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Shenzhen Branch**

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Report No.: SZEM170100060101
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TEST REPORT

Application No.: SZEM1701000601CR
Applicant: HUAWEI TECHNOLOGIES CO.,LTD.
Address of Applicant: Administration Building, Huawei Technologies Co., Ltd. Bantian, Longgang District, Shenzhen, P. R. China
Manufacturer: HUAWEI TECHNOLOGIES CO.,LTD.
Address of Manufacturer: Administration Building, Huawei Technologies Co., Ltd. Bantian, Longgang District, Shenzhen, P. R. China
Factory: Winners'Sun Plastic & Electronic (Shenzhen) Co.,Ltd
Address of Factory: Zone E, Ying Tai Industrial Park, Dalang, Longhua Town, Bao An District, Shenzhen, Guangdong Province, China
Equipment Under Test (EUT):
EUT Name: Tripod Selfie Stick
Model No.: AF15
Trade mark: HUAWEI honor
FCC ID: QISAF15
Standards: 47 CFR Part 15, Subpart C 15.247
Date of Receipt: 2017-01-25
Date of Test: 2017-02-13 to 2017-02-17
Date of Issue: 2017-02-21

Test Result :	Pass*
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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		2017-02-21		Original

Authorized for issue by:			
Tested By			
		2017-02-21	
		Bill Chen /Project Engineer	Date
Checked By			
		2017-02-21	
		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	ANSI C63.10 (2013)	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	Pass

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
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.

Product Name:	Tripod Selfie Stick
Model No.:	AF15
Trade Mark:	HUAWEI honor
Frequency Range:	2402MHz to 2480MHz
Channel Separation:	1MHz
Bluetooth Version:	V3.0 with EDR
Modulation Type:	GFSK ; Pi/4DQPSK ; 8DPSK
Number of Channels:	79
Sample Type:	Portable production
Antenna Type:	ON BOARD
Antenna Gain:	0dBi
Power Supply:	3.0V DC (1 x 3.0V "CR2025" Size Battery)

4.2 Description of Support Units

The EUT has been tested with associated equipment below.

Description	Manufacturer	Model No.
Laptop	Lenovo	T430u
Test board	Supply to SGS	FT232



4.3 Measurement Uncertainty

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



4.4 Standards Applicable for Testing

Table 1 : Tests Carried Out Under 47 CFR Part 15, Subpart C 15.247

Item	Status
Conducted Disturbance at AC Power Line(150kHz-30MHz)	×
20dB Bandwidth	√
Conducted Peak Output Power	√
Carrier Frequencies Separation	√
Hopping Channel Number	√
Dwell Time	√
Minimum 6dB Bandwidth	×
Power Spectrum Density	×
Conducted Spurious Emissions	√
Radiated Spurious Emissions	√
Radiated Emissions which fall in the restricted bands	√
Conducted Band Edges Measurement	√
Antenna Requirement	√
Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence	×

× Indicates that the test is not applicable
√ Indicates that the test is applicable



4.5 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.

4.6 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.

4.7 Deviation from Standards

None

4.8 Abnormalities from Standard Conditions

None



5 Equipment List

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
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
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
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
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
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
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
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
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
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09



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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
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
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
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
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

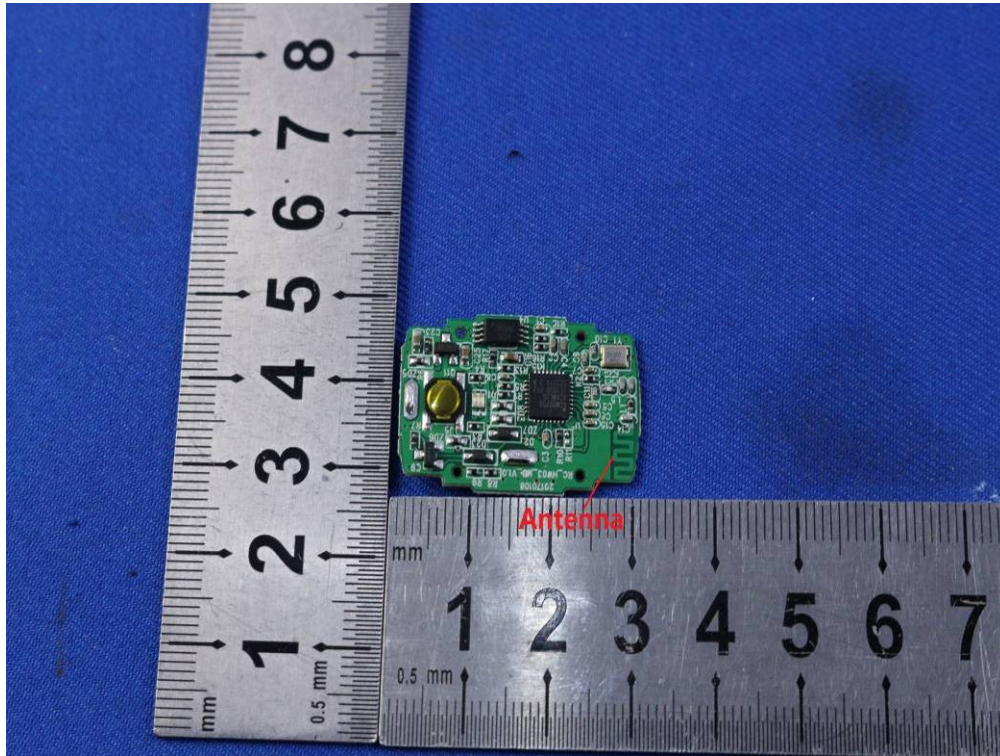
Standard Requirement:

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 0dBi.

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.

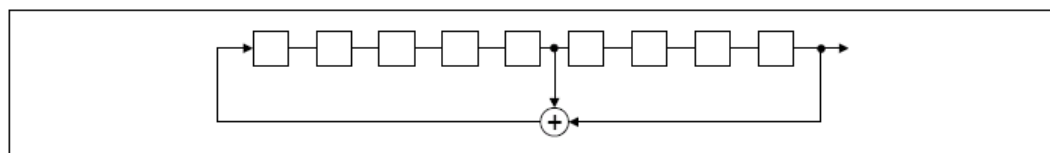
The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of 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.

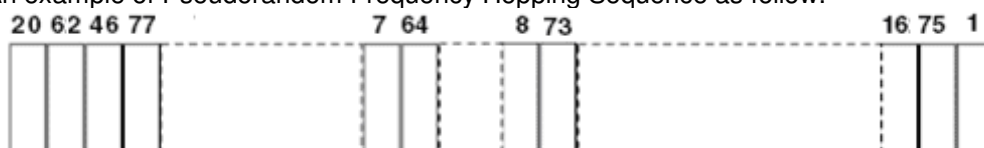
Number of shift register stages: 9

- 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 Bluetooth Core Specification, Bluetooth receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any Bluetooth transmitters and shift



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frequencies in synchronization with the transmitted signals.

7 Radio Spectrum Matter Test Results

7.1 20dB Bandwidth

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

7.1.1 E.U.T. Operation

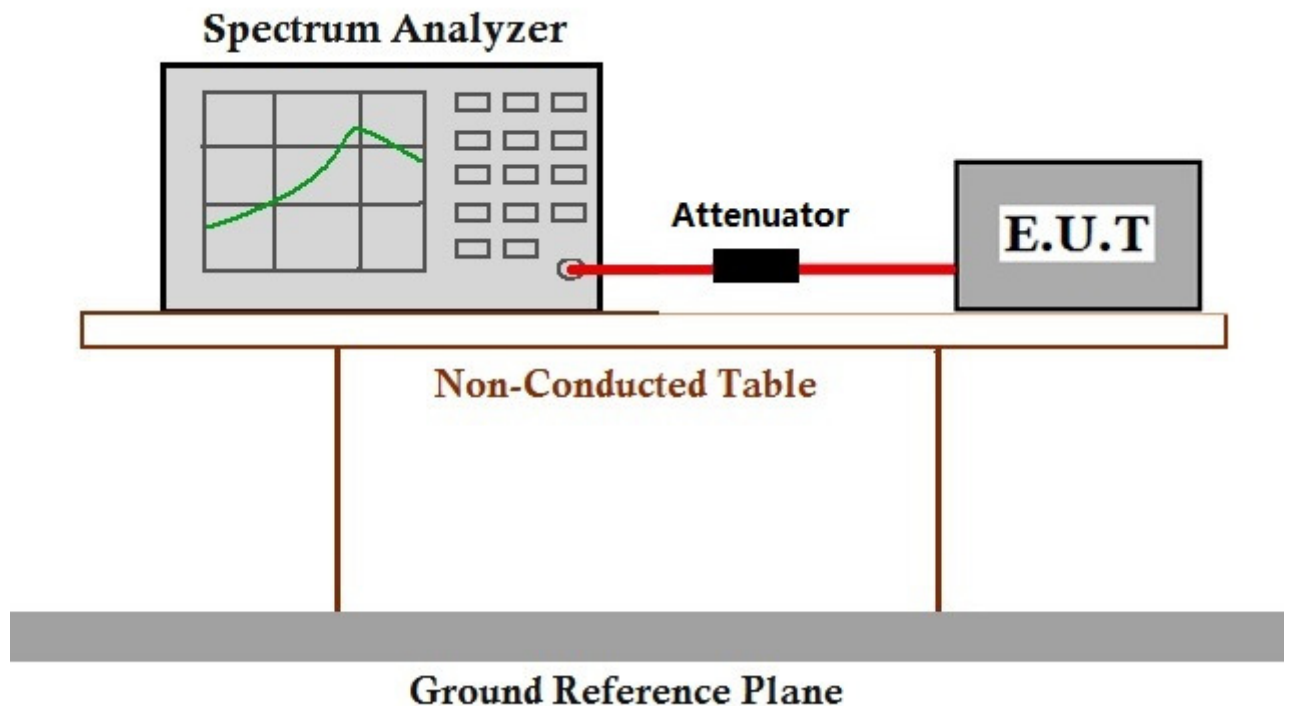
Operating Environment:

