
Operating Environment:

Temperature: 23 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar

Exploratory Test Mode: Non-hopping transmitting with all kind of modulation and all kind of data type.

Final Test Mode: Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type, 2-DH1 of data type is the worst case of  $\pi/4$ DQPSK modulation type, 3-DH1 of data type is the worst case of 8DPSK modulation type.

### 7.2.2 Test Setup Diagram



### 7.2.3 Measurement Data

The detailed test data see: Appendix 15.247



### 7.3 Carrier Frequencies Separation

Test Requirement	47 CFR Part 15, Subpart C 15.247a(1)
Test Method:	ANSI C63.10 (2013) Section 7.8.2
Limit:	2/3 of the 20dB bandwidth base on the transmission power is less than 0.125W

#### 7.3.1 E.U.T. Operation

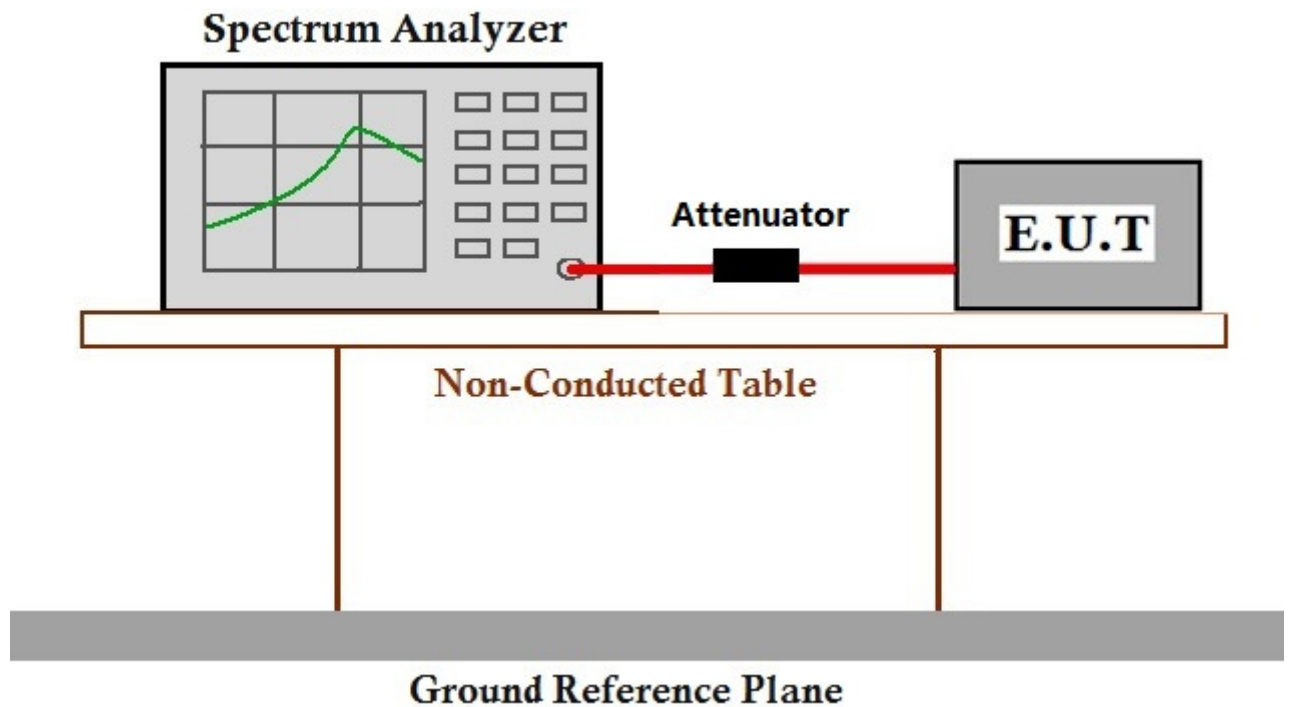
Operating Environment:

Temperature:	23 °C	Humidity:	56 % RH	Atmospheric Pressure:	1020 mbar
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Exploratory Test Mode: Hopping transmitting with all kind of modulation and all kind of data type.

Final Test Mode: Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type, 2-DH1 of data type is the worst case of  $\pi/4$ DQPSK modulation type, 3-DH1 of data type is the worst case of 8DPSK modulation type.

#### 7.3.2 Test Setup Diagram



#### 7.3.3 Measurement Data

The detailed test data see: Appendix 15.247

## 7.4 Hopping Channel Number

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(iii)

Test Method: ANSI C63.10 (2013) Section 7.8.3

Limit:

Frequency range(MHz)	Number of hopping channels (minimum)
902-928	50 for 20dB bandwidth <250kHz
	25 for 20dB bandwidth ≥250kHz
2400-2483.5	15
5725-5850	75

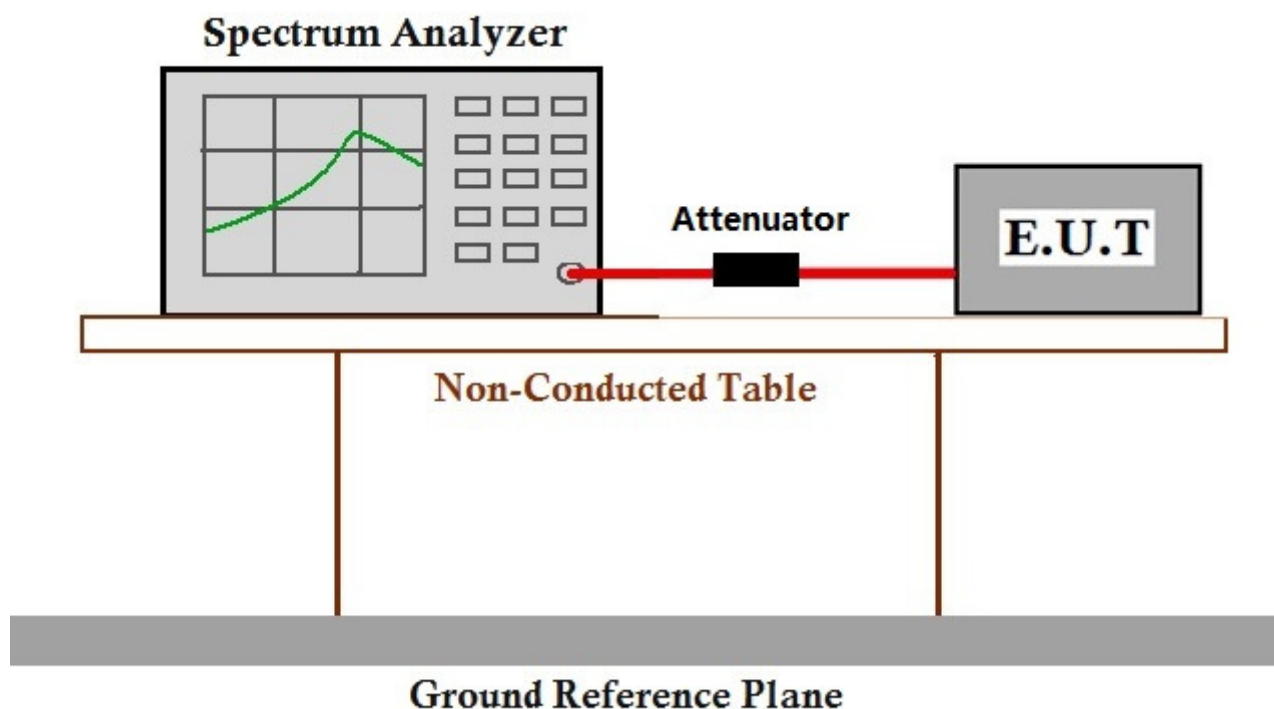
### 7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 23 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar

Test mode Hopping transmitting with all kind of modulation

### 7.4.2 Test Setup Diagram



### 7.4.3 Measurement Data

The detailed test data see: Appendix 15.247

## 7.5 Dwell Time

Test Requirement: 47 CFR Part 15, Subpart C 15.247a(1)(iii)  
 Test Method: ANSI C63.10 (2013) Section 7.8.4  
 Limit:

Frequency(MHz)	Limit
902-928	0.4S within a 20S period(20dB bandwidth<250kHz)
	0.4S within a 10S period(20dB bandwidth≥250kHz)
2400-2483.5	0.4S within a period of 0.4S multiplied by the number of hopping channels
5725-5850	0.4S within a 30S period

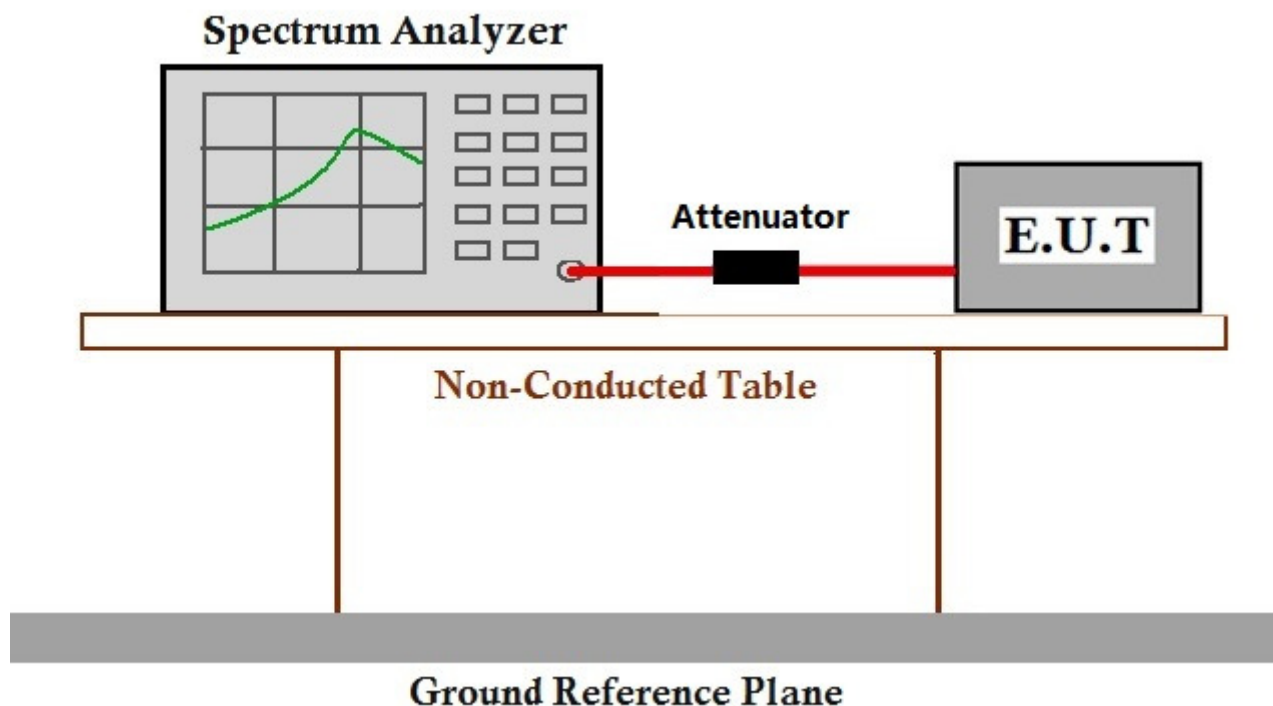
### 7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 23 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar

Test Mode: Hopping transmitting with all kind of modulation and all kind of data type.

### 7.5.2 Test Setup Diagram



### 7.5.3 Measurement Data

The detailed test data see: Appendix 15.247

## 7.6 Conducted Spurious Emissions

Test Requirement	47 CFR Part 15, Subpart C 15.247(d)
Test Method:	ANSI C63.10 (2013) Section 7.8.8
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

### 7.6.1 E.U.T. Operation

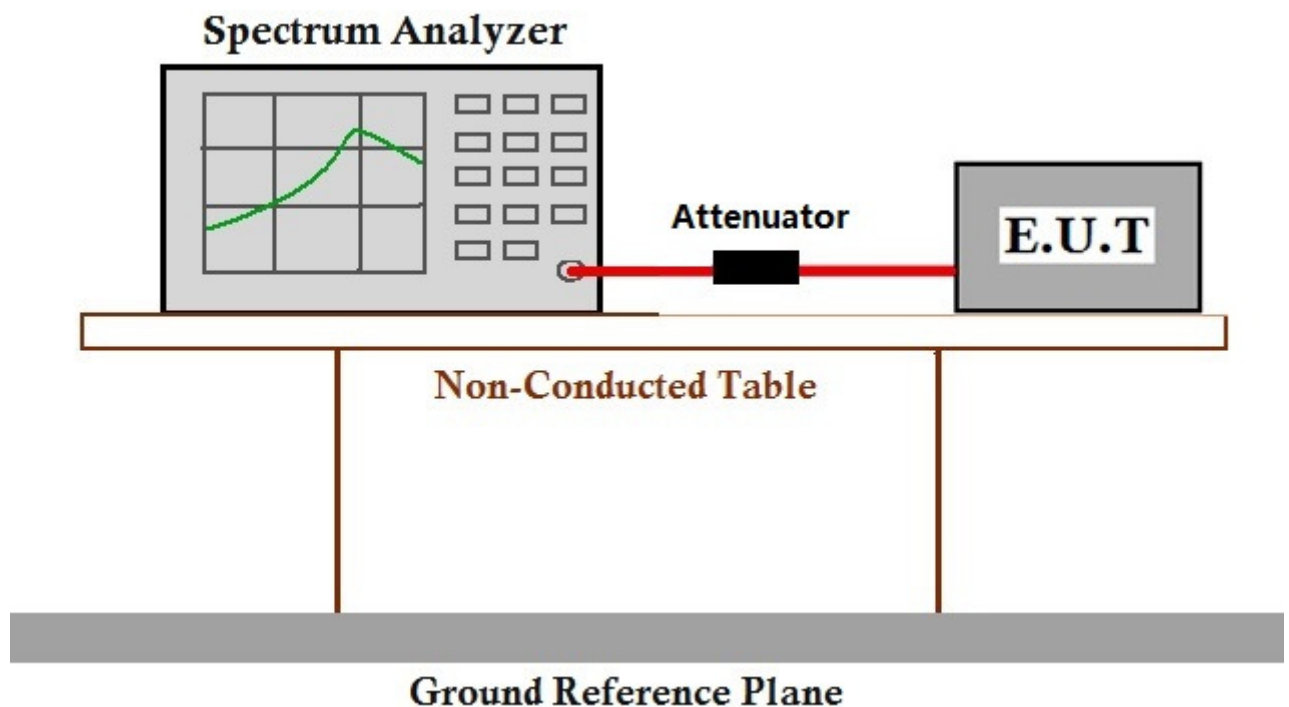
Operating Environment:

Temperature: 23 °C      Humidity: 56 % RH      Atmospheric Pressure: 1020 mbar

Exploratory Test Mode: Non-hopping transmitting with all kind of modulation and all kind of data type

Final Test Mode: Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type, 2-DH1 of data type is the worst case of  $\pi/4$ DQPSK modulation type, 3-DH1 of data type is the worst case of 8DPSK modulation type.

### 7.6.2 Test Setup Diagram



### 7.6.3 Measurement Data

The detailed test data see: Appendix 15.247



## 7.7 Radiated Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6

Measurement Distance: 3m

Limit:

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

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

### 7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 25 °C Humidity: 50 % RH Atmospheric Pressure: 1020 mbar

Exploratory Test Mode: Non-hopping transmitting mode with all kind of modulation and all kind of data type

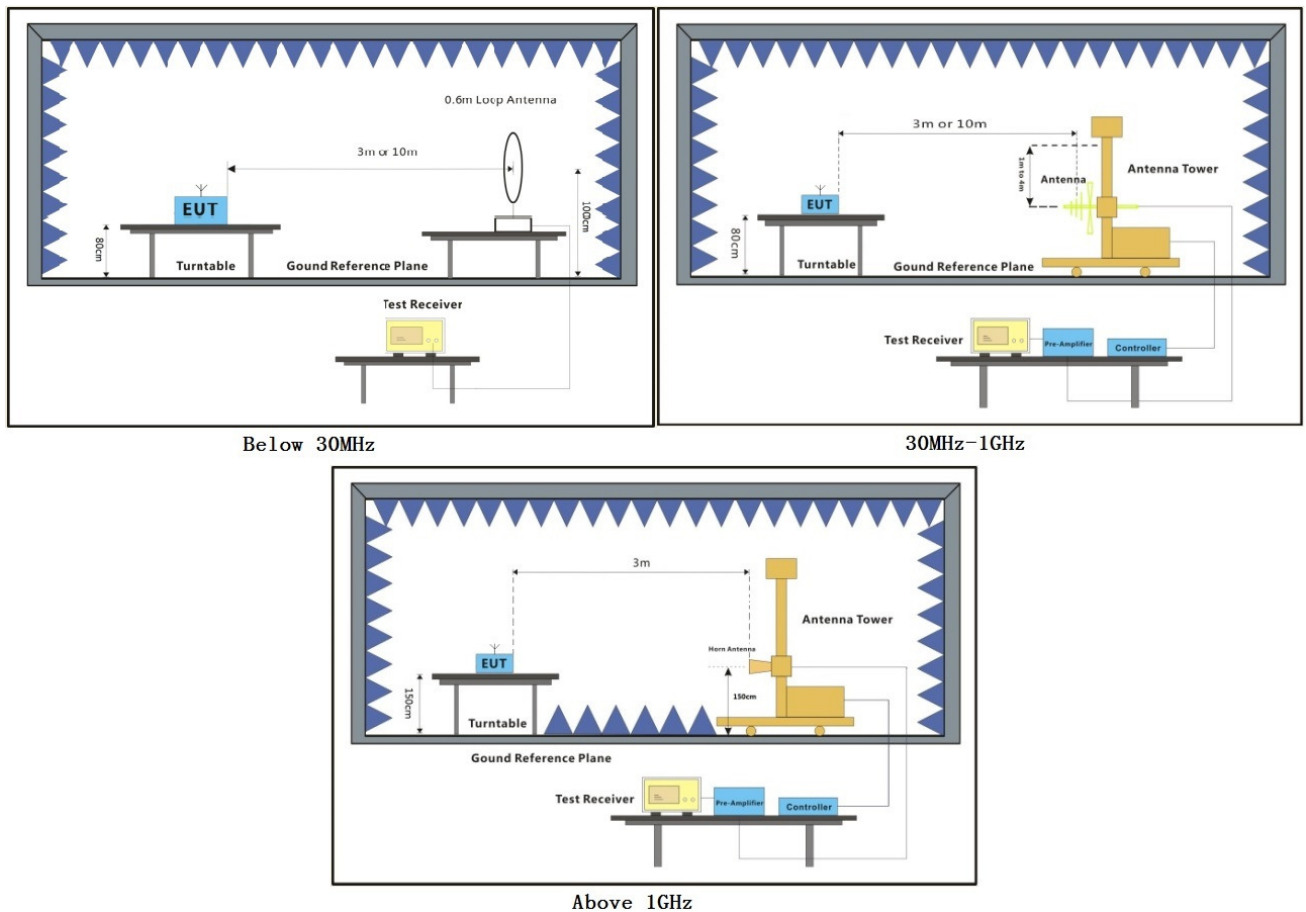
Transmitting mode

Final Test Mode: Through Pre-scan, find the DH1 of data type and GFSK modulation is the worst case.

For below 1GHz part, through pre-scan, the worst case is the lowest channel.

Only the worst case is recorded in the report.