Temperature: 23.0 °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
Test Method: ANSI C63.10 (2013) Section 7.8.5
Limit: 20.97dBm

7.2.1 E.U.T. Operation

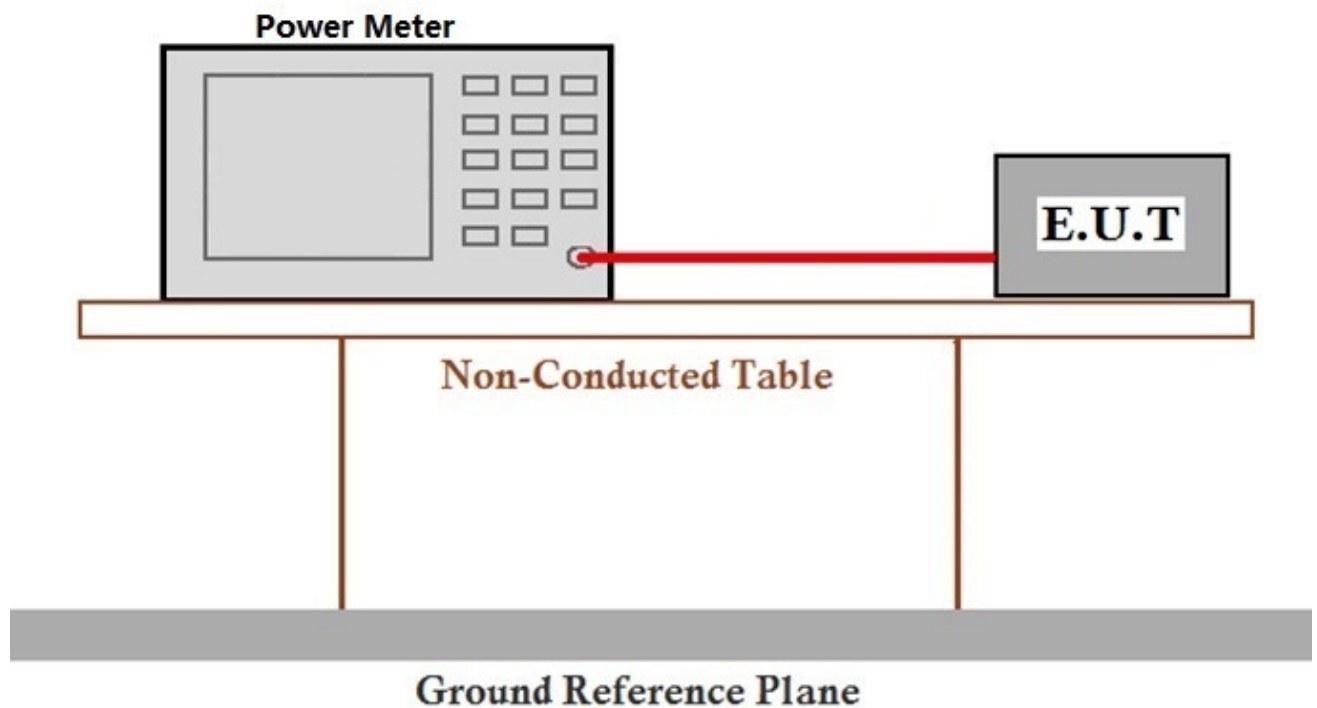
Operating Environment:

Temperature: 23.0 °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

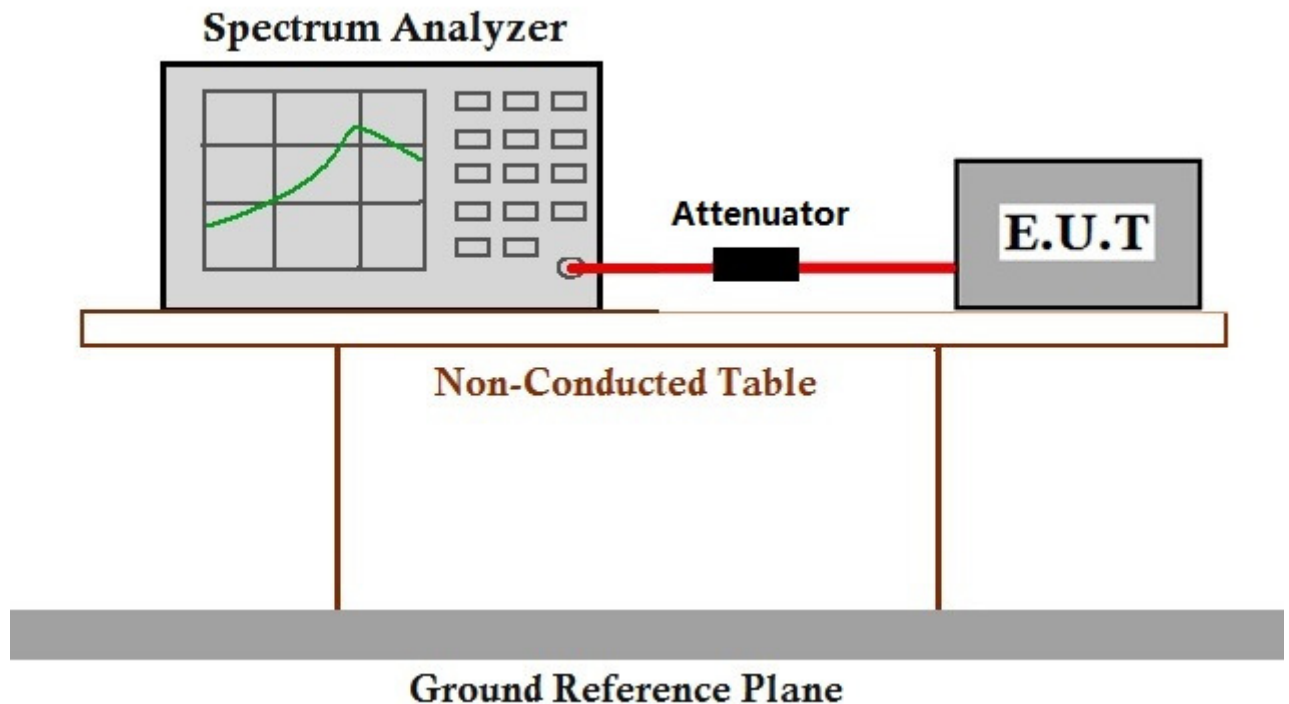
7.3 Carrier Frequencies Separation

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

7.3.1 E.U.T. Operation

Operating Environment:
Temperature: 23.0 °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.

7.3.2 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 15.247

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

Limit:

Frequency range(MHz)	Channel Number(minimum)
2400-2483.5	15

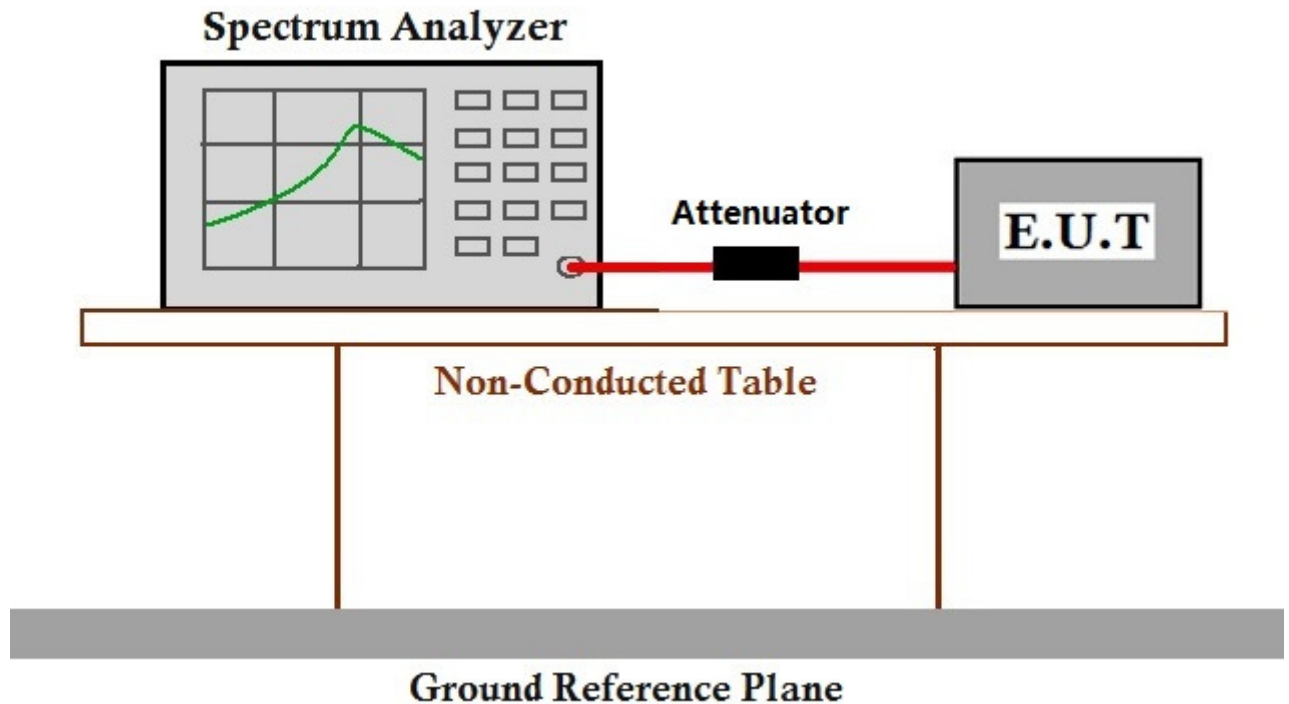
7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 23.0 °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 15.247

Test Method: ANSI C63.10 (2013) Section 7.8.4

Limit:

Frequency(MHz)	Limit
2400-2483.5	0.4S within a period of 0.4S

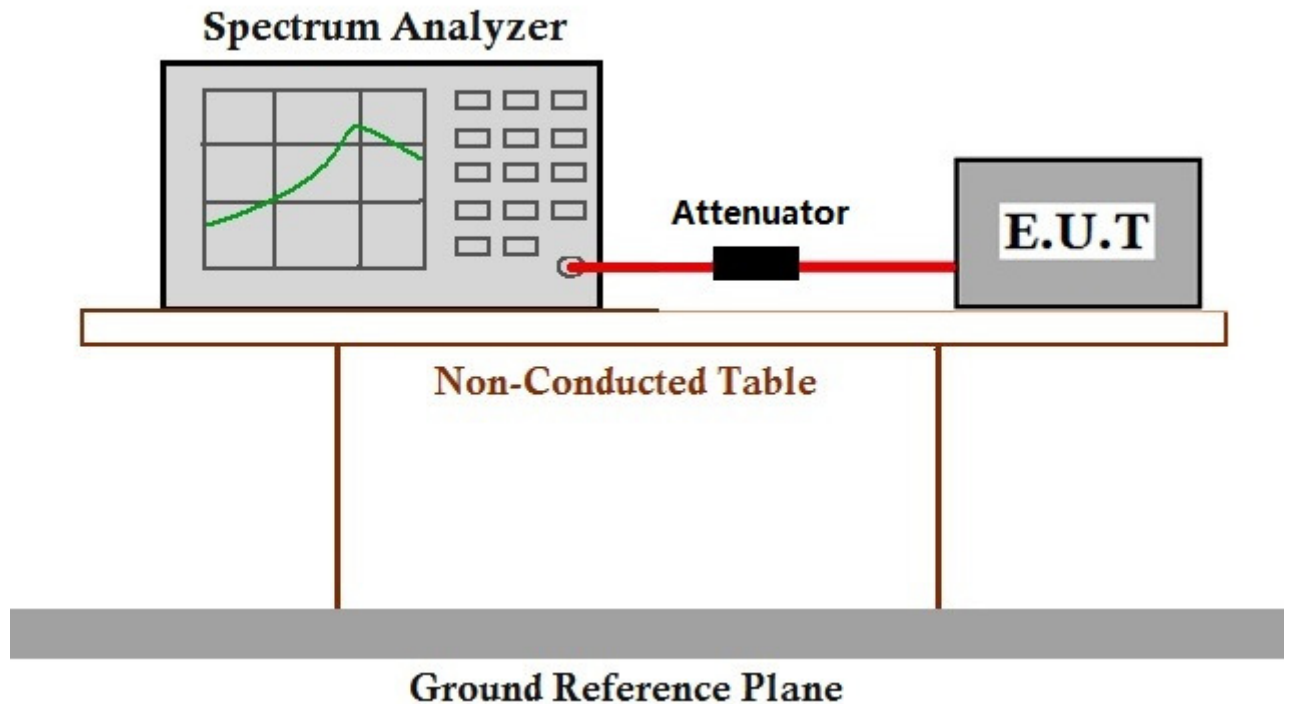
7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 23.0 °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

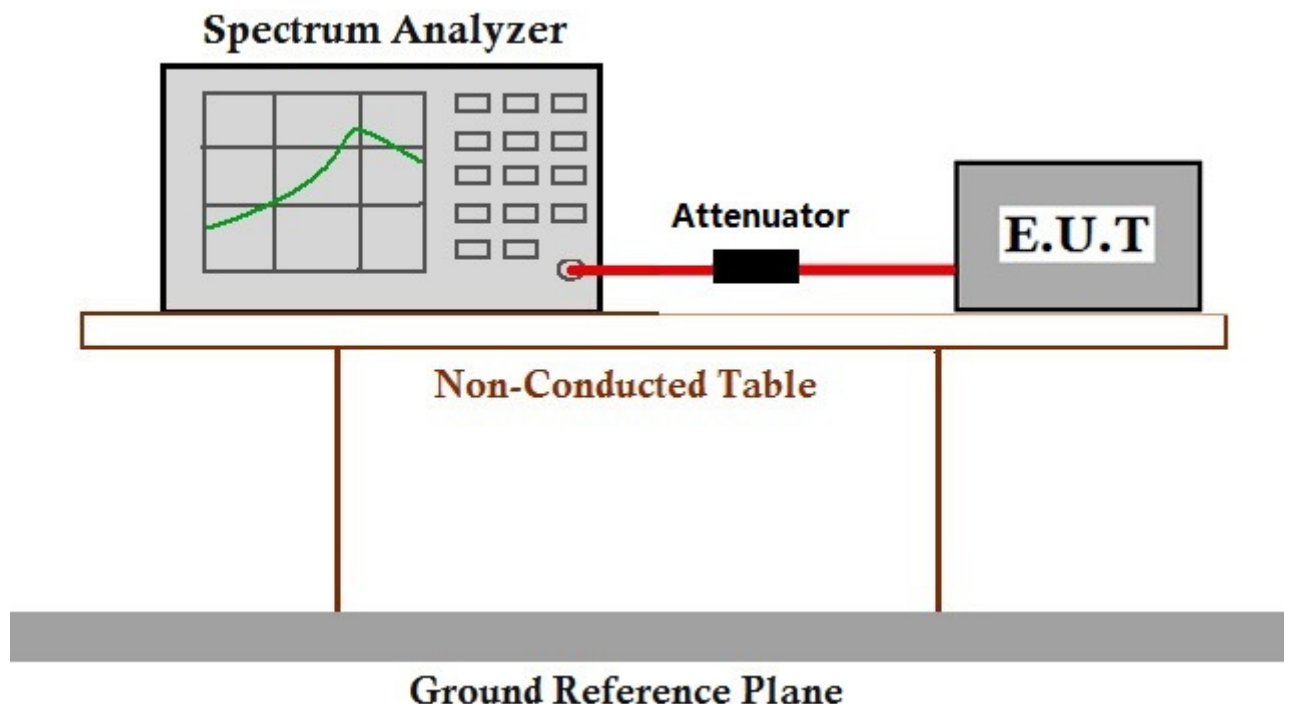
7.6 Conducted Spurious Emissions

Test Requirement: 47 CFR Part 15, Subpart C 15.247
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: 23.0 °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.