### 7.7.2 Test Setup Diagram

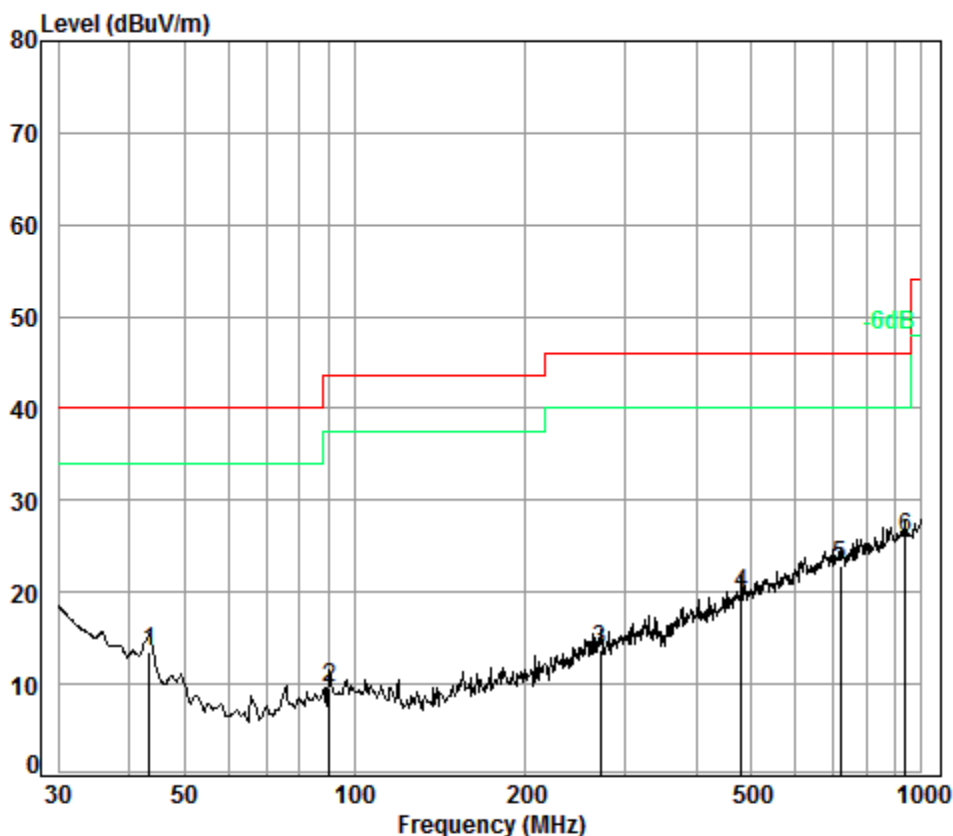




### **7.7.3 Measurement Data**

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

30MHz~1GHz (QP)		
Test mode:	Transmitting	Vertical



Condition: 3m VERTICAL

Job No. : 0802CR

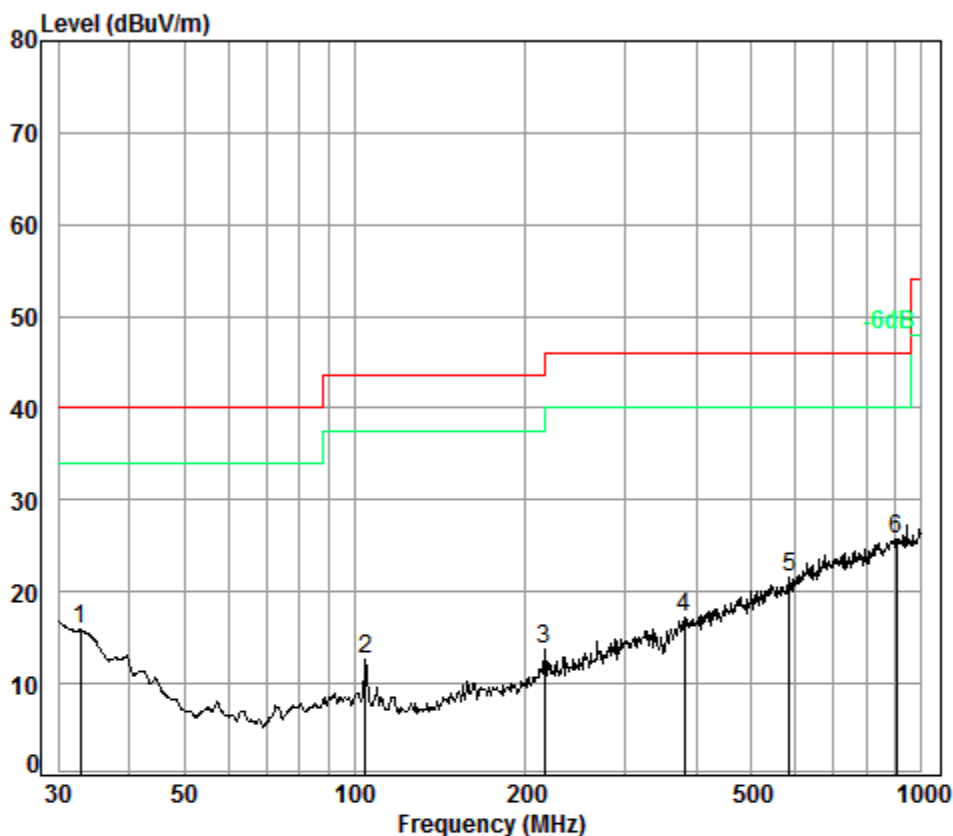
Test mode: TX mode

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	43.51	0.68	11.56	27.31	28.60	13.53	40.00	-26.47
2	90.22	1.10	8.71	27.21	26.91	9.51	43.50	-33.99
3	271.32	1.77	12.73	26.47	25.79	13.82	46.00	-32.18
4	480.53	2.53	17.80	27.60	27.08	19.81	46.00	-26.19
5	719.20	2.96	21.60	27.39	25.72	22.89	46.00	-23.11
6 pp	935.55	3.64	23.30	26.61	25.64	25.97	46.00	-20.03





Test mode:	Transmitting	Horizontal
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Condition: 3m HORIZONTAL  
Job No. : 0802CR  
Test mode: TX mode

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	32.86	0.60	17.10	27.35	25.48	15.83	40.00	-24.17
2	104.54	1.21	8.87	27.17	29.82	12.73	43.50	-30.77
3	216.02	1.49	11.03	26.64	27.93	13.81	46.00	-32.19
4	381.25	2.15	16.07	27.01	26.04	17.25	46.00	-28.75
5	584.79	2.69	19.37	27.57	26.98	21.47	46.00	-24.53
6 pp	903.31	3.60	23.21	26.75	25.68	25.74	46.00	-20.26



Transmitter Emission above 1GHz								
Test mode:		GFSK		Test channel:		Lowest		Remark:
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1498.912	25.80	4.47	38.06	47.81	40.50	74.00	-33.50	Vertical
3135.986	31.56	6.04	38.28	43.29	43.28	74.00	-30.72	Vertical
4804.000	34.17	7.73	39.03	50.53	53.79	74.00	-20.21	Vertical
7206.000	36.41	9.65	38.18	44.28	52.42	74.00	-21.58	Vertical
9608.000	37.52	11.06	36.99	40.12	52.16	74.00	-21.84	Vertical
12461.220	38.88	13.08	38.77	39.61	53.42	74.00	-20.58	Vertical
1333.284	25.10	4.26	38.04	42.35	34.17	74.00	-39.83	Horizontal
3010.828	31.32	5.94	38.21	42.86	43.04	74.00	-30.96	Horizontal
3863.900	33.24	6.60	38.64	42.56	44.24	74.00	-29.76	Horizontal
4804.000	34.17	7.73	39.03	49.71	52.97	74.00	-21.03	Horizontal
7206.000	36.41	9.65	38.18	44.33	52.47	74.00	-21.53	Horizontal
9608.000	37.52	11.06	36.99	40.06	52.10	74.00	-21.90	Horizontal

Test mode:		GFSK		Test channel:		Middle		Remark:
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1333.284	25.10	4.26	38.04	46.34	38.16	74.00	-35.84	Vertical
3325.070	31.90	6.18	38.38	42.47	42.76	74.00	-31.24	Vertical
4882.000	34.30	7.84	39.06	54.30	57.79	74.00	-16.21	Vertical
7323.000	36.37	9.73	38.07	44.57	52.84	74.00	-21.16	Vertical
9764.000	37.55	11.21	36.92	40.42	52.72	74.00	-21.28	Vertical
12241.140	38.75	12.76	38.55	39.87	53.52	74.00	-20.48	Vertical
1468.696	25.68	4.43	38.06	43.17	35.70	74.00	-38.30	Horizontal
1958.189	27.65	4.97	38.10	42.61	38.23	74.00	-35.77	Horizontal
3738.129	32.89	6.50	38.58	42.82	44.14	74.00	-29.86	Horizontal
4882.000	34.30	7.84	39.06	52.59	56.08	74.00	-17.92	Horizontal
7323.000	36.37	9.73	38.07	45.62	53.89	74.00	-20.11	Horizontal
9764.000	37.55	11.21	36.92	39.72	52.02	74.00	-21.98	Horizontal



Test mode:		GFSK		Test channel:		Middle		Remark:	Average
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamplifier Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization	
4882.000	34.30	7.84	39.06	39.81	43.30	54.00	-10.70	Vertical	
4882.000	34.30	7.84	39.06	38.69	42.18	54.00	-11.82	Horizontal	

Test mode:		GFSK		Test channel:		Highest		Remark:	Peak
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamplifier Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization	
1498.912	25.80	4.47	38.06	47.57	40.26	74.00	-33.74	Vertical	
3299.775	31.86	6.16	38.37	43.44	43.69	74.00	-30.31	Vertical	
4960.000	34.43	7.94	39.09	49.34	53.05	74.00	-20.95	Vertical	
7440.000	36.33	9.81	37.95	44.37	52.78	74.00	-21.22	Vertical	
9920.000	37.58	11.35	36.84	40.15	52.70	74.00	-21.30	Vertical	
11752.000	38.85	13.25	39.06	39.95	53.52	74.00	-20.48	Vertical	
1115.673	24.05	3.95	38.02	42.40	32.82	74.00	-41.18	Horizontal	
1663.803	26.52	4.66	38.07	42.65	36.29	74.00	-37.71	Horizontal	
3151.992	31.59	6.05	38.29	42.91	42.91	74.00	-31.09	Horizontal	
4960.000	34.43	7.94	39.09	49.42	53.13	74.00	-20.87	Horizontal	
7440.000	36.33	9.81	37.95	43.21	51.62	74.00	-22.38	Horizontal	
9920.000	37.58	11.35	36.84	40.07	52.62	74.00	-21.38	Horizontal	

Remark:

- 1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:  
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
- 2) Scan from 9kHz to 25GHz, the disturbance above 13GHz and below 30MHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 3) As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the peak measurements were shown in the report.

## 7.8 Radiated Emissions which fall in the restricted bands

Test Requirement: 47 CFR Part 15, Subpart C 15.205 & 15.209  
Test Method: ANSI C63.10 (2013) Section 6.10.5  
Measurement Distance: 3m

### 7.8.1 E.U.T. Operation

Operating Environment:

Temperature: 24 °C Humidity: 52 % RH Atmospheric Pressure: 1015 mbar

Exploratory Test Mode: Non-hopping transmitting mode with all kind of modulation and all kind of data type

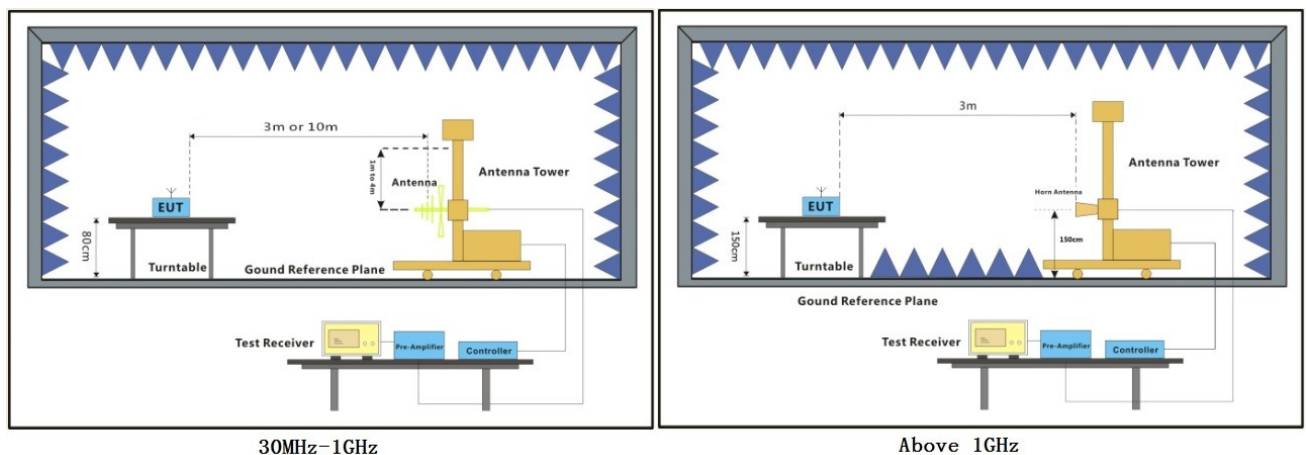
Transmitting mode

Final Test Mode: Through Pre-scan, find the DH1 of data type and GFSK modulation is the worst case.

For below 1GHz part, through pre-scan, the worst case is the lowest channel.

Only the worst case is recorded in the report.

### 7.8.2 Test Setup Diagram



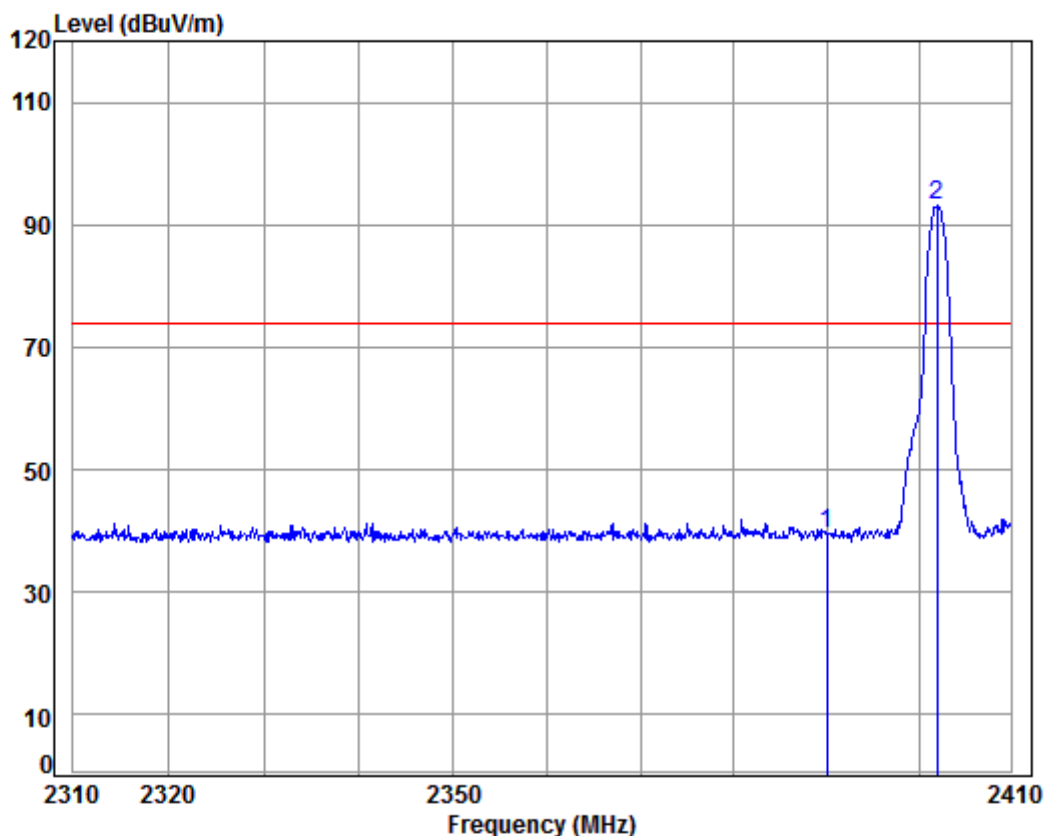


### **7.8.3 Measurement Data**

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.



Polarization:Horizontal; Modulation Type:GFSK; ; Channel:Low

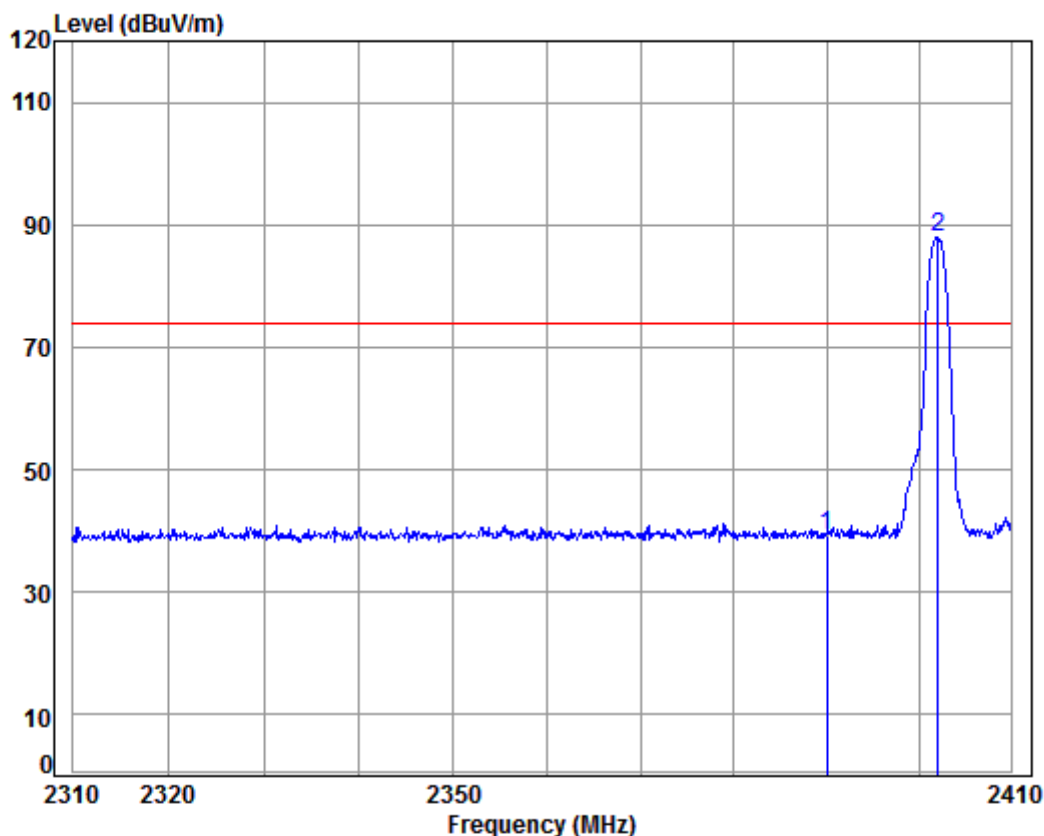


Condition: 3m HORIZONTAL  
Job No: : 802CR  
Mode: : 2402 Band edge  
: Classic

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2390.000	5.34	29.08	38.14	43.12	39.40	74.00	-34.60	
2 pp	2401.945	5.35	29.11	38.15	96.87	93.18	74.00	19.18	



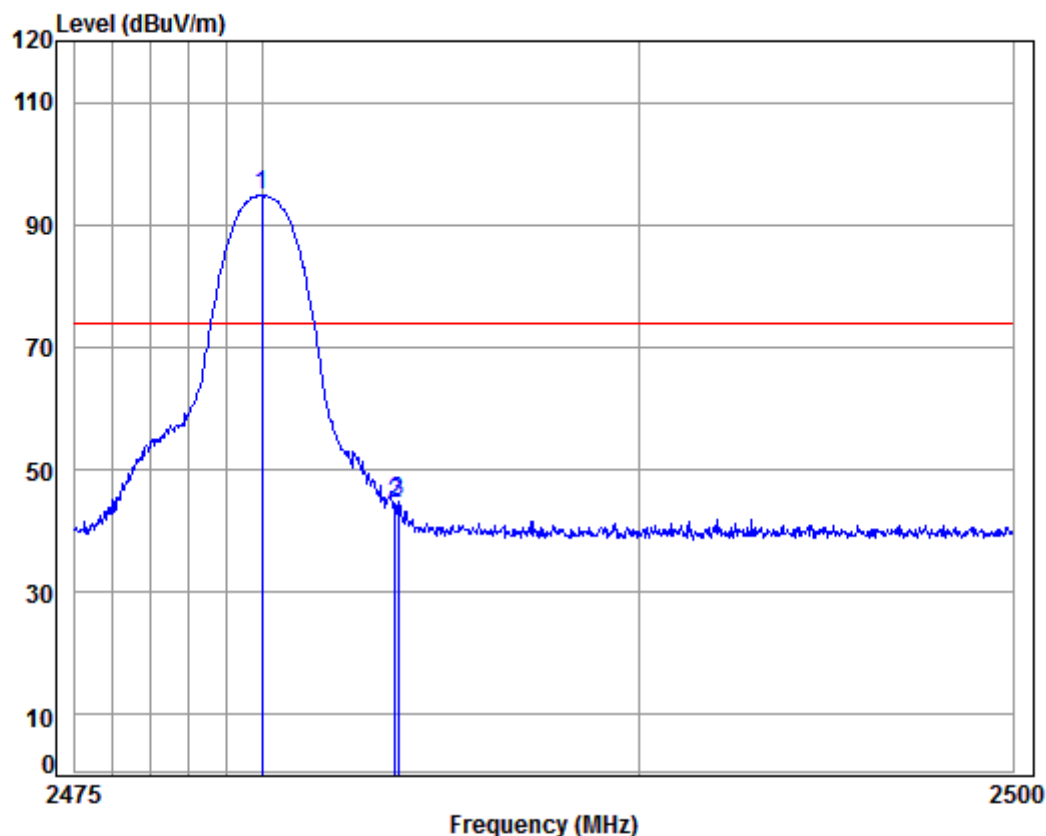
Polarization:Vertical; Modulation Type:GFSK; ; Channel:Low