7.6.2 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 15.247
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: 24.0 °C Humidity: 54 % RH Atmospheric Pressure: 1020 mbar

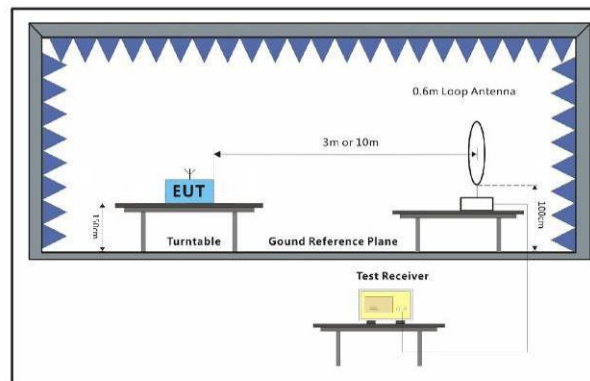
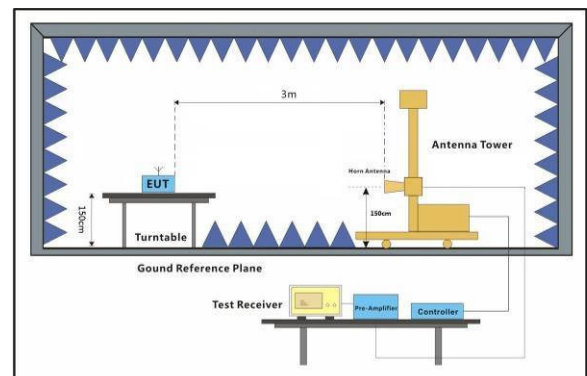
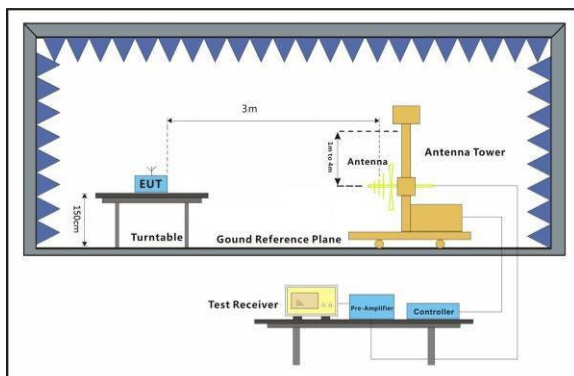
Exploratory Test Mode: Non-hopping transmitting mode with all kind of modulation and all kind of data type

Transmitting mode

Final Test Mode: Through Pre-scan, find the DH1 of data type 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. 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





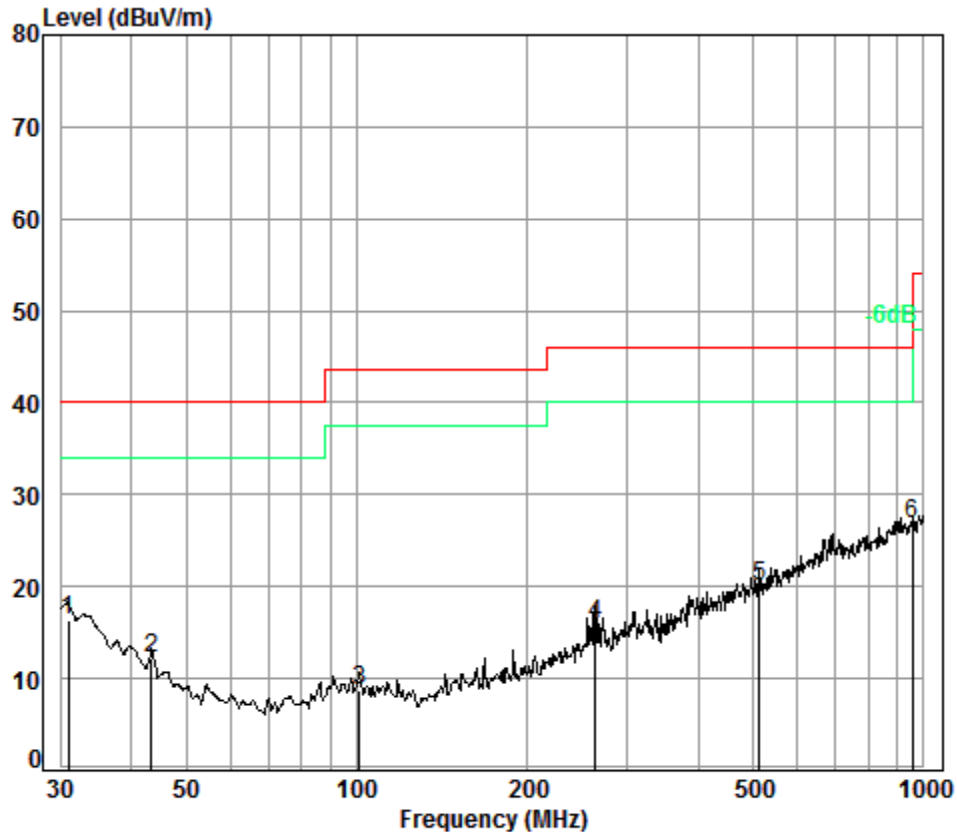
7.7.3 Measurement Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 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 full-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 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 (2402MHz), the middle channel (2441MHz), the Highest channel (2480MHz)
- 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.



Radiated Emission below 1GHz

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



Condition: 3m VERTICAL

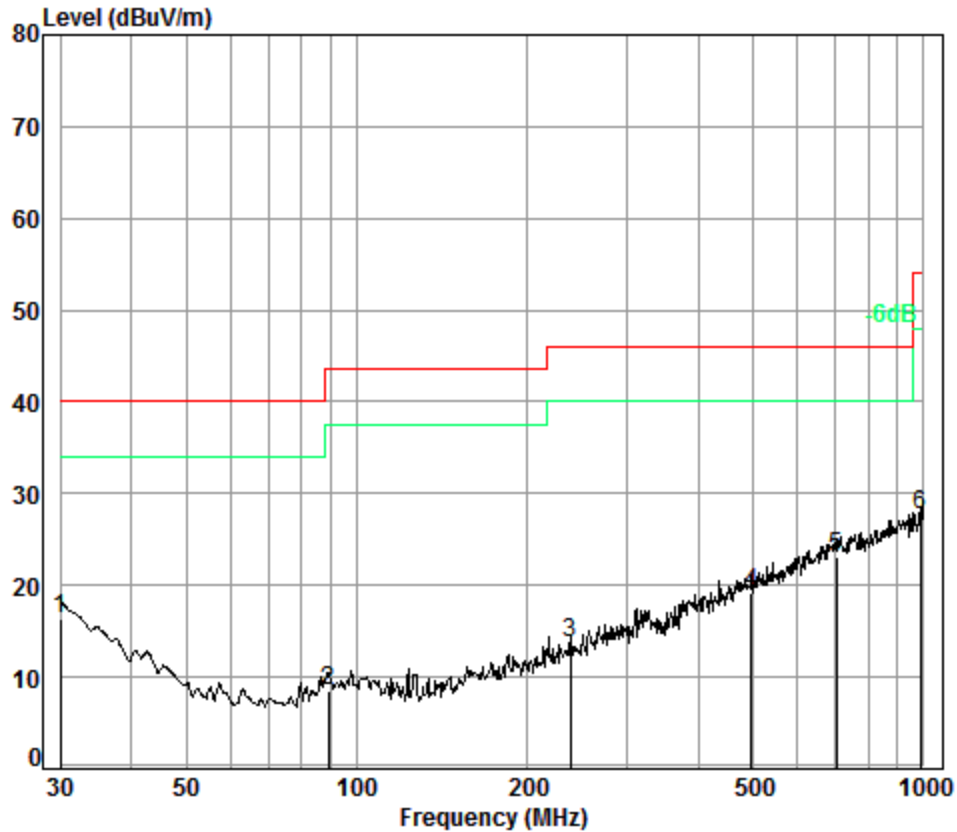
Job No. : 0601CR

Test mode: TX

	Freq	Cable Loss	Ant Factor	Preamplifier Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	30.96	0.60	18.16	27.35	24.93	16.34	40.00	-23.66
2	43.51	0.68	11.56	27.31	27.28	12.21	40.00	-27.79
3	100.93	1.20	9.05	27.19	25.63	8.69	43.50	-34.81
4	263.82	1.74	12.58	26.50	27.99	15.81	46.00	-30.19
5	513.63	2.62	18.18	27.67	26.84	19.97	46.00	-26.03
6 pp	955.44	3.66	23.30	26.51	26.26	26.71	46.00	-19.29



Test mode:	Transmitting	Horizontal
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Condition: 3m HORIZONTAL

Job No. : 0601CR

Test mode: TX

	Freq	Cable Loss	Ant Factor	Preamplifier Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	30.00	0.60	18.70	27.36	24.49	16.43	40.00	-23.57
2	89.28	1.10	8.63	27.22	26.04	8.55	43.50	-34.95
3	238.31	1.62	11.93	26.57	26.67	13.65	46.00	-32.35
4	497.68	2.59	17.80	27.70	26.45	19.14	46.00	-26.86
5 pp	701.76	2.91	21.60	27.41	25.95	23.05	46.00	-22.95
6	986.07	3.69	23.74	26.37	26.55	27.61	54.00	-26.39