Condition: 3m VERTICAL  
Job No: : 802CR  
Mode: : 2402 Band edge  
: Classic

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit	Over	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2390.000	5.34	29.08	38.14	43.04	39.32	74.00	-34.68	
2 pp	2402.047	5.35	29.11	38.15	91.73	88.04	74.00	14.04	

Polarization:Horizontal; Modulation Type:GFSK; ; Channel:High



Condition: 3m HORIZONTAL

Job No: : 802CR

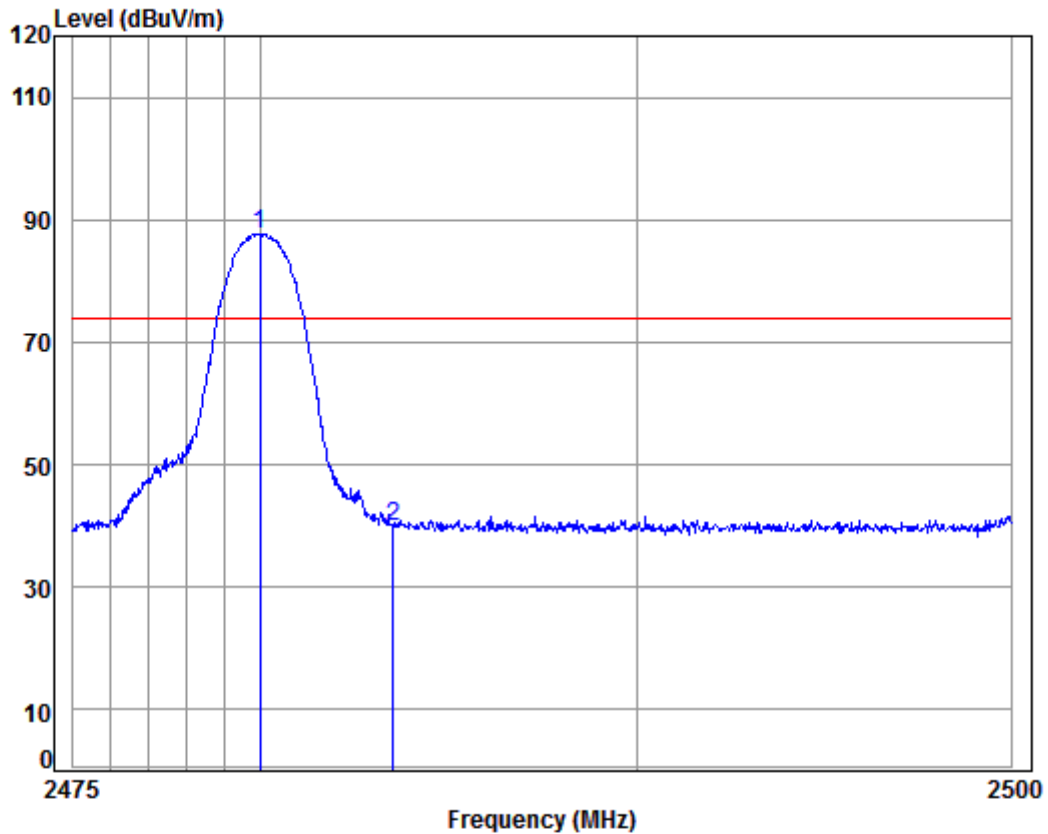
Mode: : 2480 Band edge

: Classic

		Cable	Ant	Preamp	Read		Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 pp	2479.955	5.41	29.34	38.15	98.25	94.85	74.00	20.85	
2	2483.500	5.41	29.35	38.15	47.85	44.46	74.00	-29.54	
3	2483.597	5.41	29.35	38.15	48.14	44.75	74.00	-29.25	



Polarization:Vertical; Modulation Type:GFSK; ; Channel:High



Condition: 3m VERTICAL

Job No: : 802CR

Mode: : 2480 Band edge  
: Classic

		Cable	Ant	Preamp	Read		Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 pp	2479.955	5.41	29.34	38.15	91.17	87.77	74.00	13.77	
2	2483.500	5.41	29.35	38.15	43.37	39.98	74.00	-34.02	

## 7.9 Conducted Band Edges Measurement

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)

Test Method: ANSI C63.10 (2013) Section 7.8.6

### 7.9.1 E.U.T. Operation

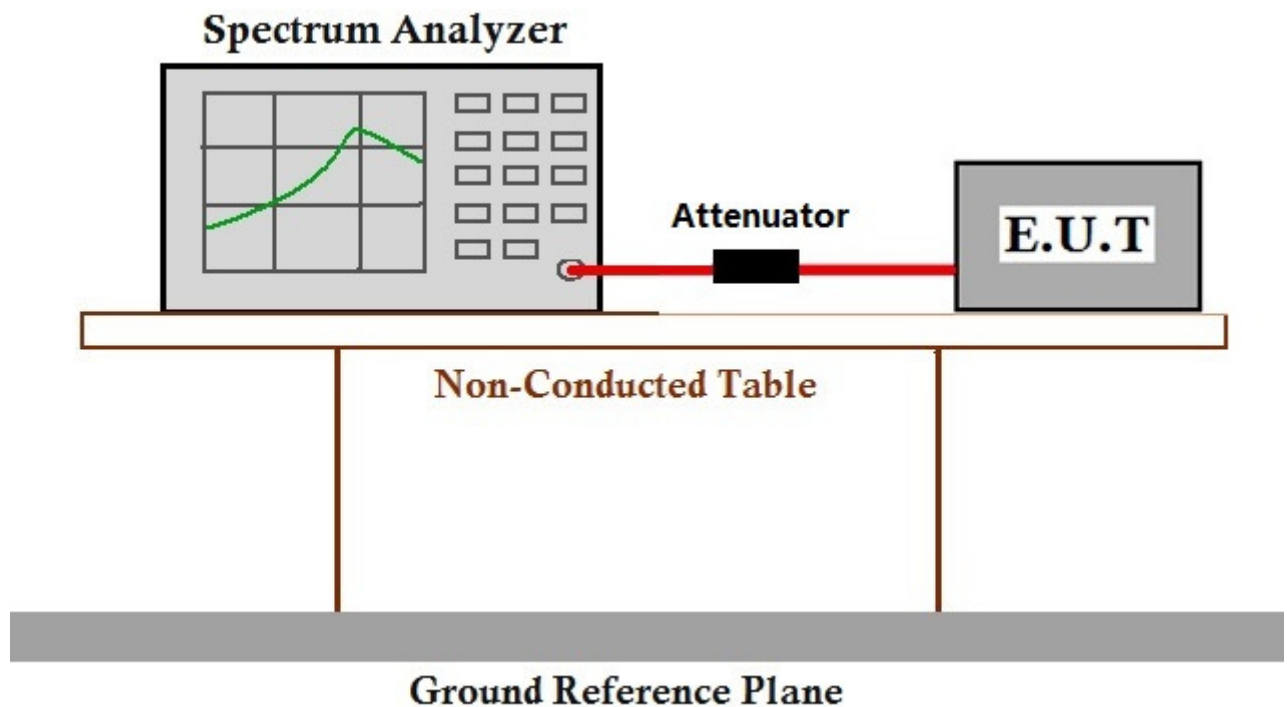
Operating Environment:

Temperature: 23 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar

Exploratory Test Mode: Hopping and Non-hopping transmitting with all kind of modulation and all kind of data type

Final Test Mode: Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type, 2-DH1 of data type is the worst case of  $\pi/4$ DQPSK modulation type, 3-DH1 of data type is the worst case of 8DPSK modulation type.

### 7.9.2 Test Setup Diagram

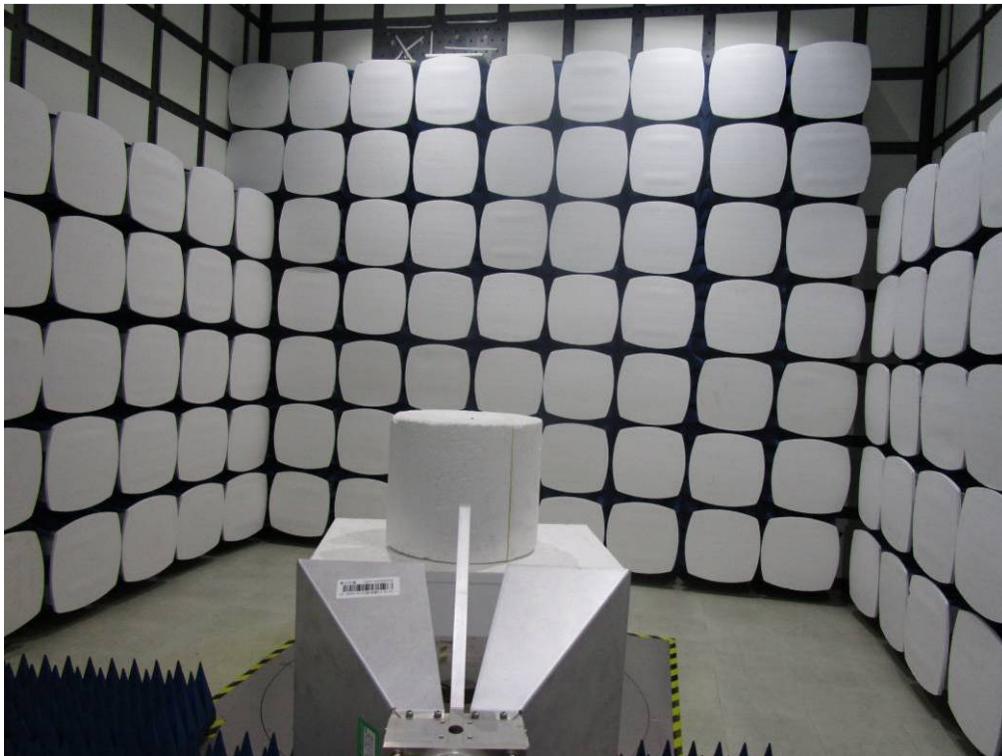


### 7.9.3 Measurement Data

The detailed test data see: Appendix 15.247

## 8 Photographs

### 8.1 Radiated Spurious Emissions Test Setup







## **8.2 EUT Constructional Details**

Refer to Appendix A - Photographs of EUT Constructional Details for SZEM1702000802CR.

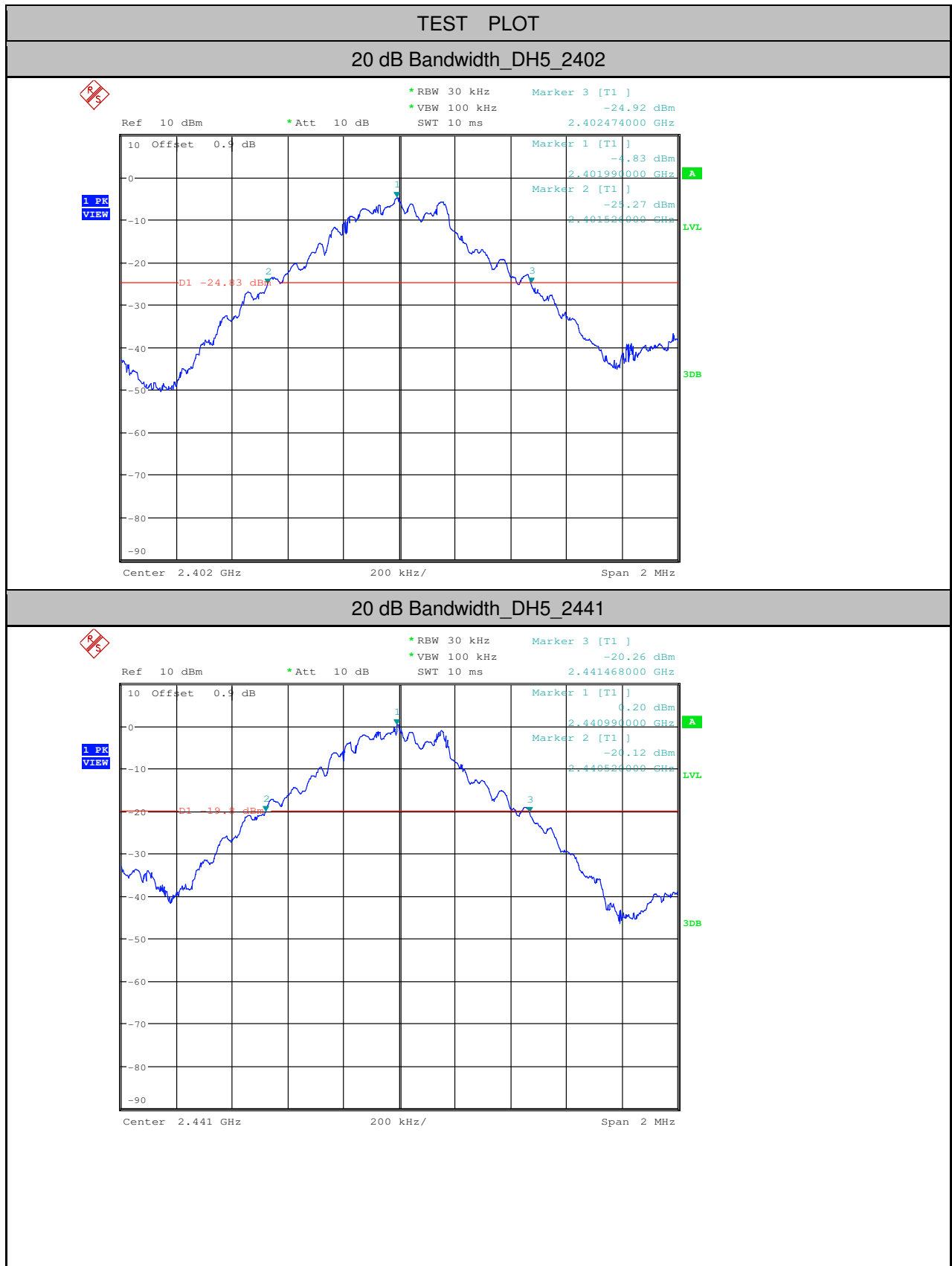


## 9 Appendix

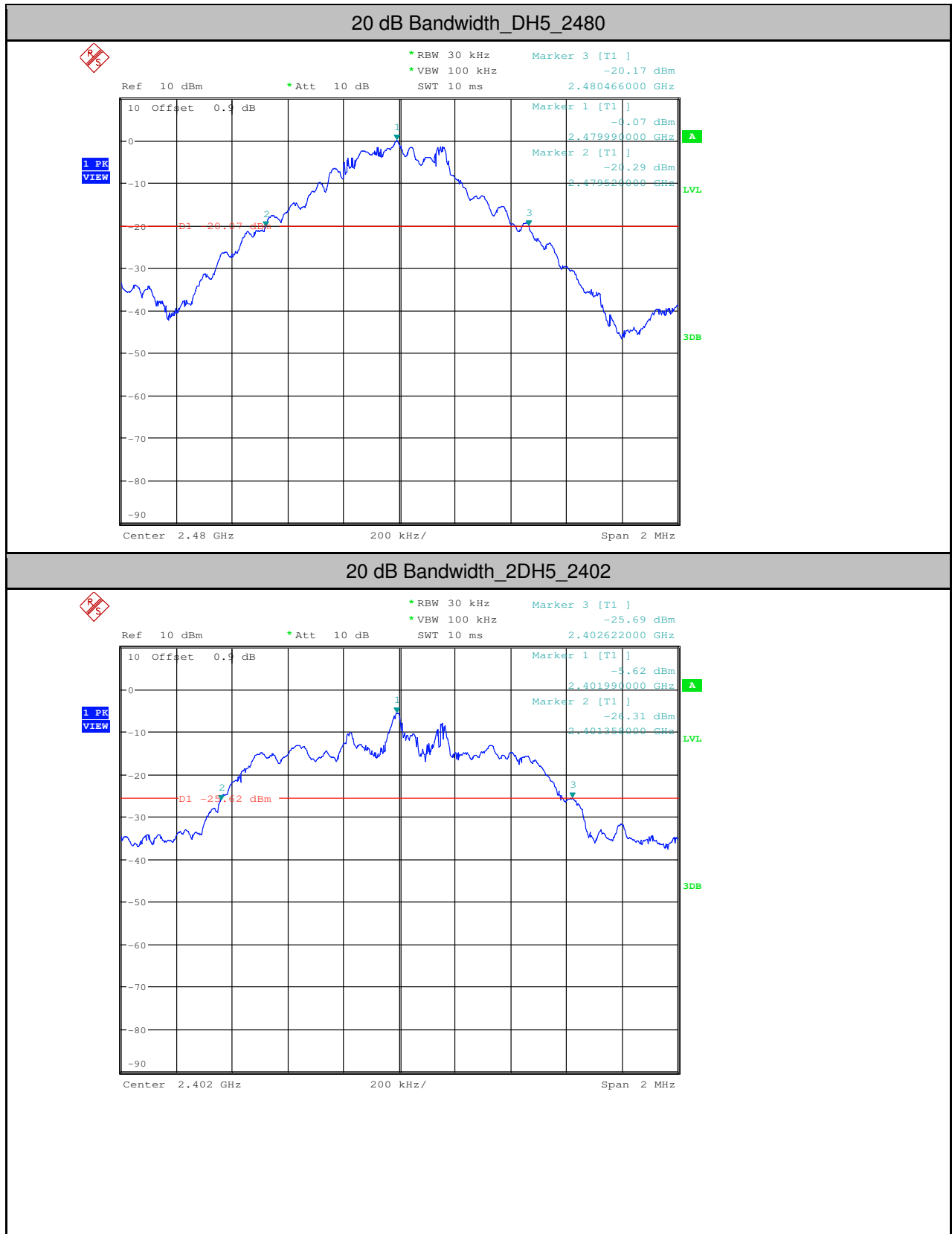
### 9.1 Appendix 15.247

#### 1.20 dB Bandwidth

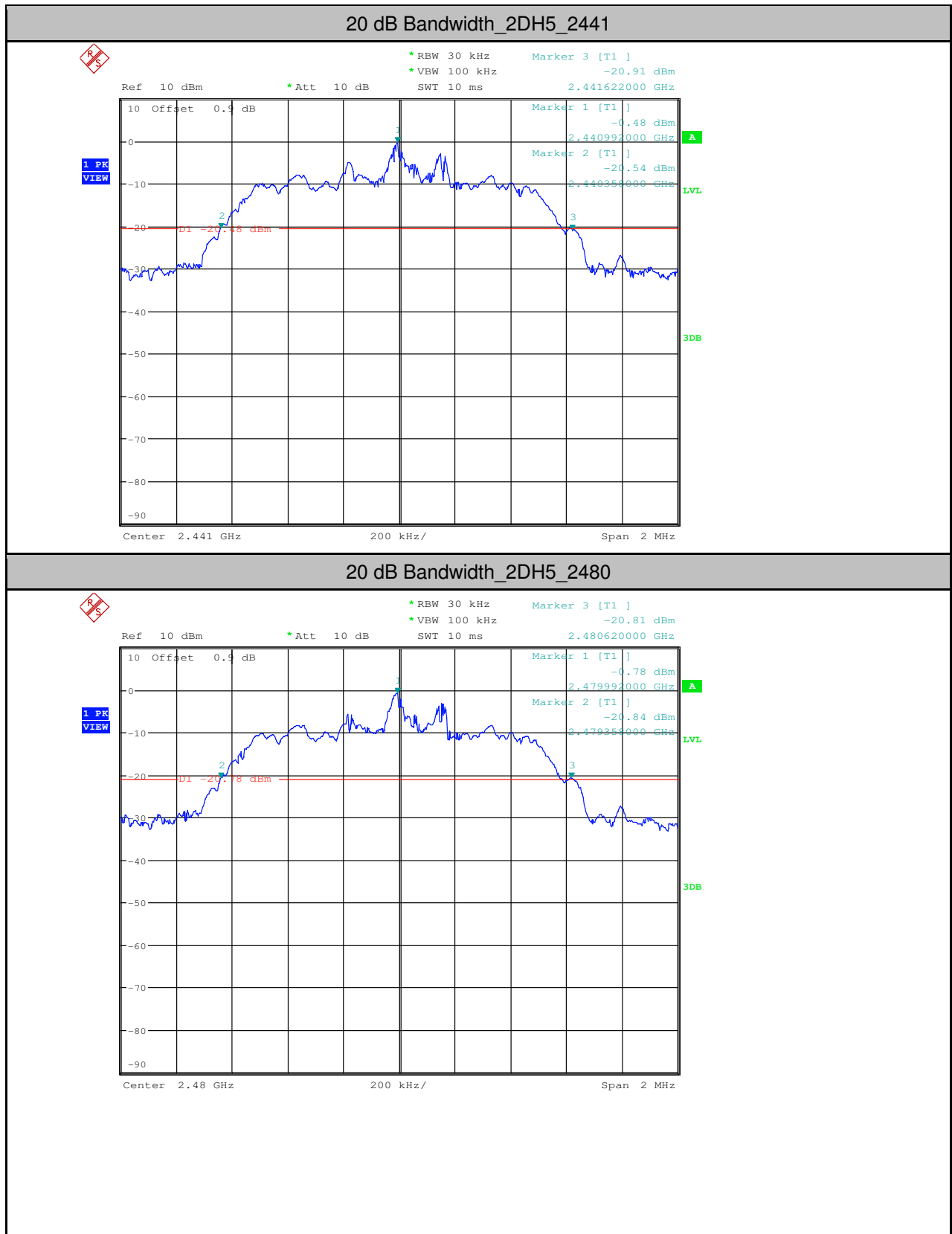
Test Mode	Test Channel	EBW[MHz]	Limit[MHz]	Verdict
DH5	2402	0.948	---	PASS
DH5	2441	0.948	---	PASS
DH5	2480	0.946	---	PASS
2DH5	2402	1.264	---	PASS
2DH5	2441	1.264	---	PASS
2DH5	2480	1.262	---	PASS
3DH5	2402	1.268	---	PASS
3DH5	2441	1.240	---	PASS
3DH5	2480	1.246	---	PASS