Transmitter Emission above 1GHz

Test mode:		GFSK(DH1)		Test channel:		Lowest		Remark:	Peak
Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization	
3563.687	32.39	7.65	37.96	45.21	47.29	74	-26.71	Vertical	
4804.000	34.16	8.87	38.40	43.31	47.94	74	-26.06	Vertical	
5786.418	34.58	9.96	38.34	44.64	50.84	74	-23.16	Vertical	
7206.000	36.42	10.68	37.11	41.36	51.35	74	-22.65	Vertical	
9608.000	37.52	12.50	35.10	37.80	52.72	74	-21.28	Vertical	
12137.940	38.68	14.45	35.93	35.92	53.12	74	-20.88	Vertical	
3732.570	32.87	7.72	37.97	45.37	47.99	74	-26.01	Horizontal	
4804.000	34.16	8.87	38.40	44.34	48.97	74	-25.03	Horizontal	
5836.872	34.60	10.10	38.33	43.67	50.04	74	-23.96	Horizontal	
7206.000	36.42	10.68	37.11	42.01	52.00	74	-22.00	Horizontal	
9608.000	37.52	12.50	35.10	37.35	52.27	74	-21.73	Horizontal	
12137.940	38.68	14.45	35.93	36.66	53.86	74	-20.14	Horizontal	

Test mode:		GFSK(DH1)		Test channel:		Middle		Remark:	Peak
Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Over limit (dB)	Polarization	
3831.060	33.15	7.75	37.98	44.84	47.76	74	-26.24	Vertical	
4882.000	34.30	8.98	38.44	43.20	48.04	74	-25.96	Vertical	
5947.702	34.67	10.42	38.31	43.94	50.72	74	-23.28	Vertical	
7323.000	36.37	10.72	37.01	41.60	51.68	74	-22.32	Vertical	
9764.000	37.55	12.58	35.02	37.17	52.28	74	-21.72	Vertical	
12190.740	38.72	14.40	36.06	36.00	53.06	74	-20.94	Vertical	
3842.163	33.18	7.76	37.98	45.20	48.16	74	-25.84	Horizontal	
4882.000	34.30	8.98	38.44	43.83	48.67	74	-25.33	Horizontal	
5956.314	34.67	10.44	38.31	43.42	50.22	74	-23.78	Horizontal	
7323.000	36.37	10.72	37.01	41.41	51.49	74	-22.51	Horizontal	
9764.000	37.55	12.58	35.02	37.76	52.87	74	-21.13	Horizontal	
12243.770	38.75	14.36	36.19	36.29	53.21	74	-20.79	Horizontal	



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Test mode:		GFSK(DH1)		Test channel:		Highest		Remark:	Peak
Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Over limit (dB)	Polarization	
3754.236	32.94	7.72	37.98	44.89	47.57	74	-26.43	Vertical	
4960.000	34.43	9.09	38.48	43.21	48.25	74	-25.75	Vertical	
6051.874	34.74	10.49	38.25	43.42	50.40	74	-23.60	Vertical	
7440.000	36.32	10.77	36.90	41.53	51.72	74	-22.28	Vertical	
9920.000	37.58	12.67	34.94	36.95	52.26	74	-21.74	Vertical	
12368.410	38.82	14.26	36.48	36.61	53.21	74	-20.79	Vertical	
3853.298	33.21	7.76	37.99	45.29	48.27	74	-25.73	Horizontal	
4960.000	34.43	9.09	38.48	44.67	49.71	74	-24.29	Horizontal	
6016.949	34.71	10.54	38.28	44.79	51.76	74	-22.24	Horizontal	
7440.000	36.32	10.77	36.90	40.73	50.92	74	-23.08	Horizontal	
9920.000	37.58	12.67	34.94	36.74	52.05	74	-21.95	Horizontal	
12386.320	38.83	14.24	36.53	36.56	53.10	74	-20.90	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 15.247
Test Method: ANSI C63.10 (2013) Section 6.10.5
Measurement Distance: 3m

7.8.1 E.U.T. Operation

Operating Environment:

Temperature: 24.0 °C Humidity: 55 % 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 DH5 of data type and GFSK modulation is the worst case.

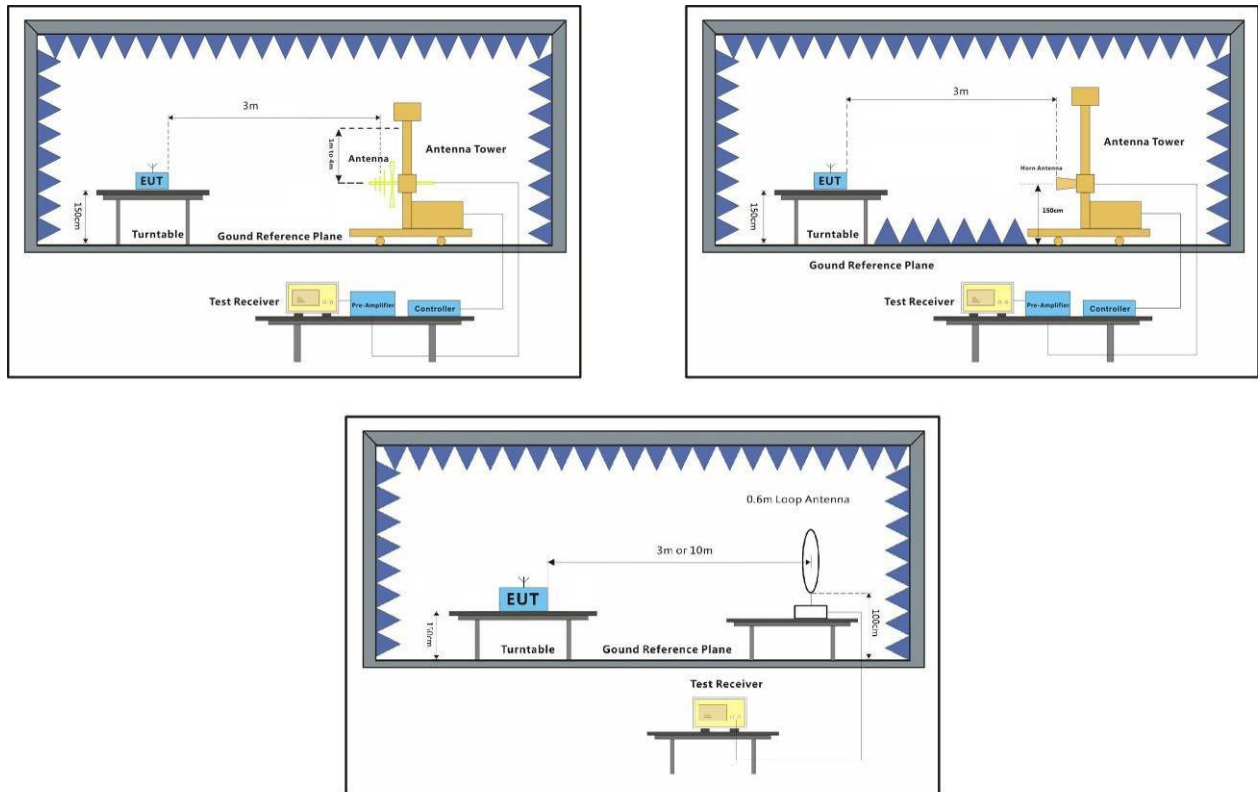
Only the worst case is recorded in the report.

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.

7.8.2 Test Setup Diagram

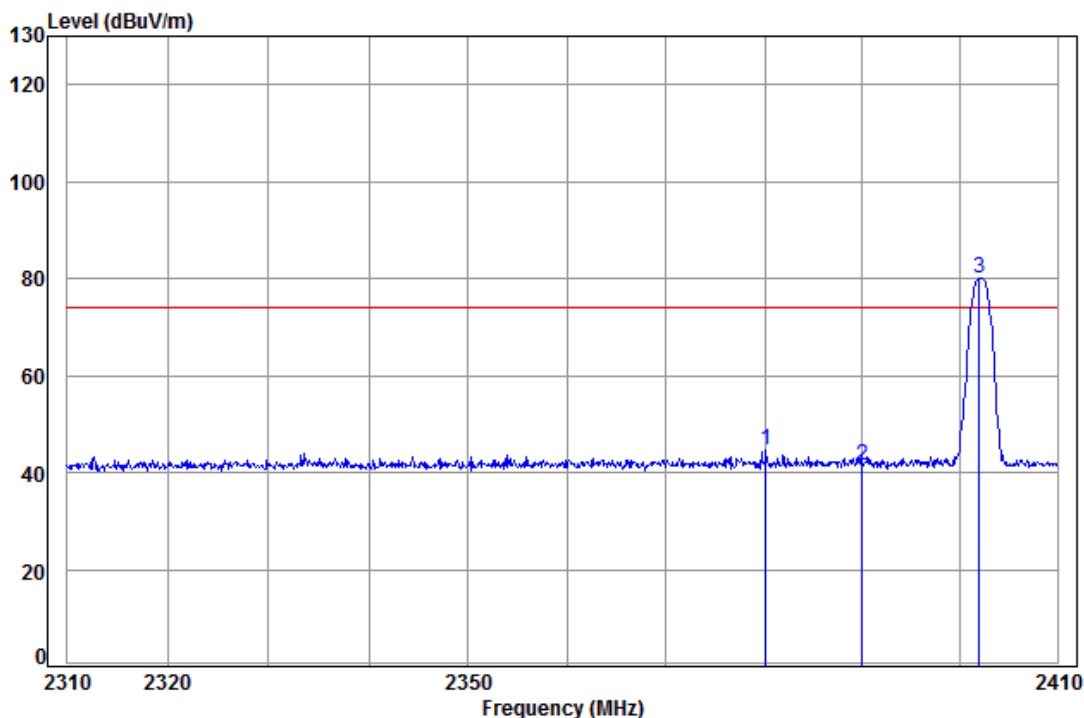


7.8.3 Measurement Data

- For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 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.
- 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.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 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.
- Test the EUT in the lowest channel (2402MHz), the middle channel (2441MHz), the Highest channel (2480MHz)
- 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.
- Repeat above procedures until all frequencies measured was complete.