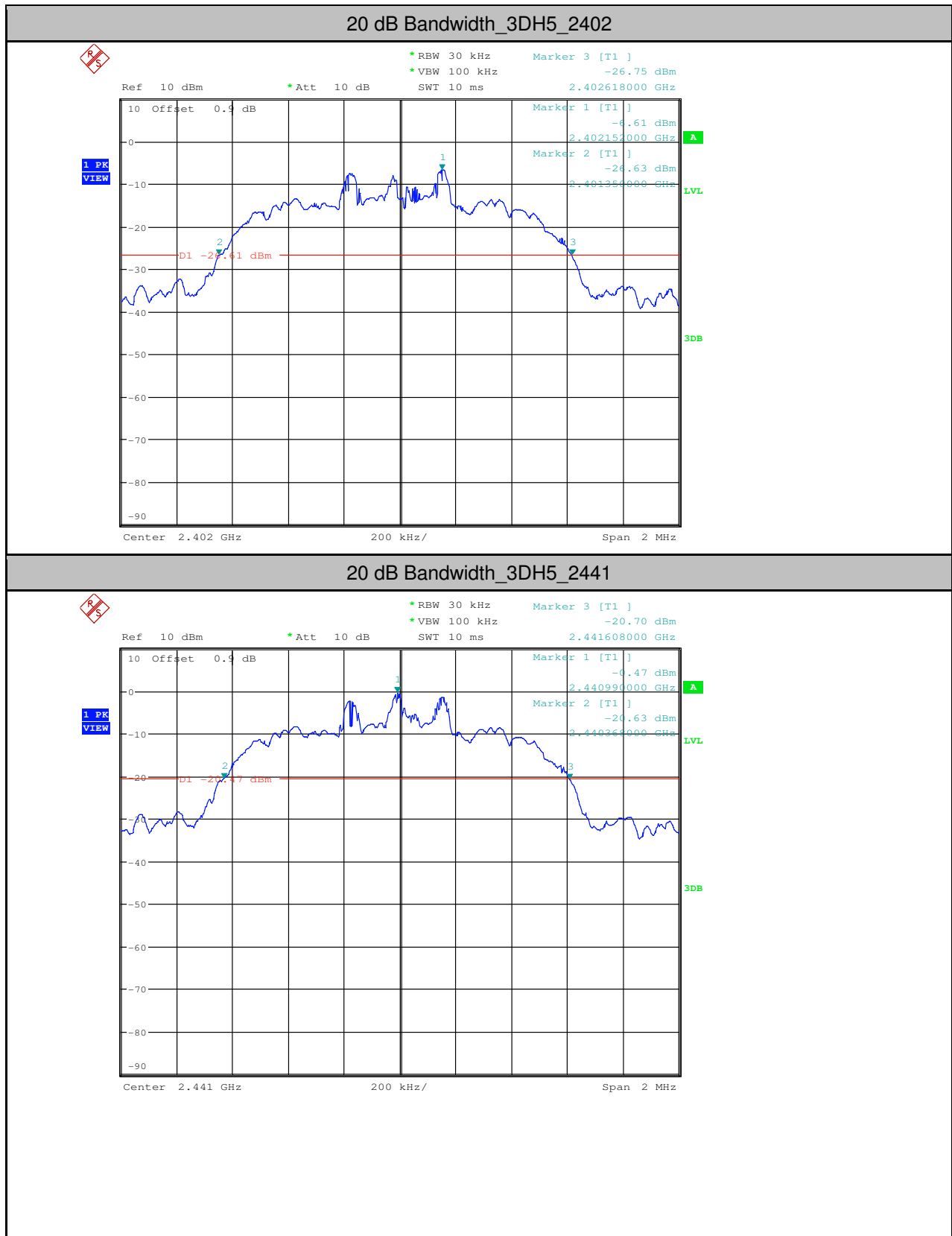


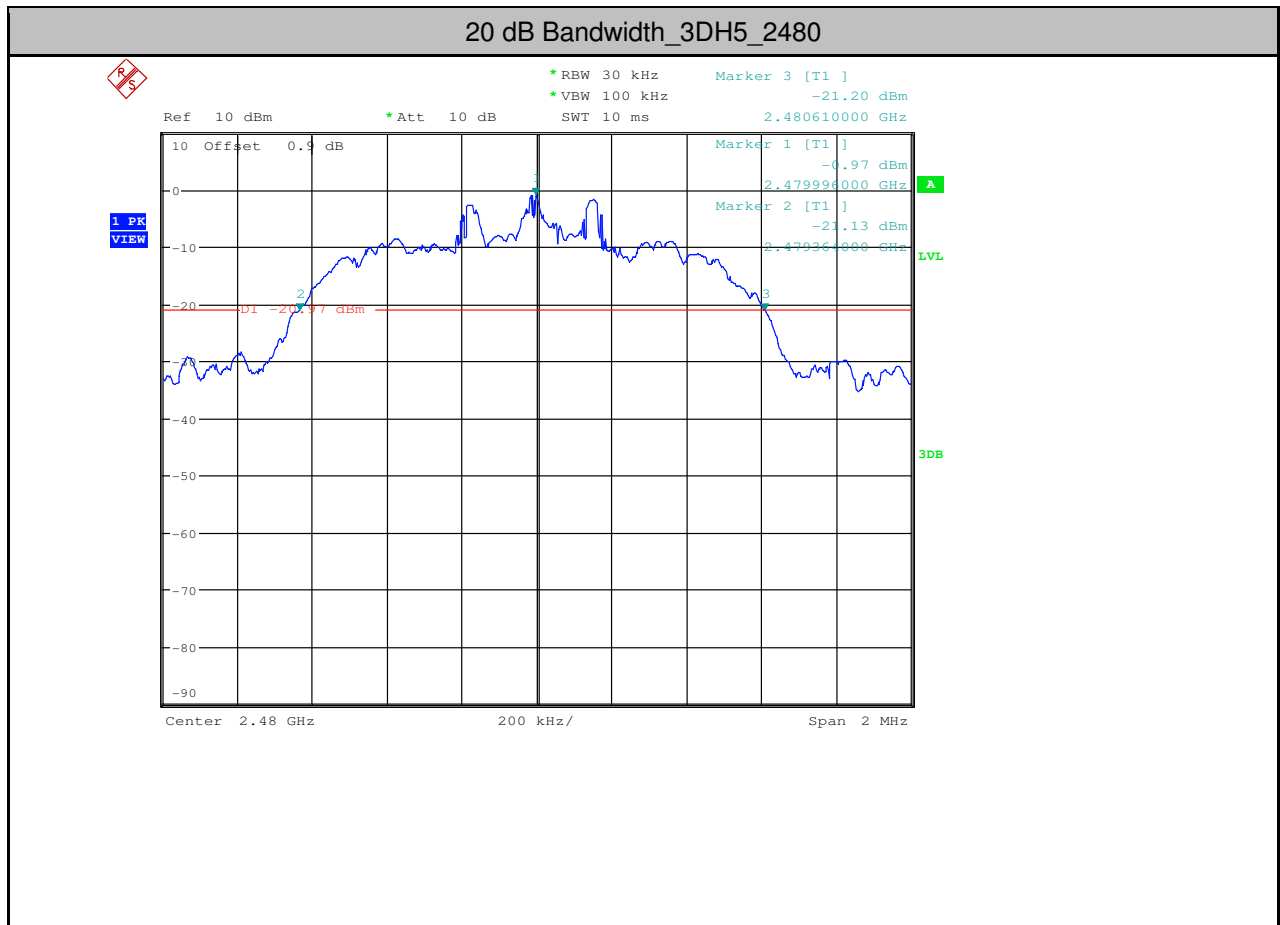














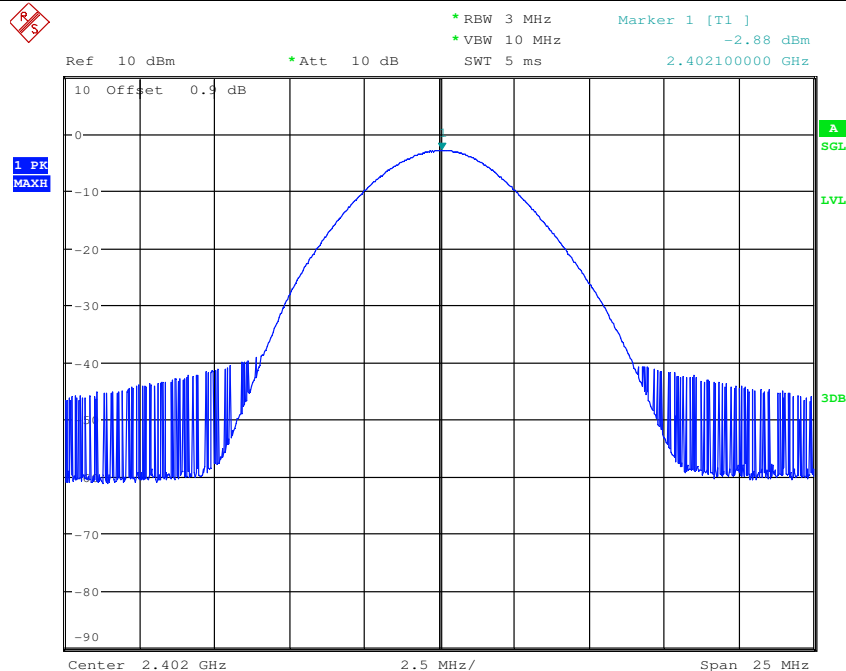
## 2. Conducted Peak Output Power

Test Mode	Test Channel	Power[dBm]	Limit[dBm]	Verdict
DH5	2402	-2.88	<20.96	PASS
DH5	2441	2.11	<20.96	PASS
DH5	2480	1.86	<20.96	PASS
2DH5	2402	-1.97	<20.96	PASS
2DH5	2441	2.9	<20.96	PASS
2DH5	2480	2.71	<20.96	PASS
3DH5	2402	-1.64	<20.96	PASS
3DH5	2441	2.86	<20.96	PASS
3DH5	2480	2.52	<20.96	PASS