Worse case mode:	GFSK (DH5)	Test channel:	Lowest	Remark:	Peak	Vertical
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Condition: 3m VERTICAL
Job No: : 00601CR
Mode: : 2402 Bandedge
: BT

	Freq	Cable	Ant	Preamp	Read	Limit	Over	
	MHz	Loss	Factor	Factor	Level	Line	Limit	Remark
		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2380.159	5.33	29.05	37.96	48.19	44.61	74.00	-29.39
2	2390.000	5.34	29.08	37.96	45.15	41.61	74.00	-32.39
3 pp	2401.945	5.35	29.11	37.96	83.53	80.03	74.00	6.03

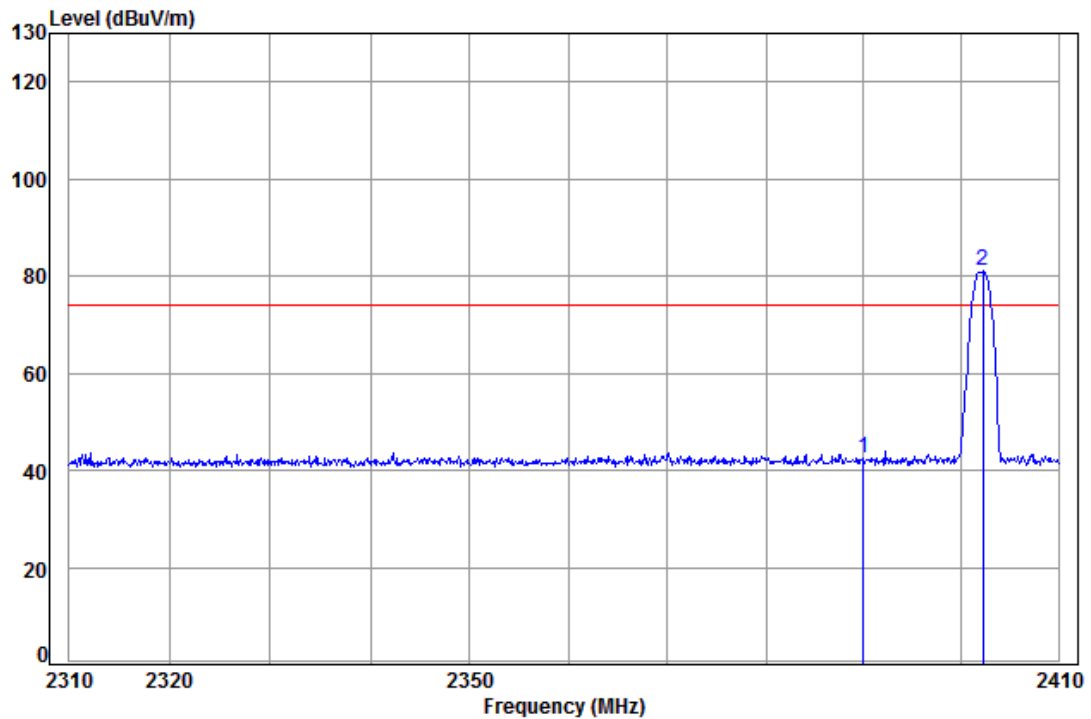


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Worse case mode:	GFSK (DH5)	Test channel:	Lowest	Remark:	Peak	Horizontal
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Condition: 3m HORIZONTAL

Job No: : 00601CR

Mode: : 2402 Bandedge

: BT

	Freq	Cable	Ant	Preamp	Read	Limit	Over	
	MHz	Loss	Factor	Factor	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2390.000	5.34	29.08	37.96	46.00	42.46	74.00	-31.54
2 pp	2402.250	5.35	29.11	37.96	84.49	80.99	74.00	6.99

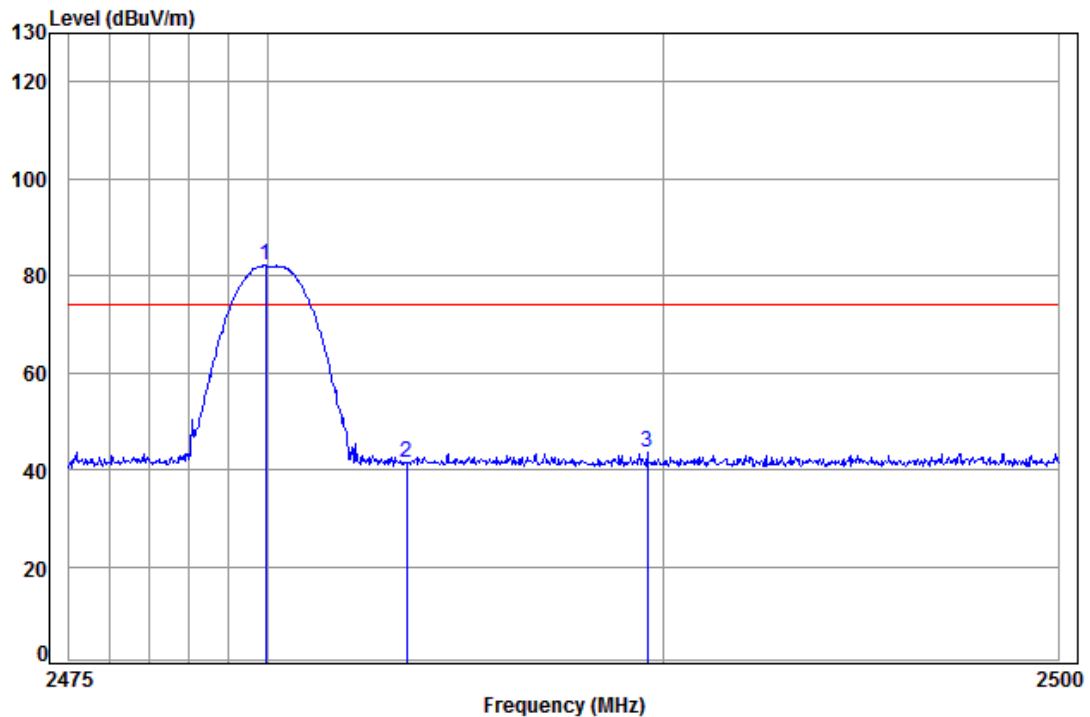


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Worse case mode:	GFSK (DH5)	Test channel:	Highest	Remark:	Peak	Vertical
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Condition: 3m VERTICAL
Job No: : 00601CR
Mode: : 2480 Bandedge
: BT

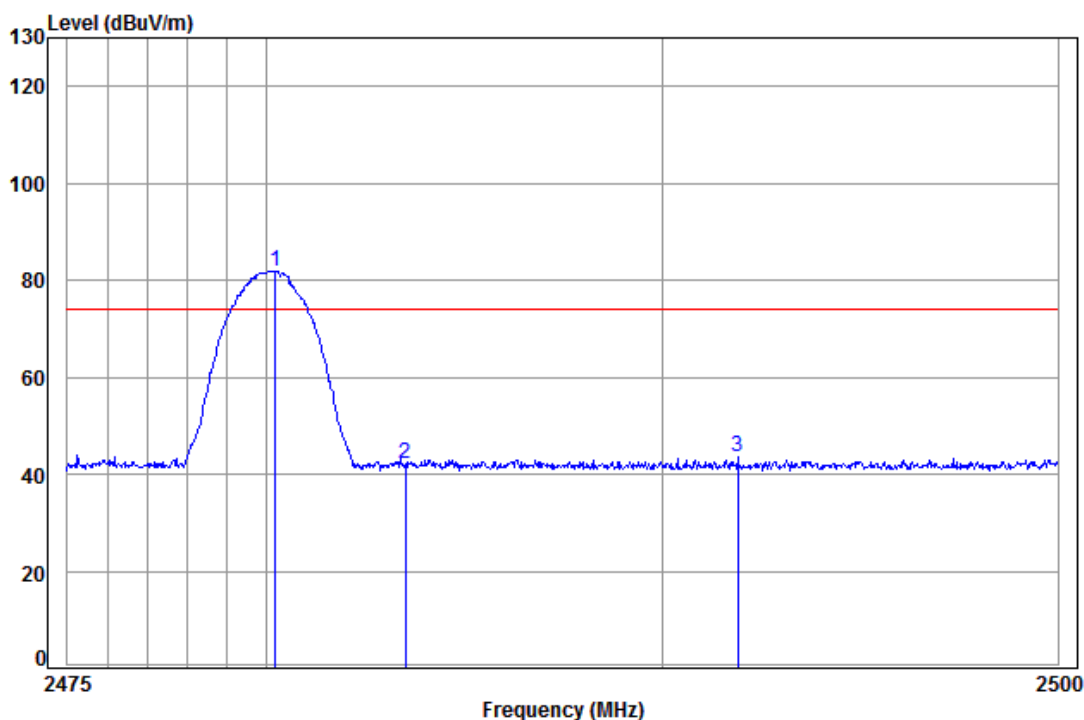
	Freq	Cable	Ant	Preamp	Read	Limit	Over	
	MHz	Loss	Factor	Factor	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1 pp	2479.955	5.41	29.34	37.95	85.24	82.04	74.00	8.04
2	2483.500	5.41	29.35	37.95	44.77	41.58	74.00	-32.42
3	2489.594	5.41	29.37	37.95	46.61	43.44	74.00	-30.56



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Worse case mode:	GFSK(DH5)	Test channel:	Highest	Remark:	Peak	Horizontal
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Condition: 3m HORIZONTAL
Job No: : 00601CR
Mode: : 2480 Bandedge
: BT

	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 pp	2480.229	5.41	29.34	37.95	84.91	81.71	74.00	7.71	
2	2483.500	5.41	29.35	37.95	45.21	42.02	74.00	-31.98	
3	2491.897	5.41	29.38	37.95	46.68	43.52	74.00	-30.48	

Note:

The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

$$\text{Final Test Level} = \text{Receiver Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Preamplifier Factor}$$

7.9 Conducted Band Edges Measurement

Test Requirement: 47 CFR Part 15, Subpart C 15.247
Test Method: ANSI C63.10 (2013) Section 7.8.6

7.9.1 E.U.T. Operation

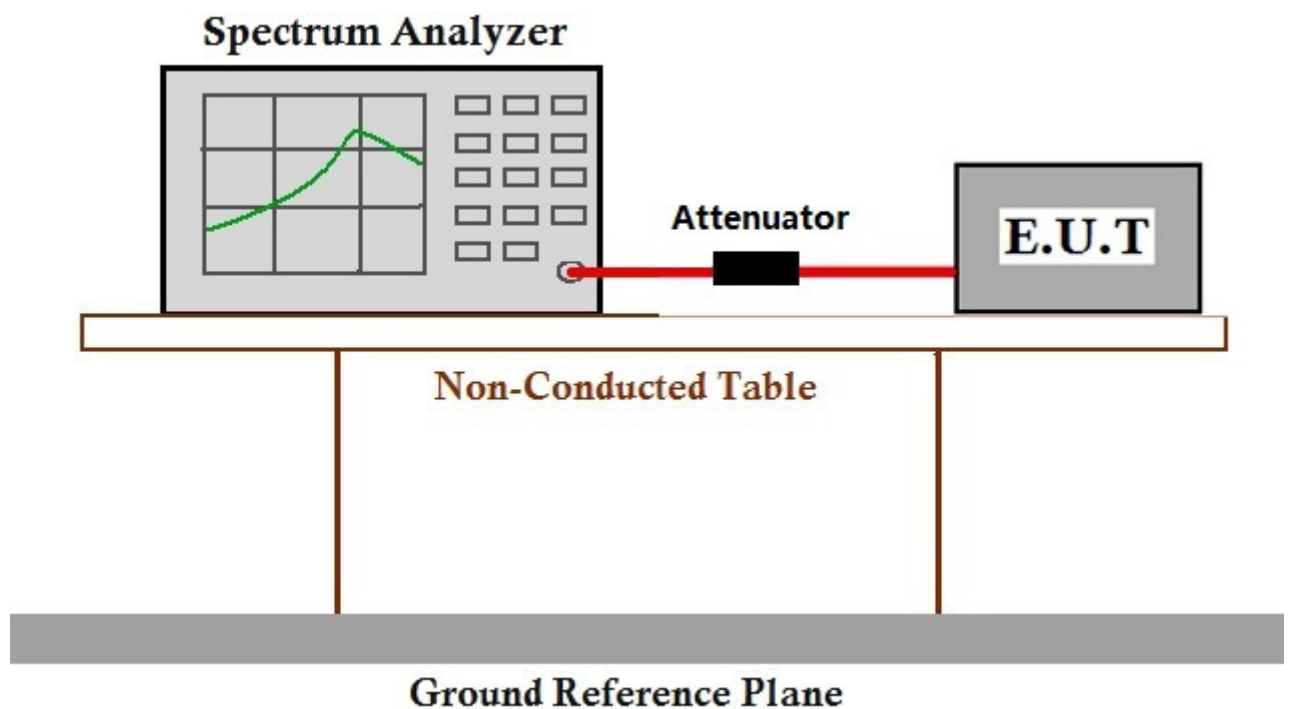
Operating Environment:

Temperature: 23.0 °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 Appendix

8.1 Appendix 15.247

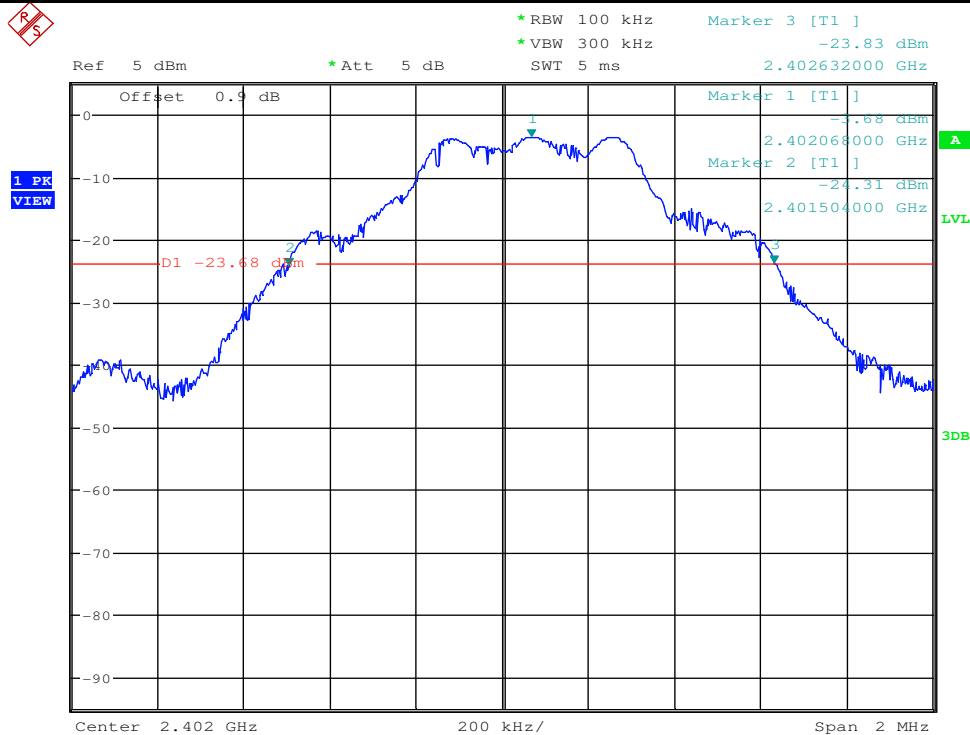
1.20 dB Bandwidth

Test Mode	Test Channel	EBW[MHz]	Limit[MHz]	Verdict
DH5	2402	1.128	---	PASS
DH5	2441	1.138	---	PASS
DH5	2480	1.134	---	PASS
2DH5	2402	1.132	---	PASS
2DH5	2441	1.136	---	PASS
2DH5	2480	1.140	---	PASS
3DH5	2402	1.136	---	PASS
3DH5	2441	1.132	---	PASS
3DH5	2480	1.124	---	PASS