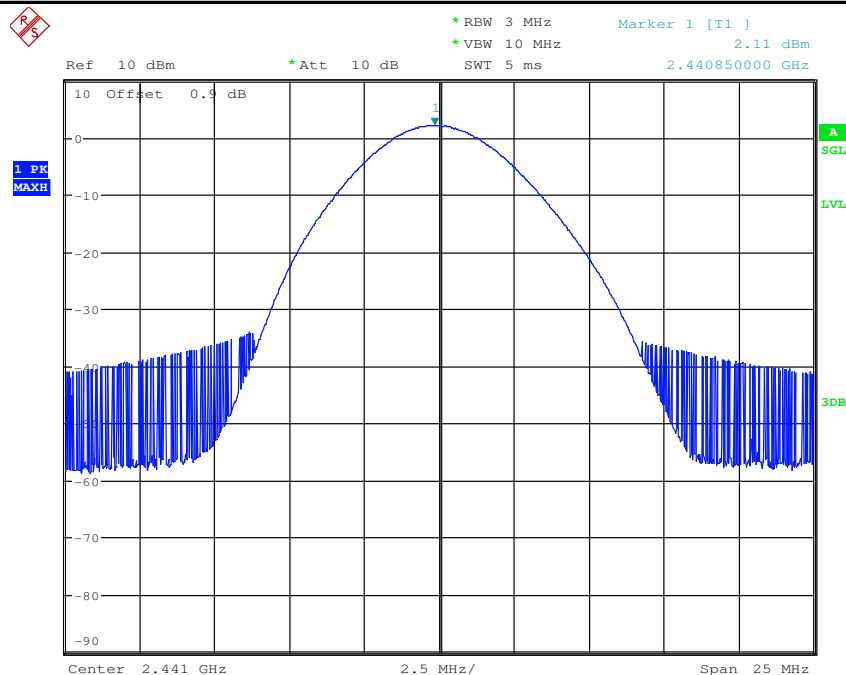


TEST PLOT

Conducted Peak Output Power\_DH5\_2402

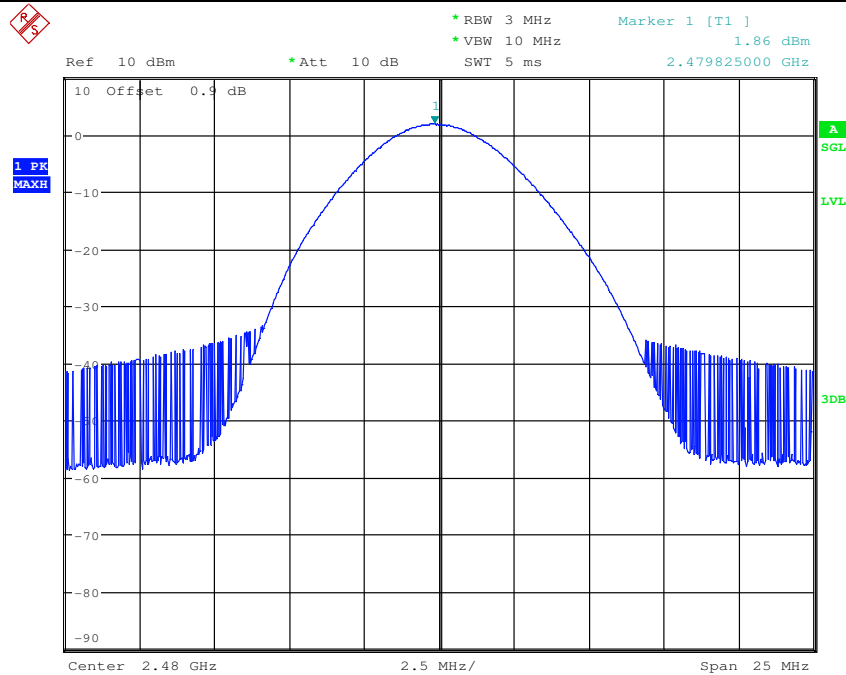


Conducted Peak Output Power\_DH5\_2441

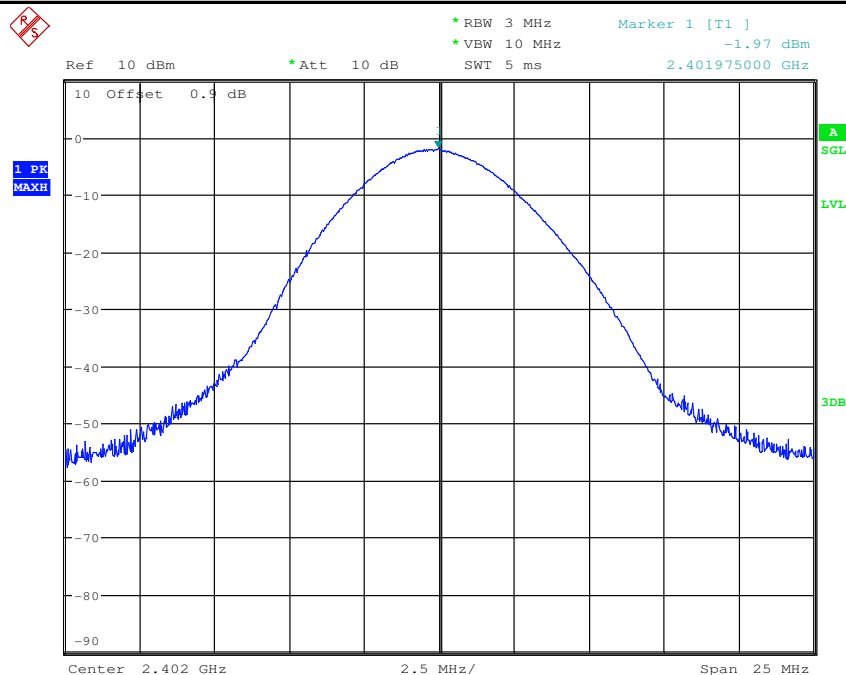




Conducted Peak Output Power\_DH5\_2480

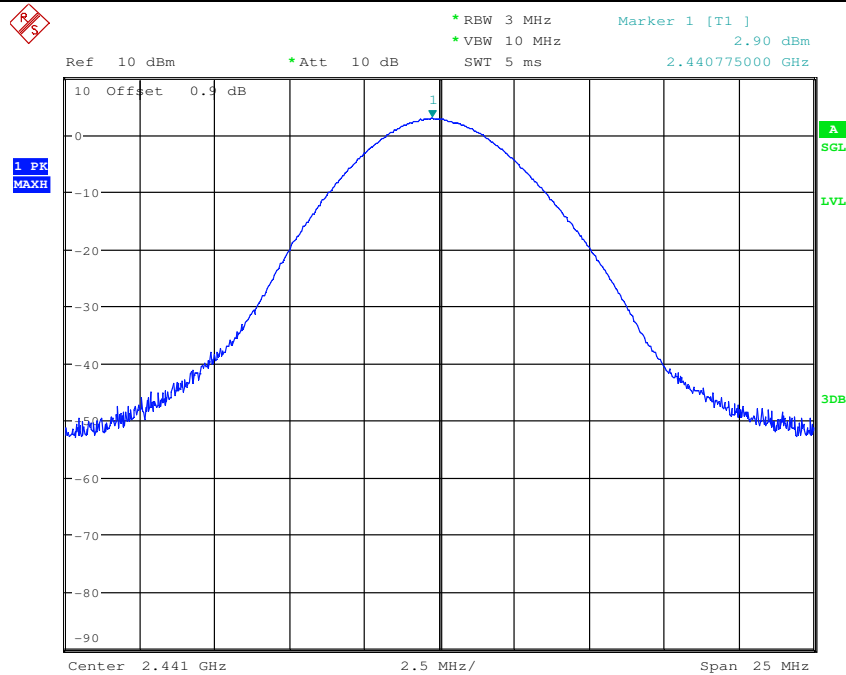


Conducted Peak Output Power\_2DH5\_2402

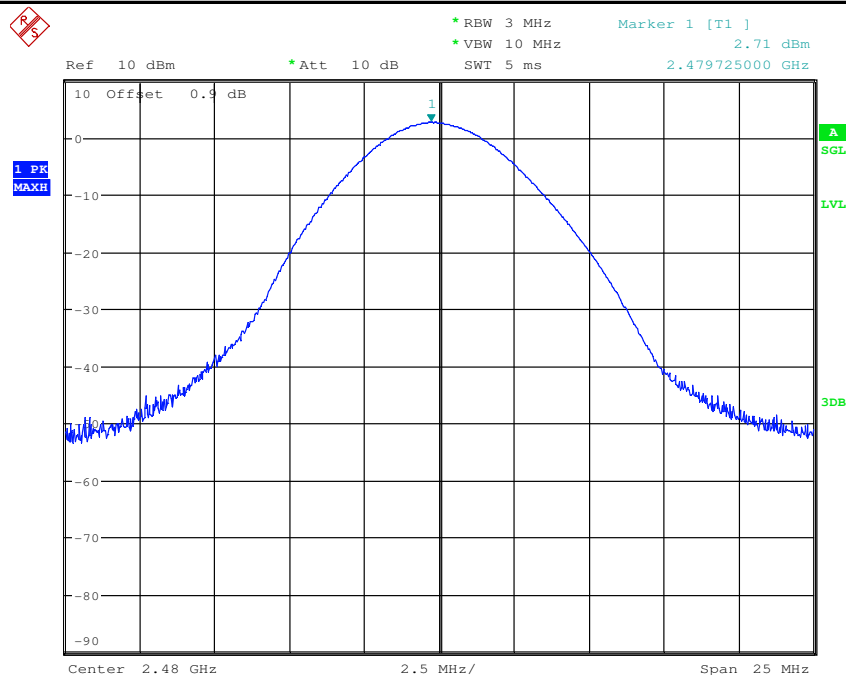




Conducted Peak Output Power\_2DH5\_2441

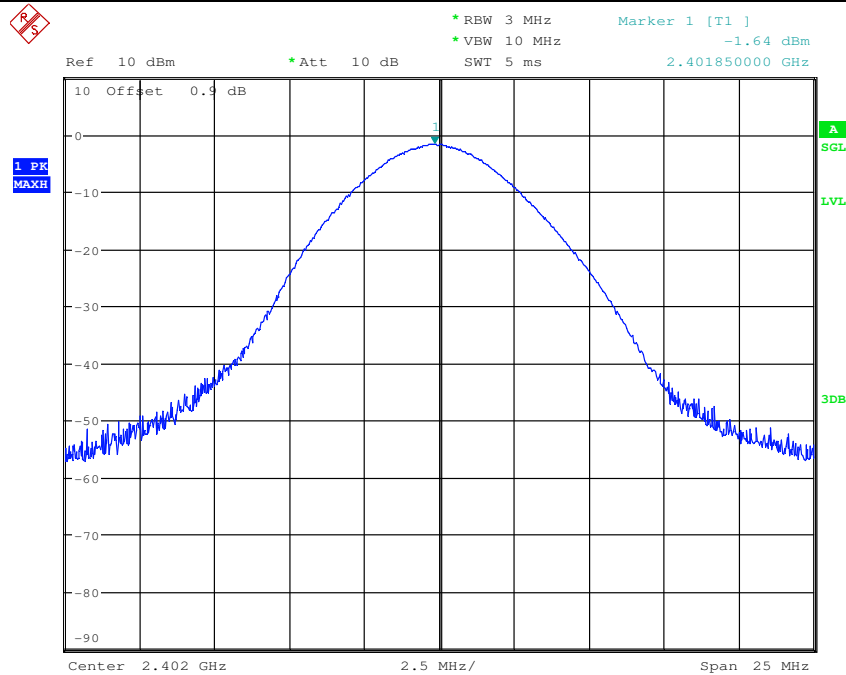


Conducted Peak Output Power\_2DH5\_2480

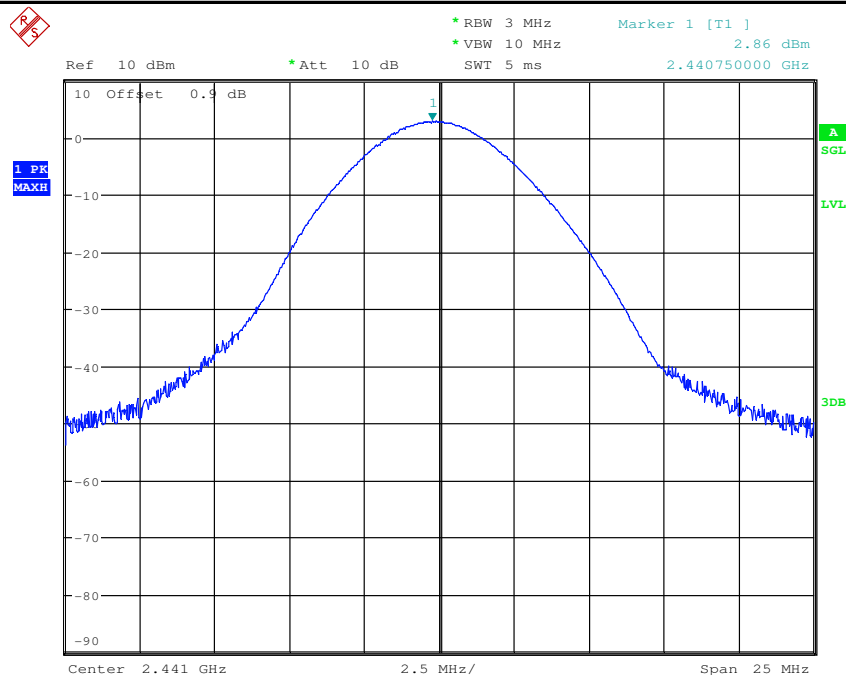




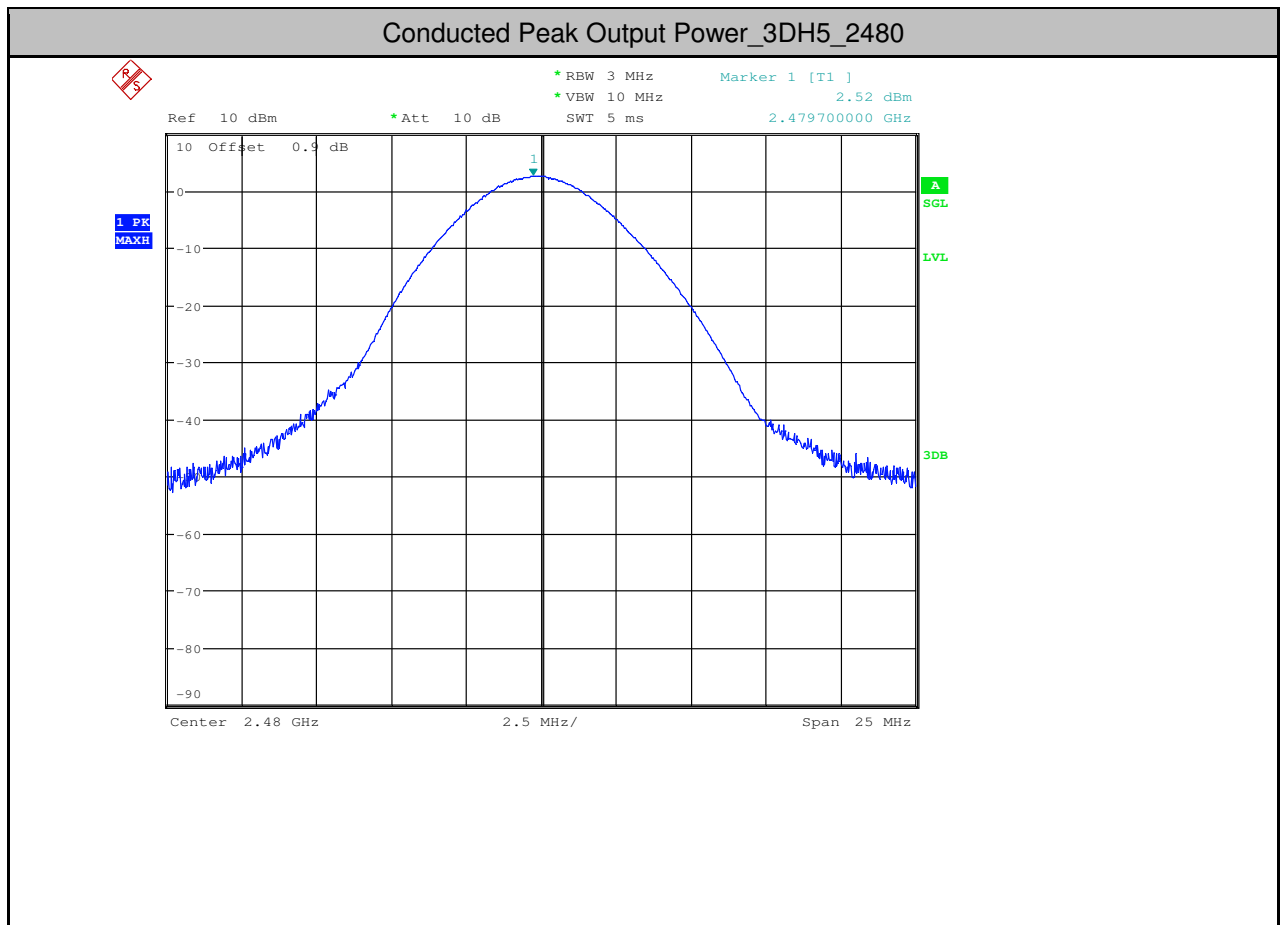
Conducted Peak Output Power\_3DH5\_2402



Conducted Peak Output Power\_3DH5\_2441



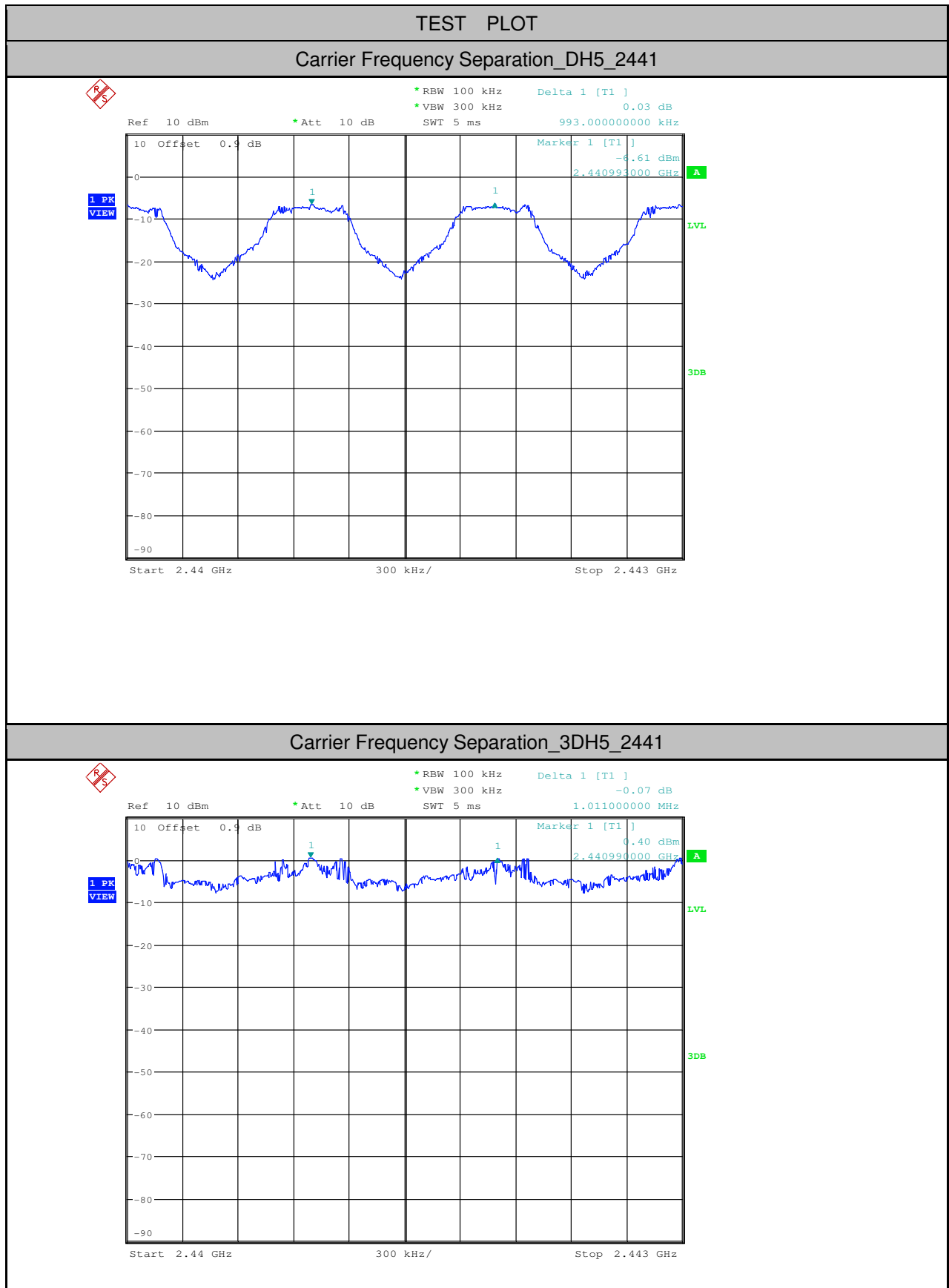


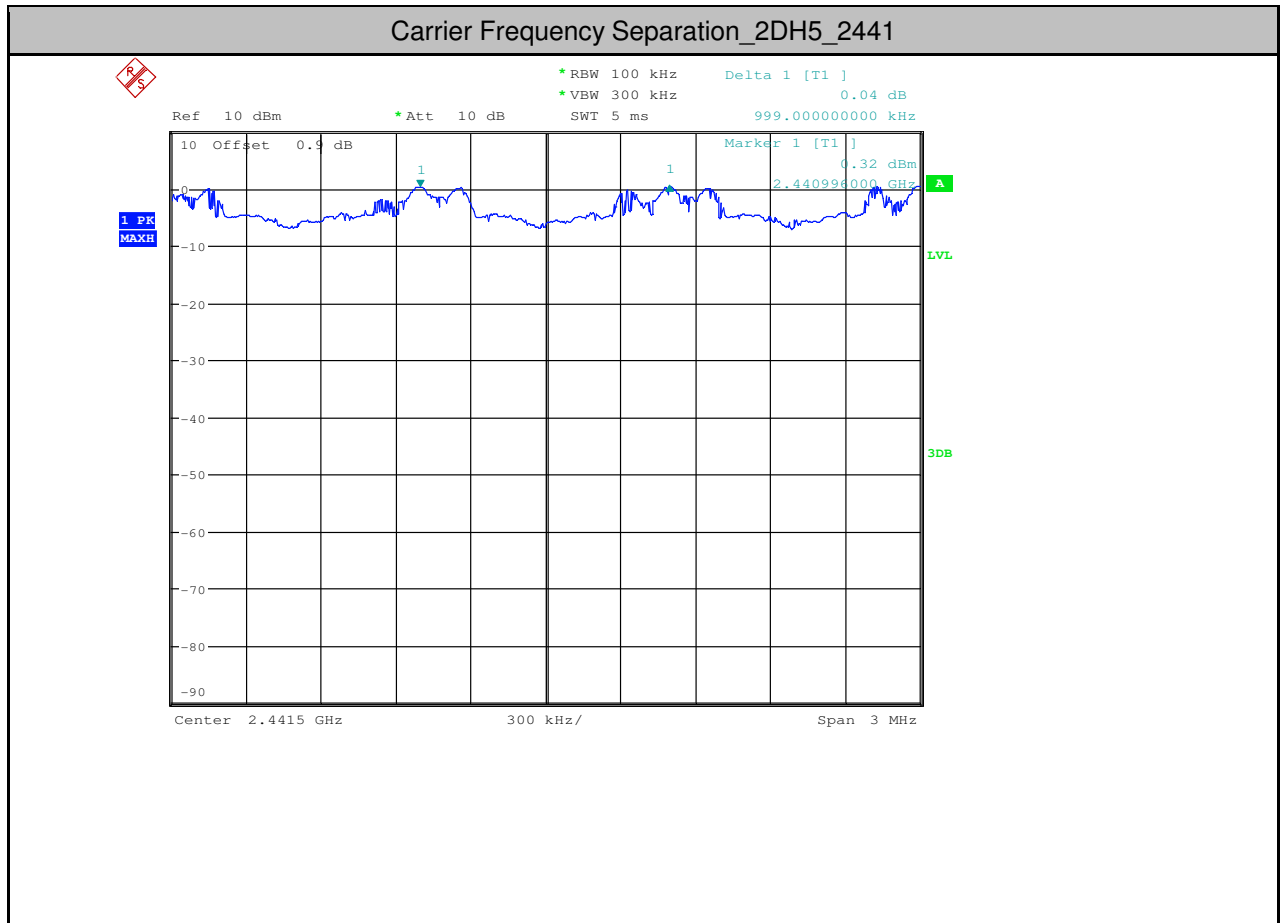




### 3.Carrier Frequency Separation

Test Mode	Test Channel	Result[MHz]	Limit[MHz]	Verdict
DH5	2441	0.993	$\geq 0.632$	PASS
3DH5	2441	1.011	$\geq 0.843$	PASS
2DH5	2441	0.999	$\geq 0.845$	PASS

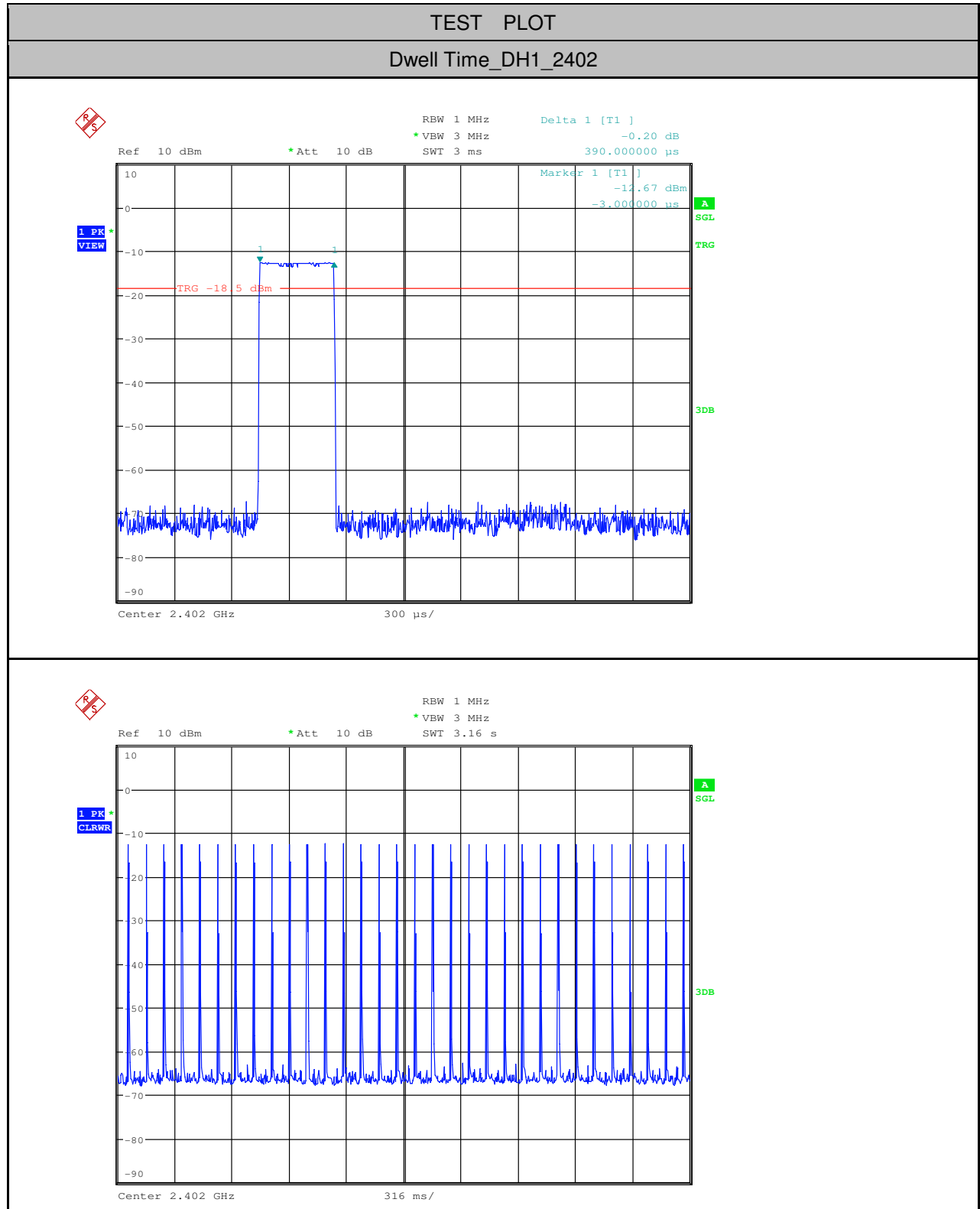


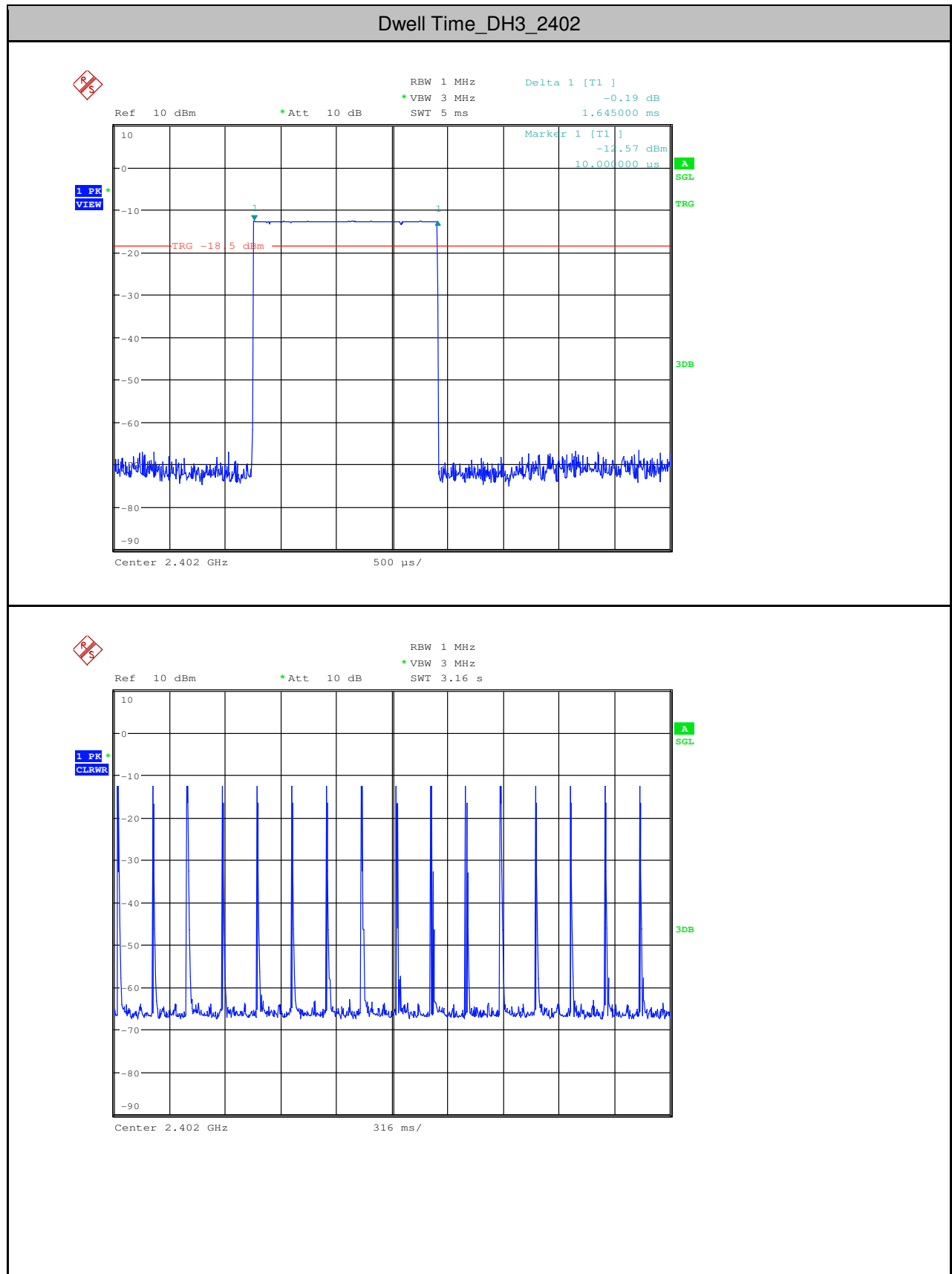




#### 4.Dwell Time

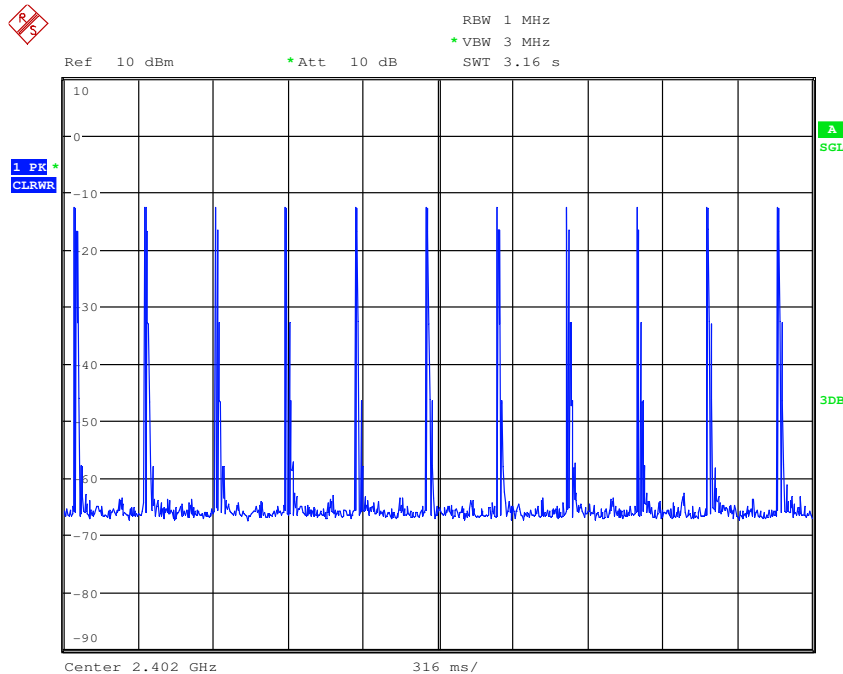
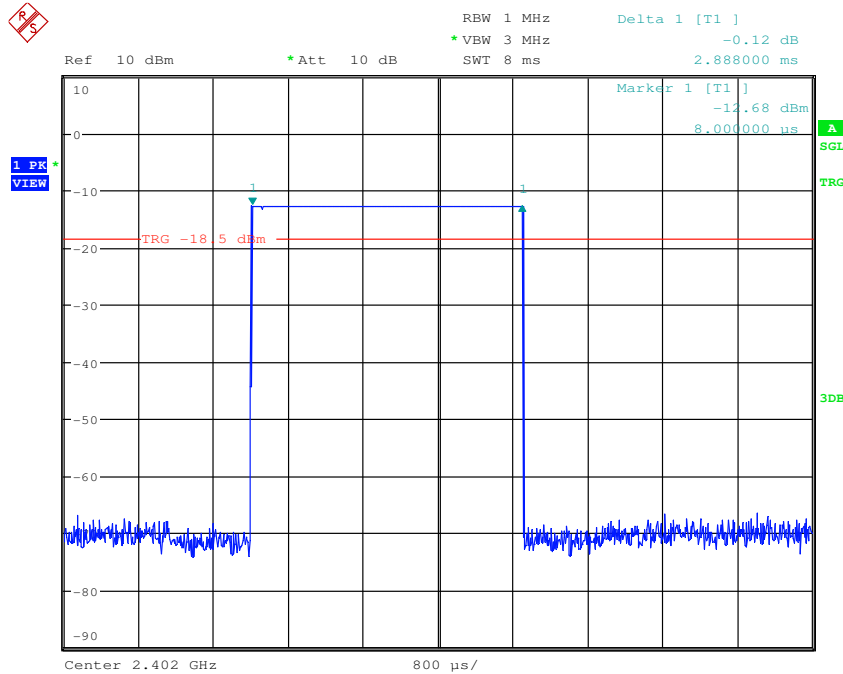
Test Mode	Test Channel	Burst Width[ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[s]	Limit[s]	Verdict
DH1	2402	0.39	320	0.125	<0.4	PASS
DH3	2402	1.65	160	0.264	<0.4	PASS
DH5	2402	2.89	110	0.318	<0.4	PASS
2DH1	2402	0.4	320	0.128	<0.4	PASS
2DH3	2402	1.66	160	0.266	<0.4	PASS
2DH5	2402	2.9	110	0.319	<0.4	PASS
3DH1	2402	0.4	320	0.128	<0.4	PASS
3DH3	2402	1.66	160	0.266	<0.4	PASS
3DH5	2402	2.9	110	0.319	<0.4	PASS



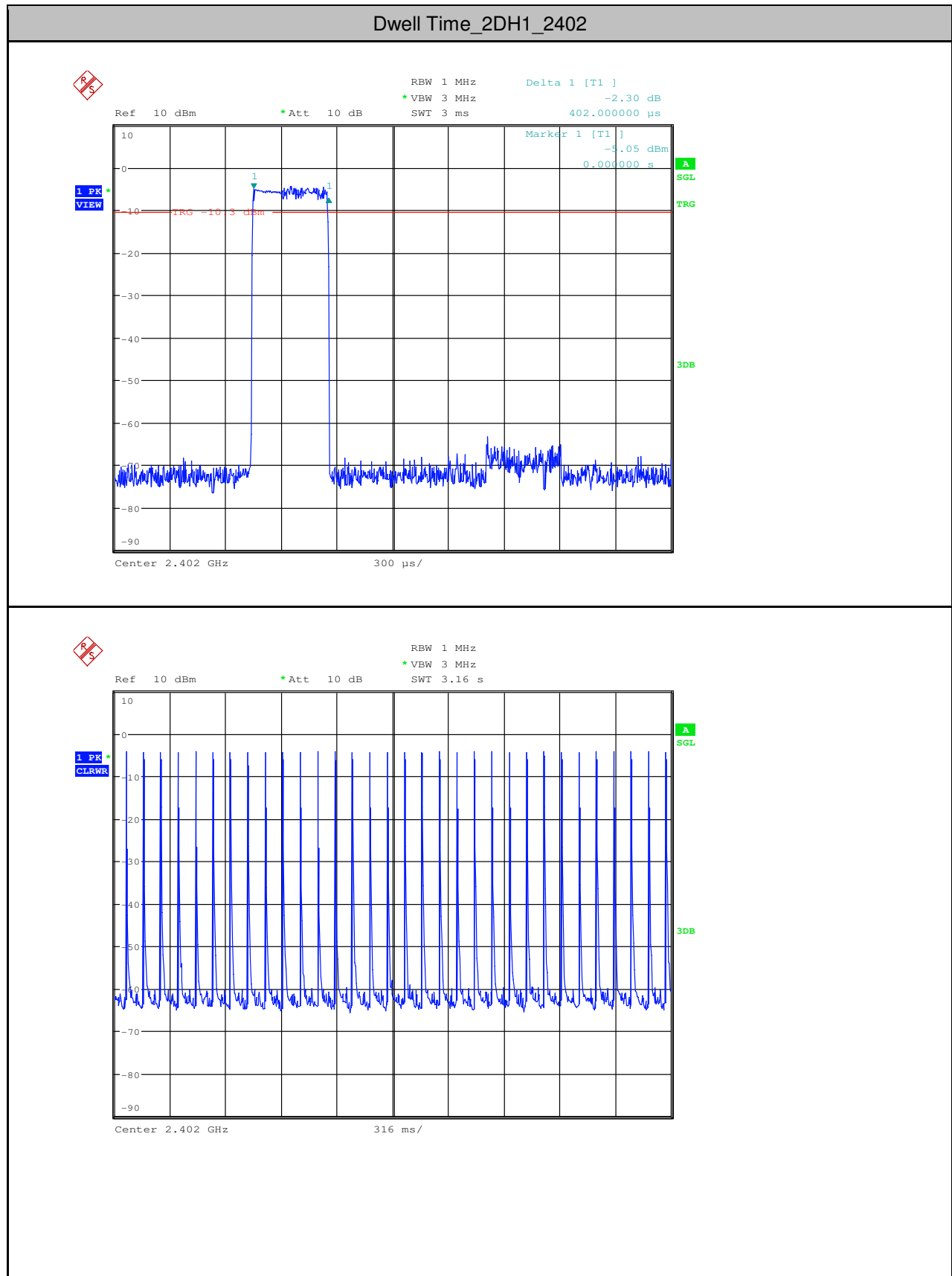




Dwell Time\_DH5\_2402

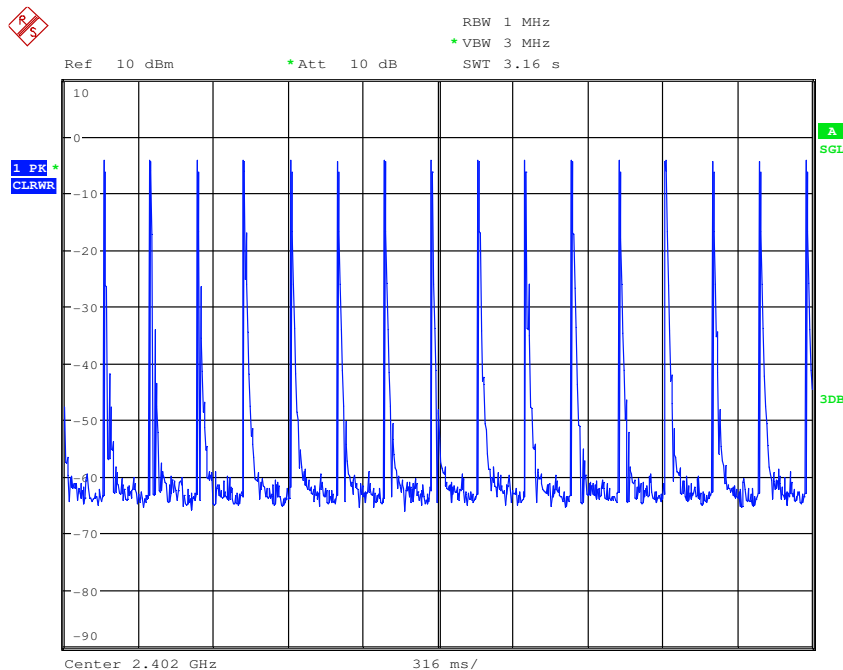
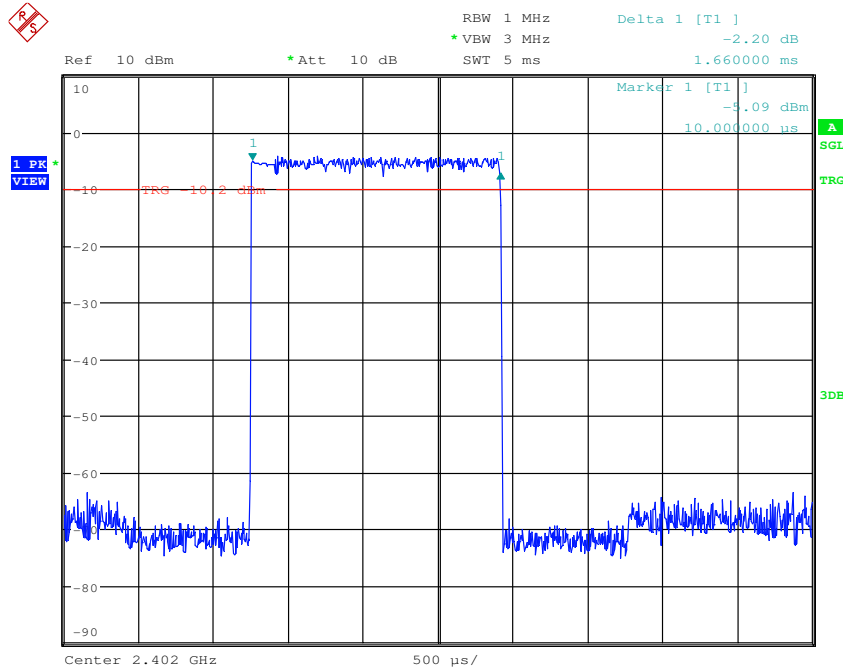


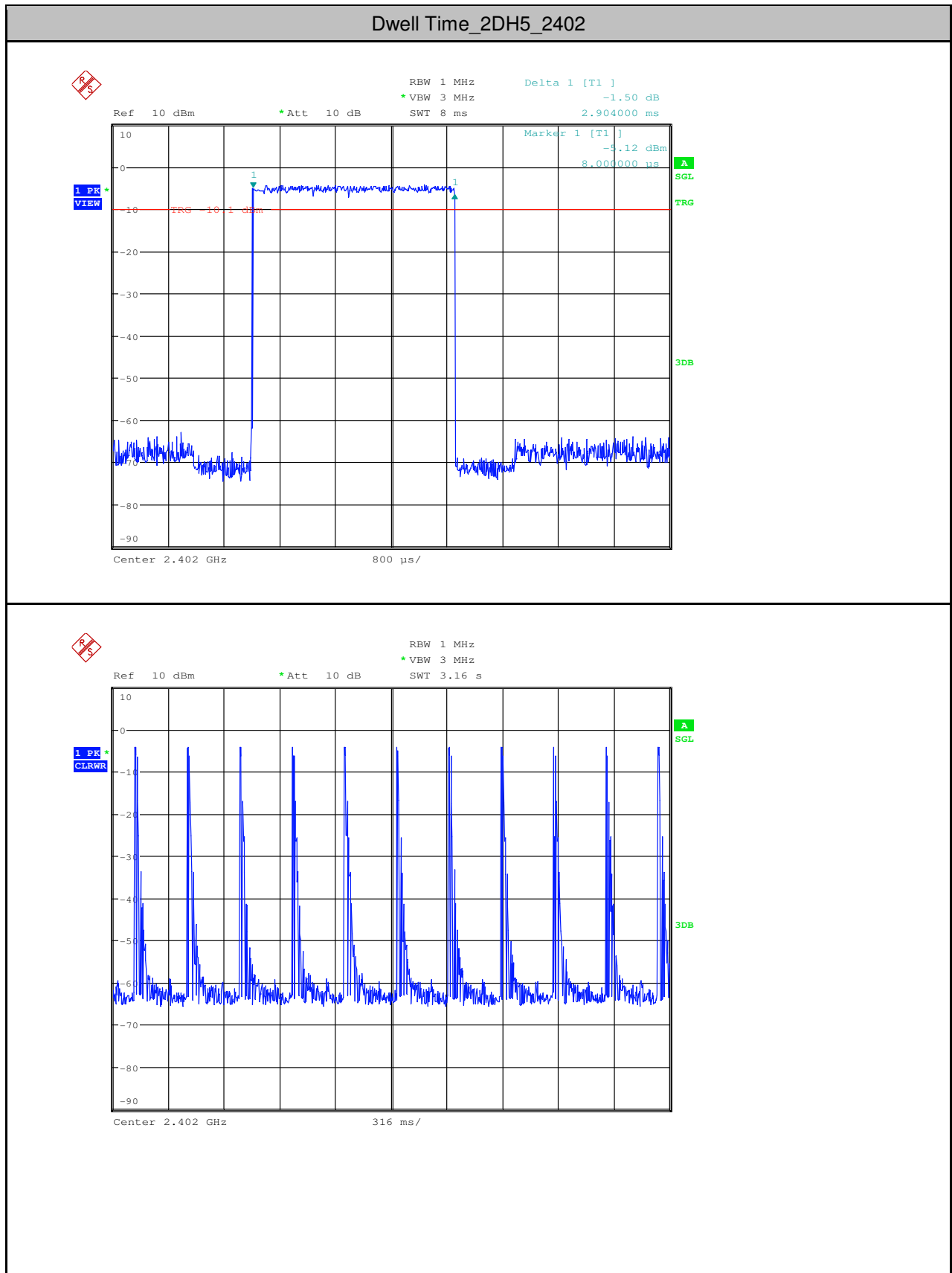






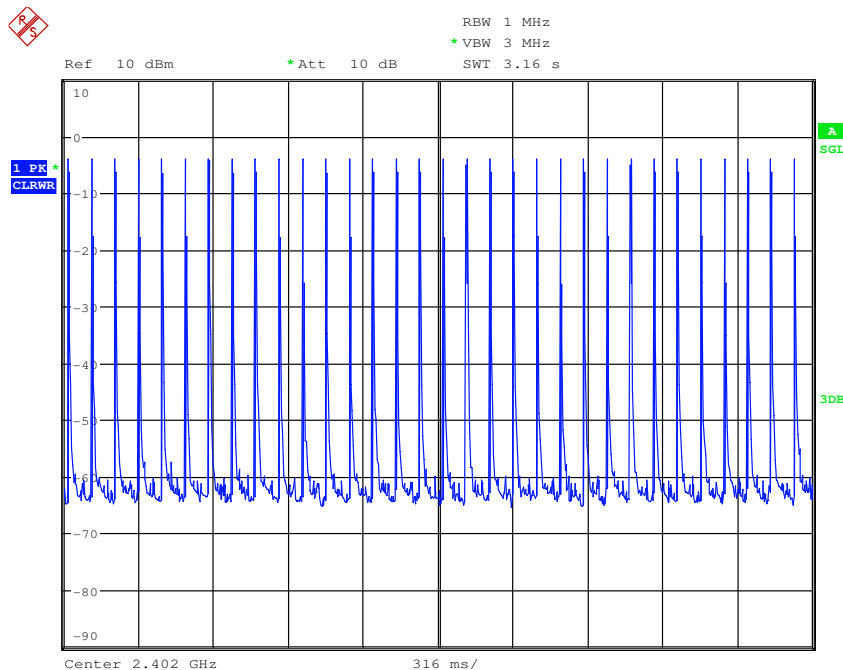
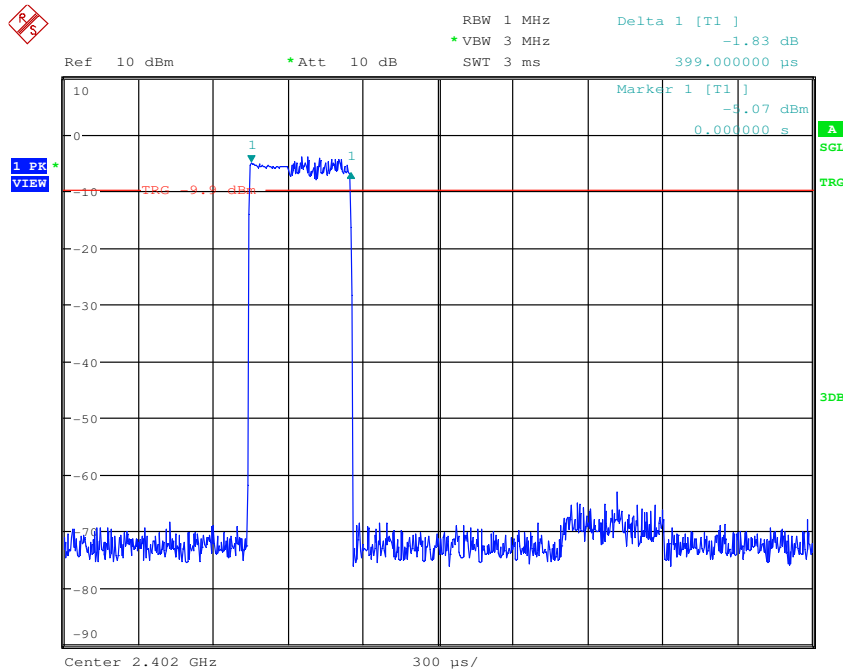
Dwell Time\_2DH3\_2402

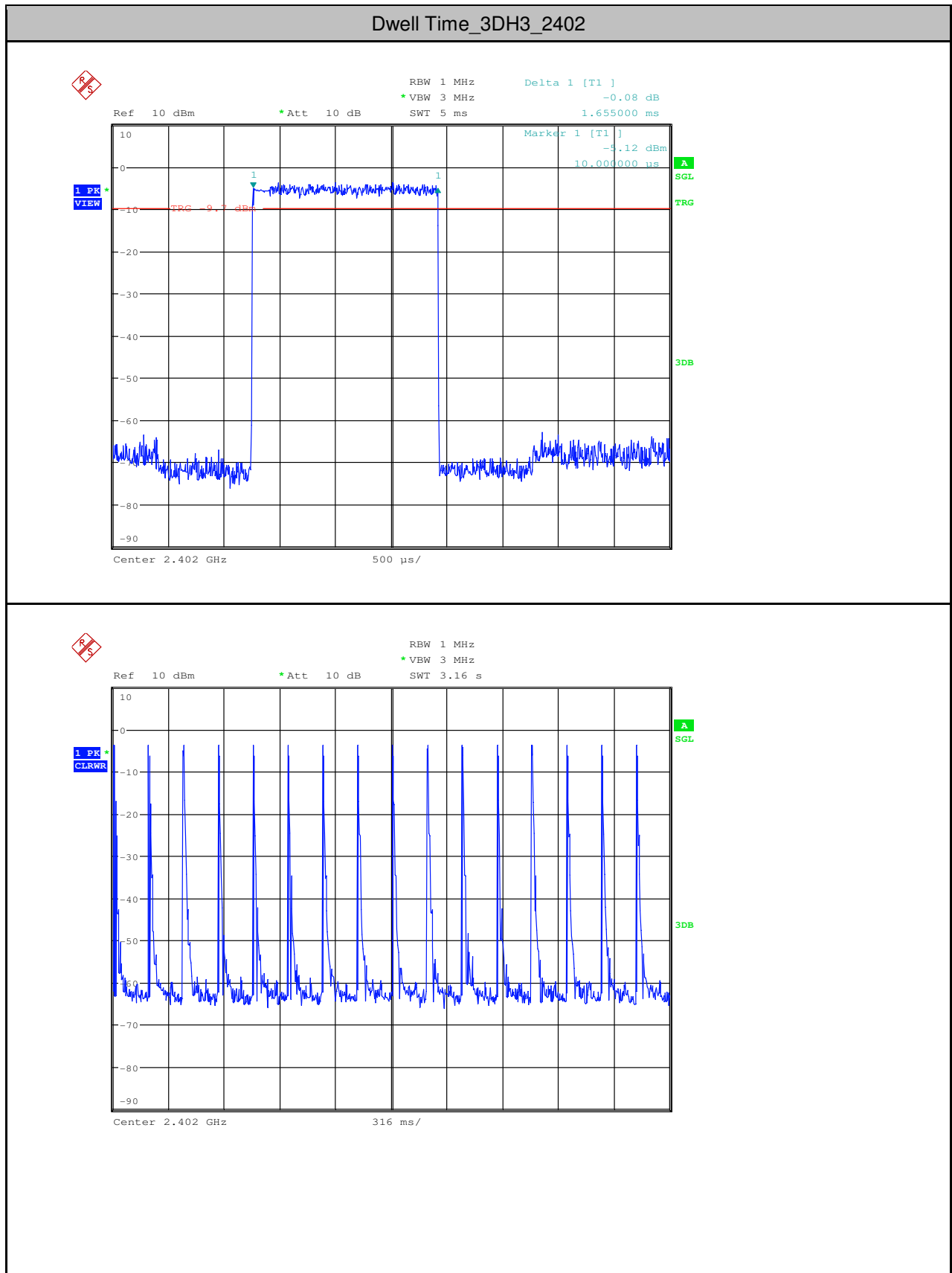






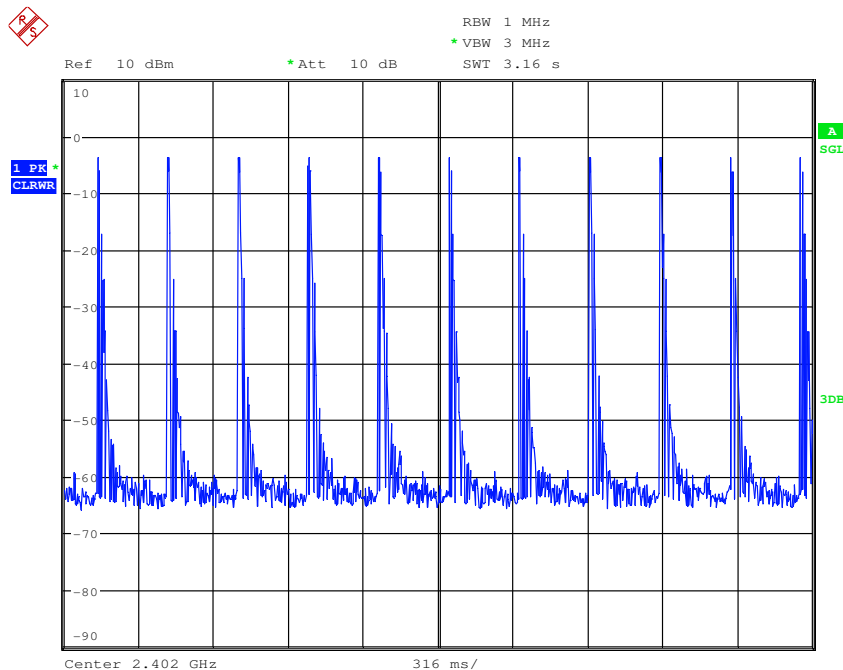
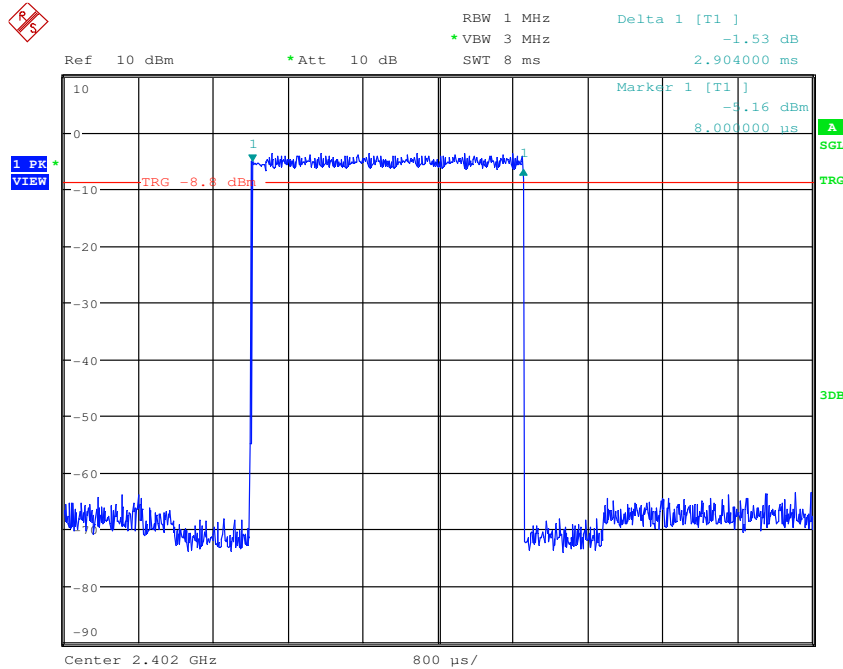
Dwell Time\_3DH1\_2402







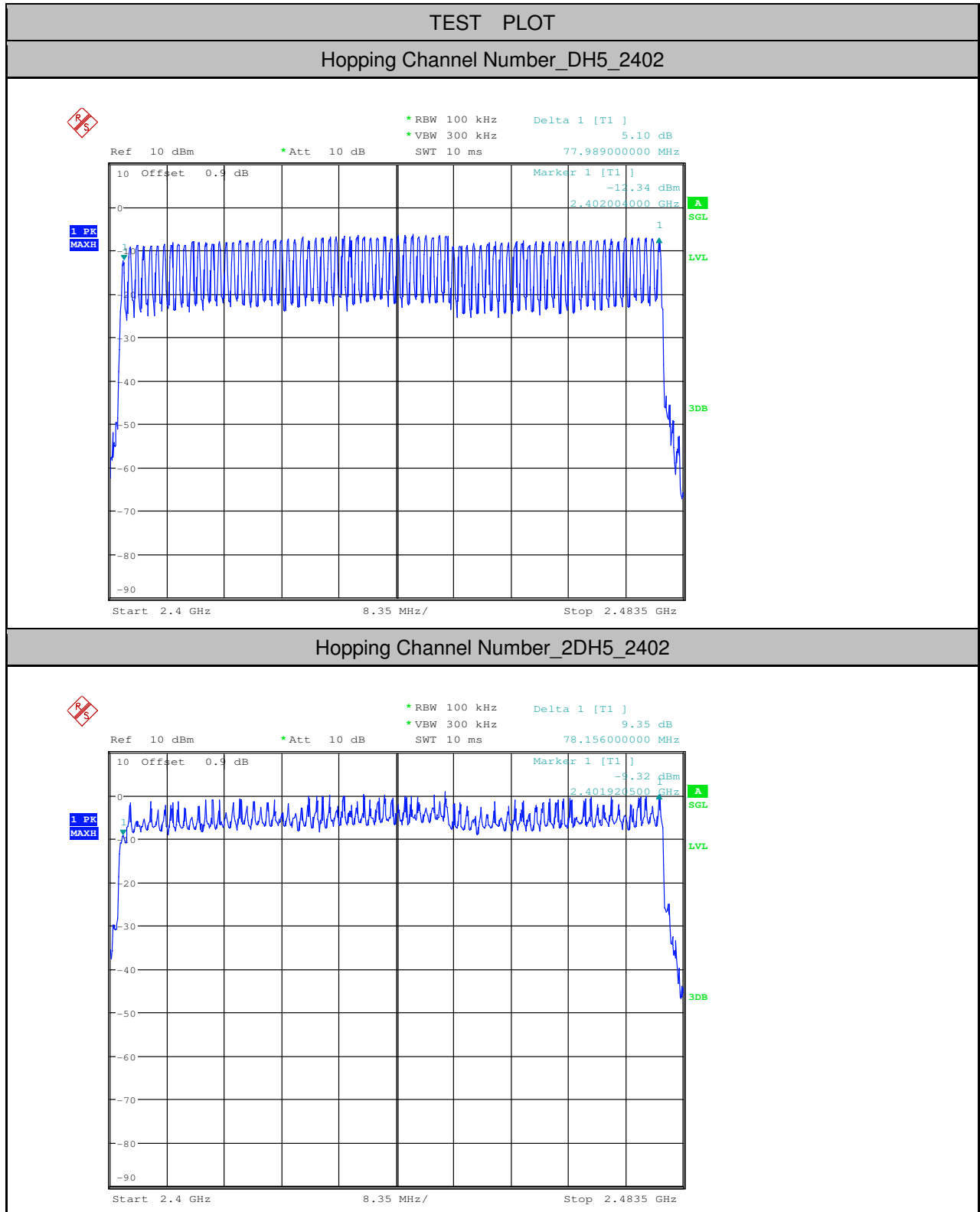
Dwell Time\_3DH5\_2402



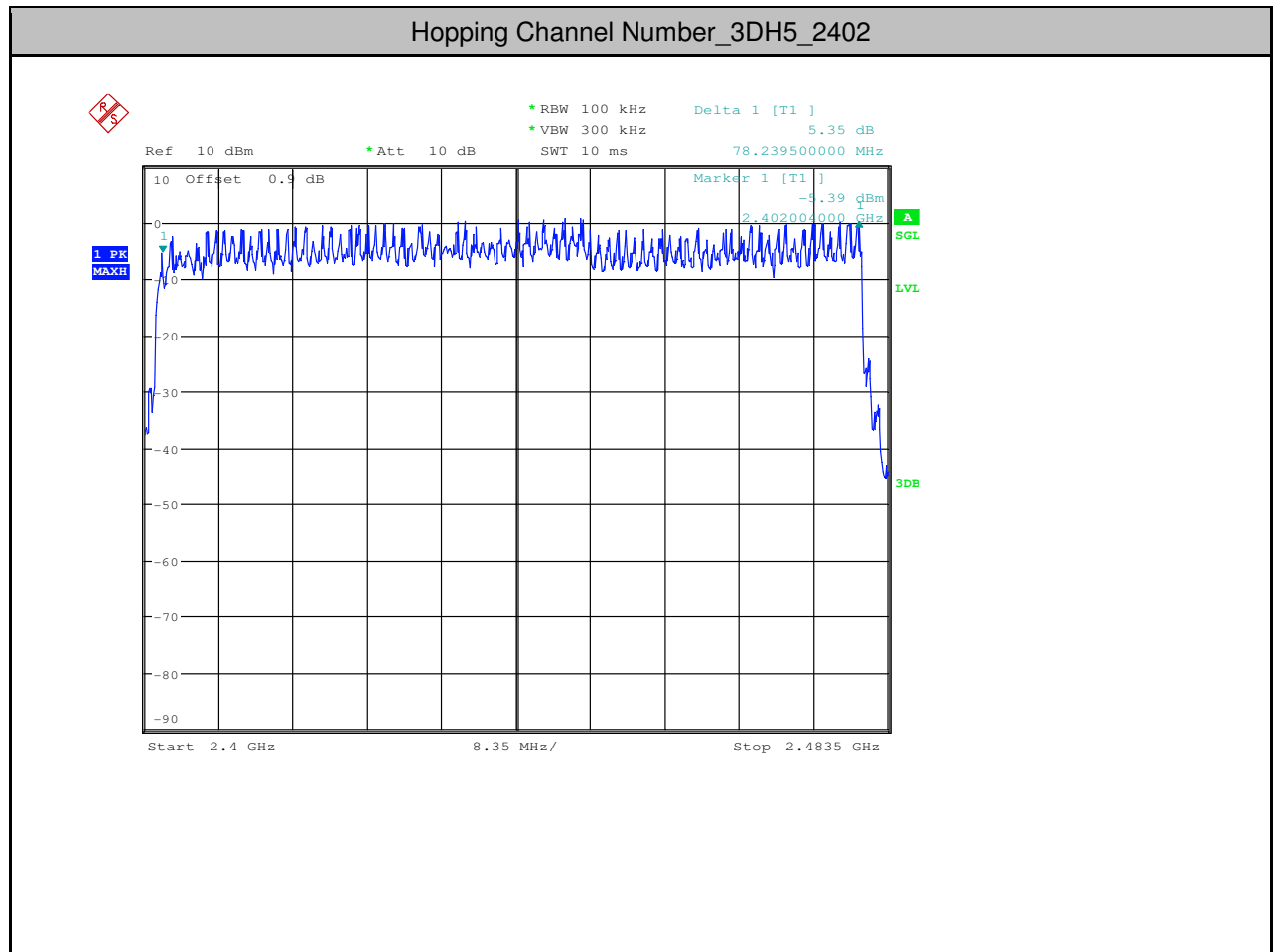


## 5.Hopping Channel Number

Test Mode	Test Channel	Number of Hopping Channel[N]	Limit[N]	Verdict
DH5	2402	79	$\geq 15$	PASS
2DH5	2402	79	$\geq 15$	PASS
3DH5	2402	79	$\geq 15$	PASS



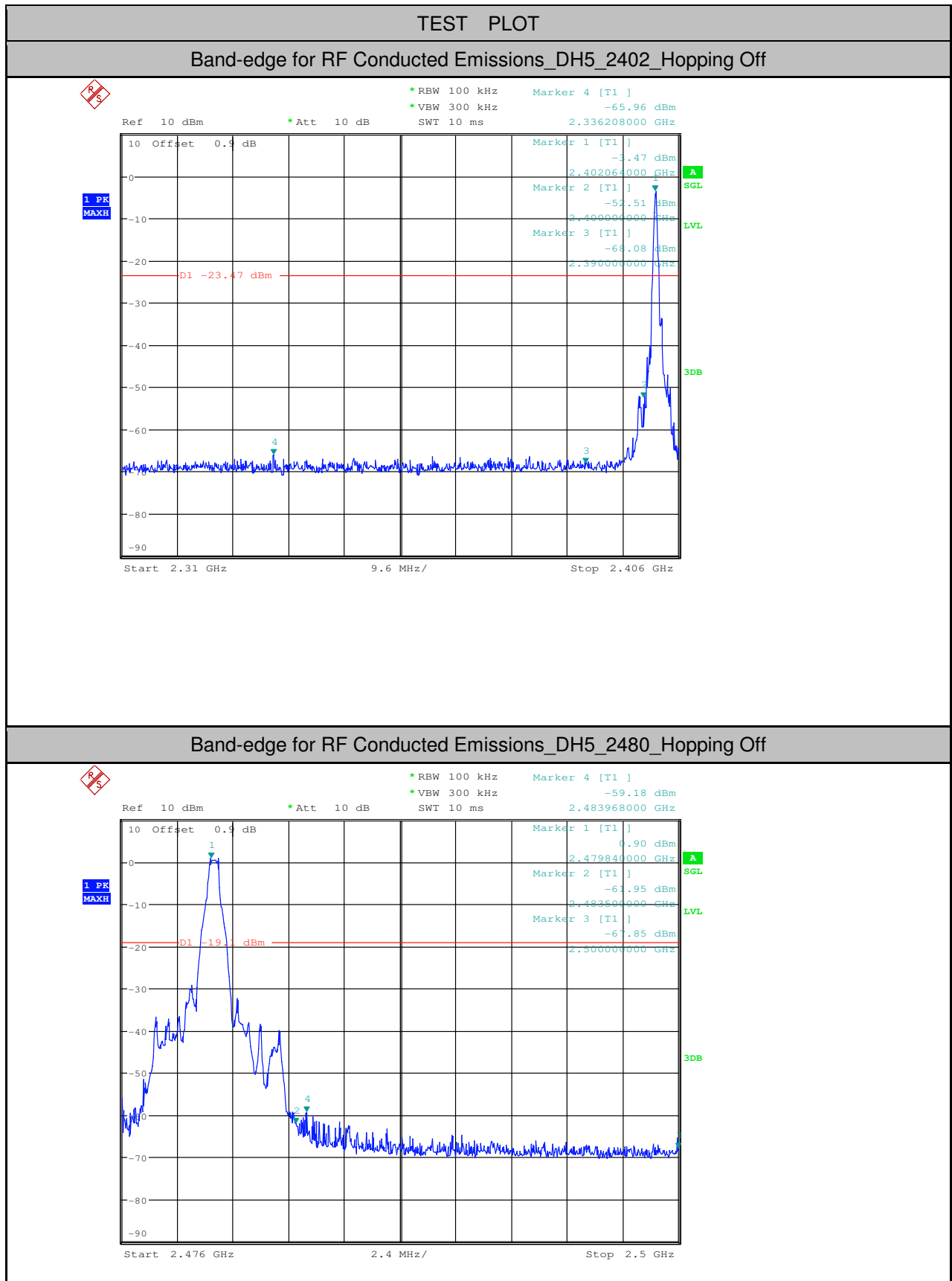






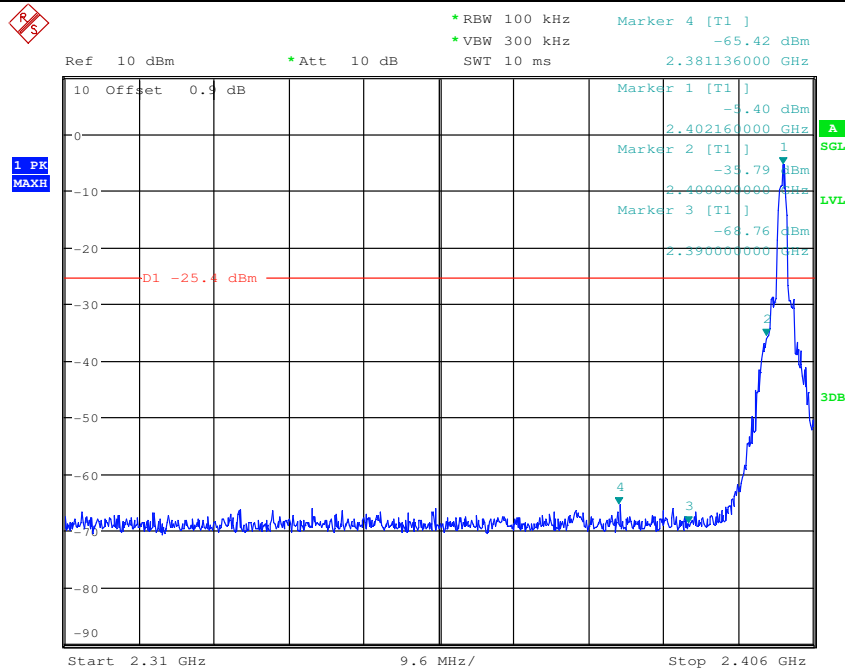
## 6. Band-edge for RF Conducted Emissions

Test Mode	Test Channel	Hopping	Carrier Power[dBm]	Max. Spurious Level [dBm]	Limit[dBm]	Verdict
DH5	2402	Off	-3.470	-65.955	<-23.47	PASS
DH5	2480	Off	0.900	-59.182	<-19.1	PASS
2DH5	2402	Off	-5.400	-65.417	<-25.4	PASS
2DH5	2480	Off	0.110	-46.803	<-19.89	PASS
3DH5	2402	Off	-4.650	-64.839	<-24.65	PASS
3DH5	2480	Off	-0.050	-45.607	<-20.05	PASS
DH5	2402	On	-9.170	-63.330	<-29.17	PASS
DH5	2480	On	-7.590	-63.077	<-27.59	PASS
2DH5	2402	On	-1.750	-59.224	<-21.75	PASS
2DH5	2480	On	-1.330	-48.150	<-21.33	PASS
3DH5	2402	On	-2.120	-58.343	<-22.12	PASS
3DH5	2480	On	-2.650	-48.478	<-22.65	PASS

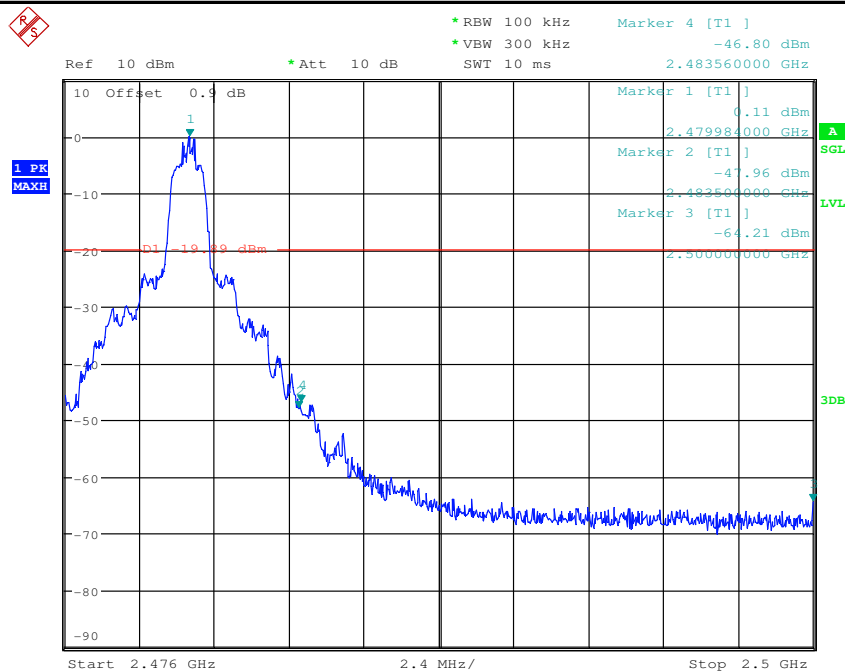




Band-edge for RF Conducted Emissions\_2DH5\_2402\_Hopping Off

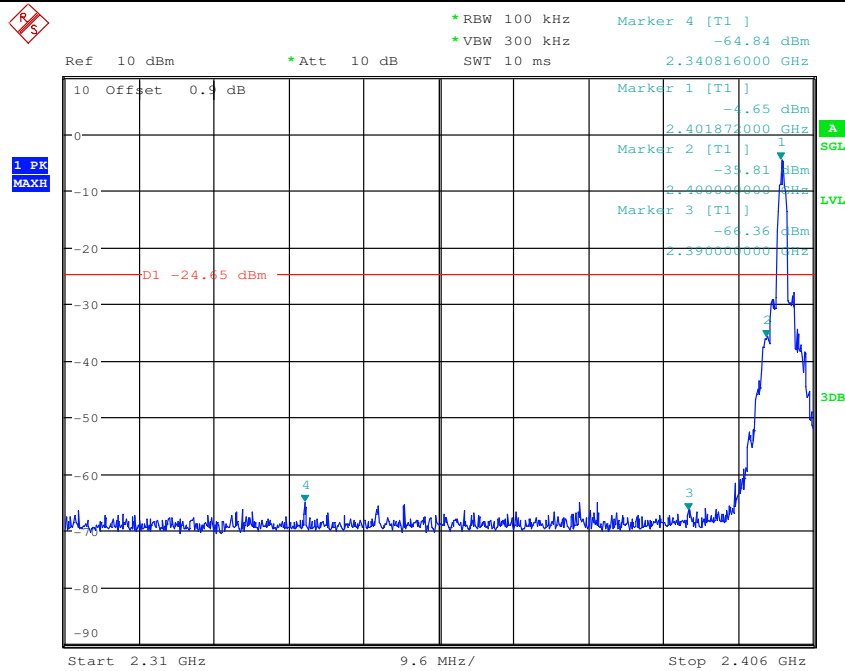


Band-edge for RF Conducted Emissions\_2DH5\_2480\_Hopping Off

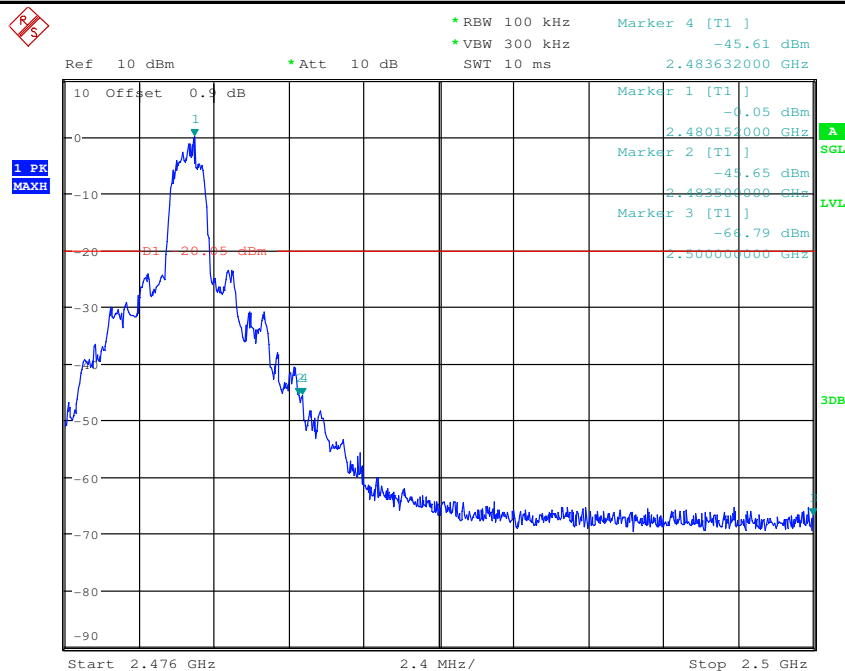




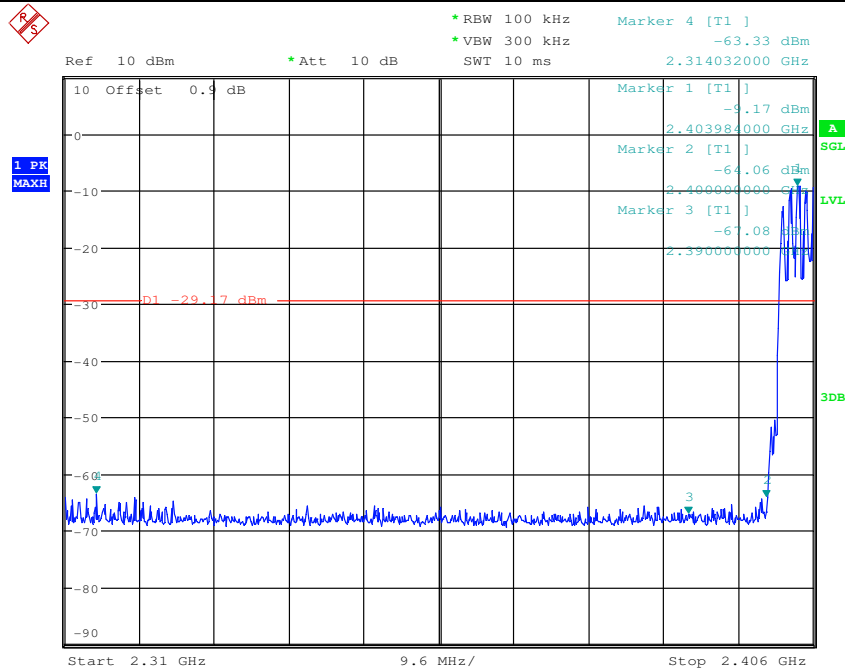
Band-edge for RF Conducted Emissions\_3DH5\_2402\_Hopping Off



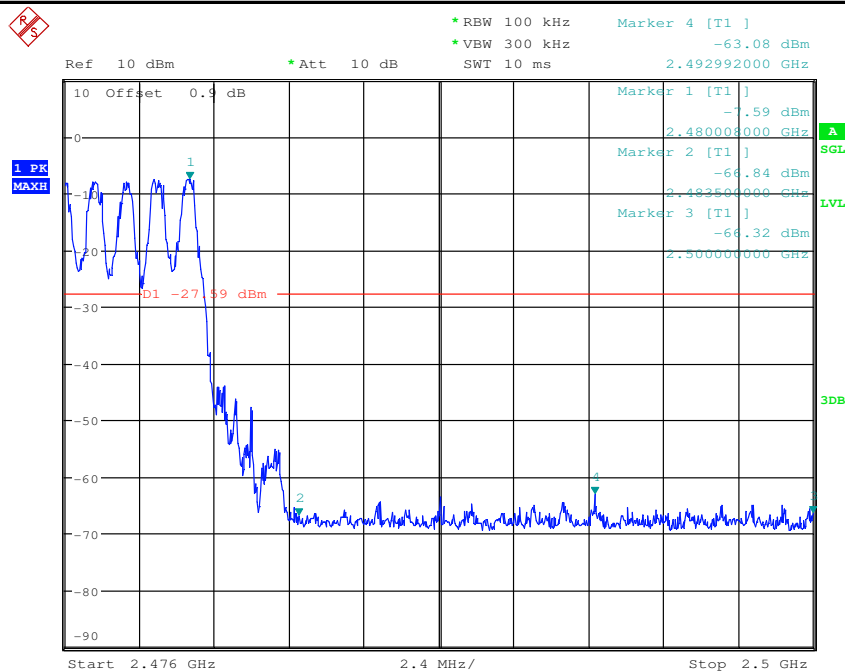
Band-edge for RF Conducted Emissions\_3DH5\_2480\_Hopping Off



## Band-edge for RF Conducted Emissions\_DH5\_2402\_Hopping On

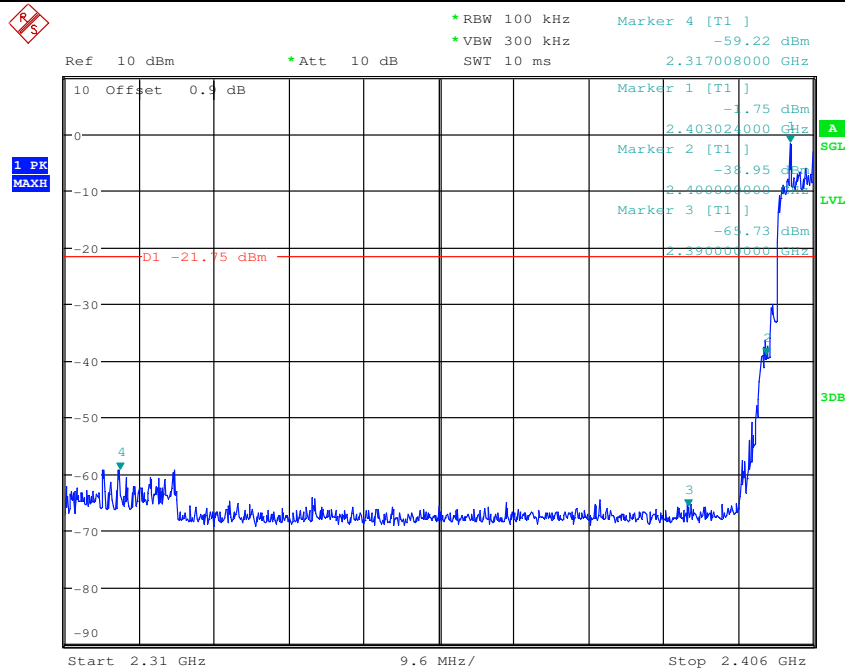


## Band-edge for RF Conducted Emissions\_DH5\_2480\_Hopping On

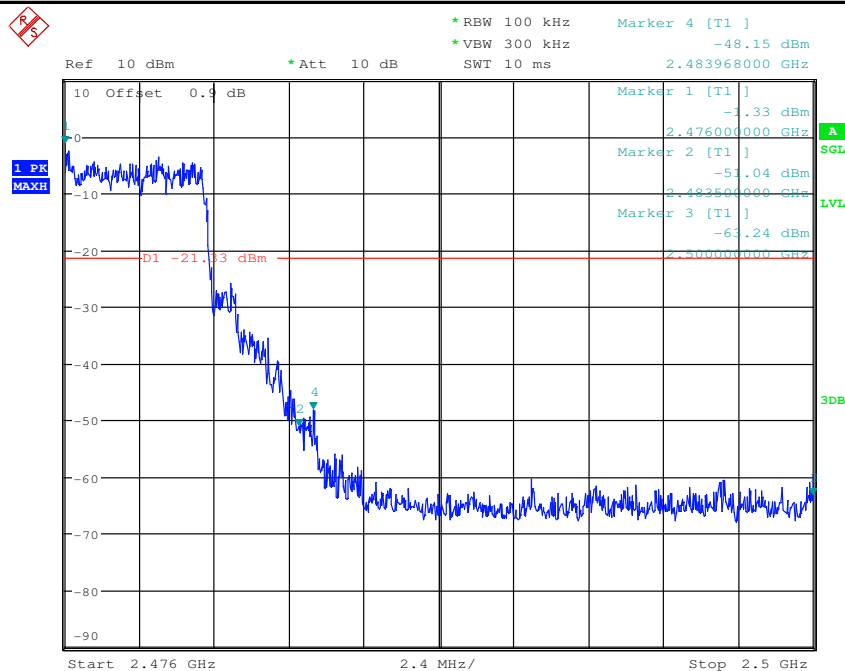




Band-edge for RF Conducted Emissions\_2DH5\_2402\_Hopping On

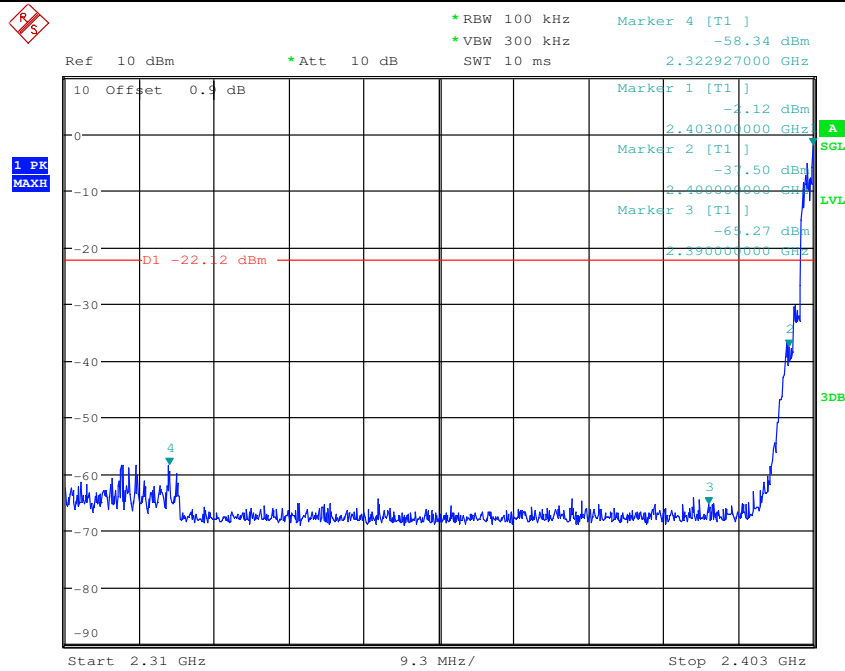


Band-edge for RF Conducted Emissions\_2DH5\_2480\_Hopping On

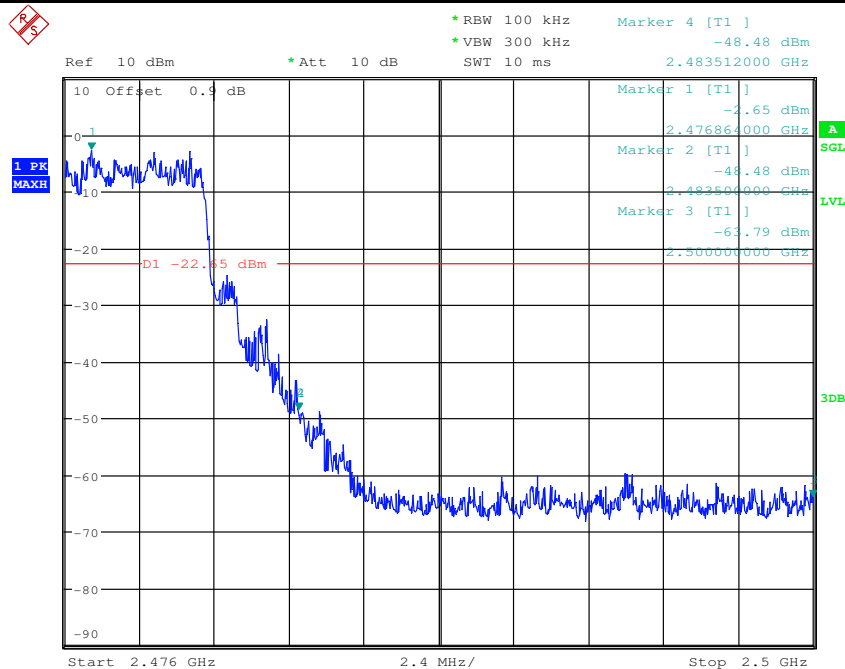




Band-edge for RF Conducted Emissions\_3DH5\_2402\_Hopping On



Band-edge for RF Conducted Emissions\_3DH5\_2480\_Hopping On





## 7.RF Conducted Spurious Emissions