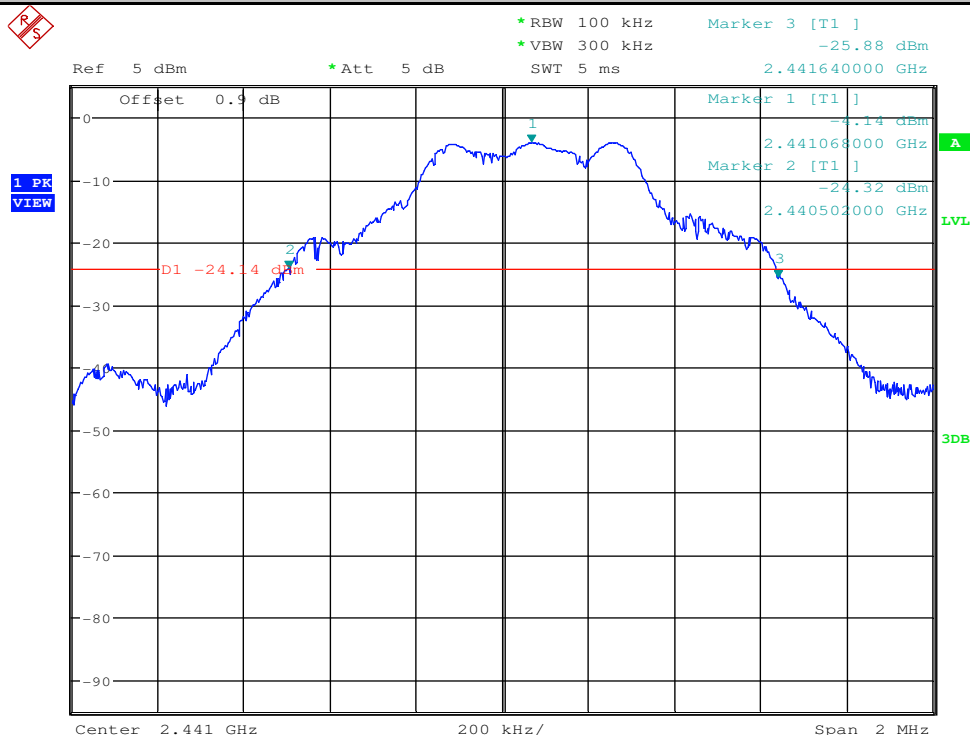


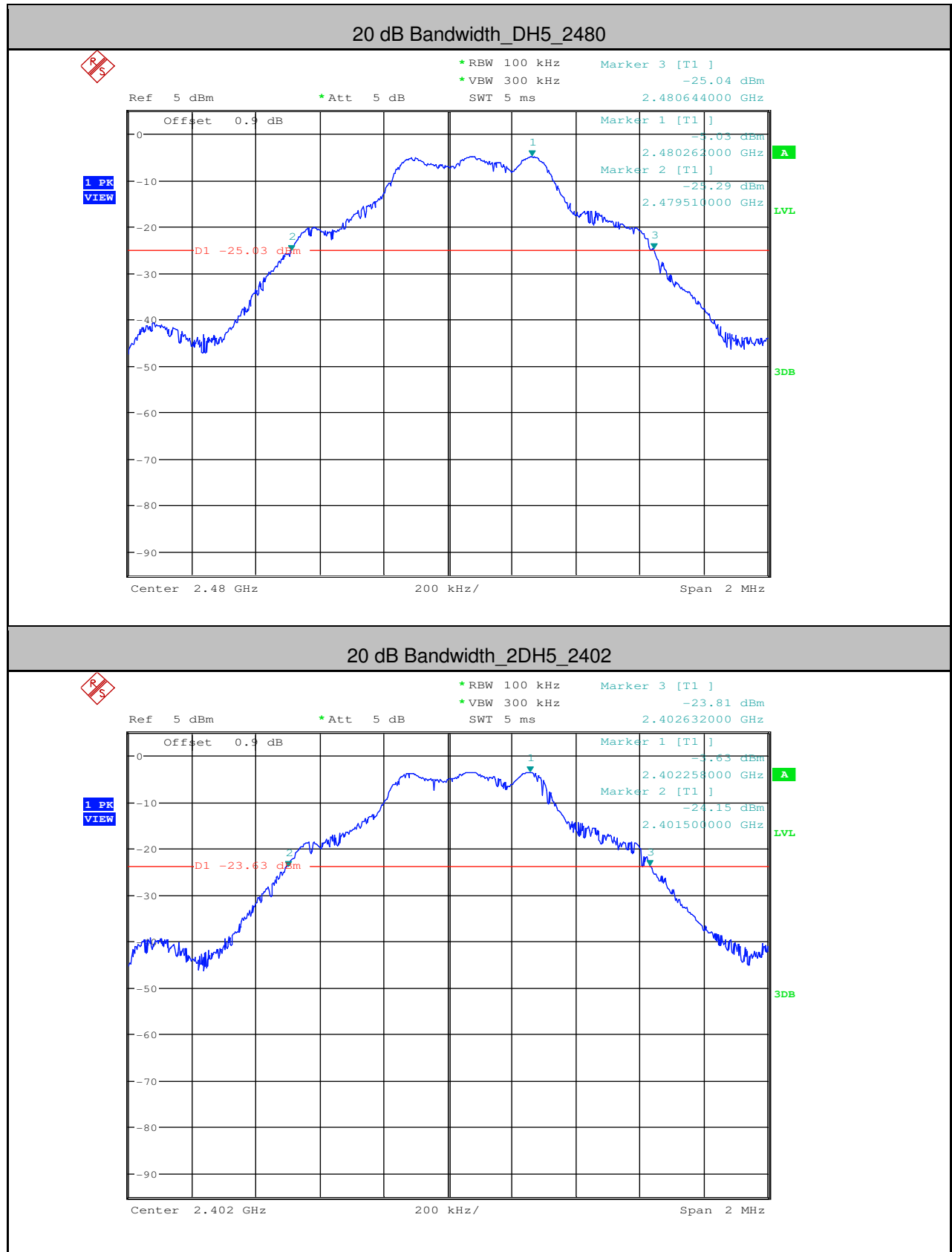
TEST PLOT

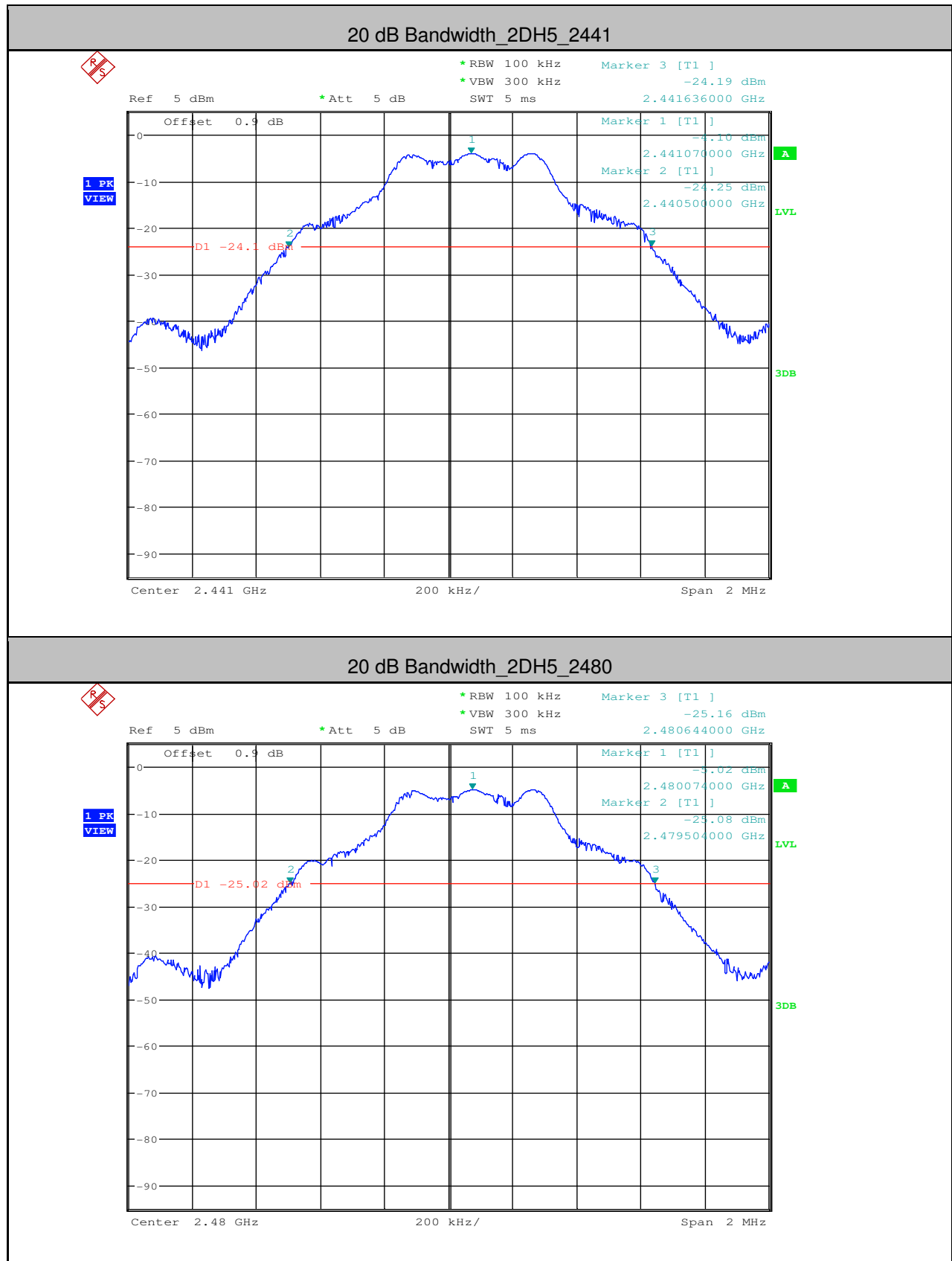
20 dB Bandwidth_DH5_2402



20 dB Bandwidth_DH5_2441

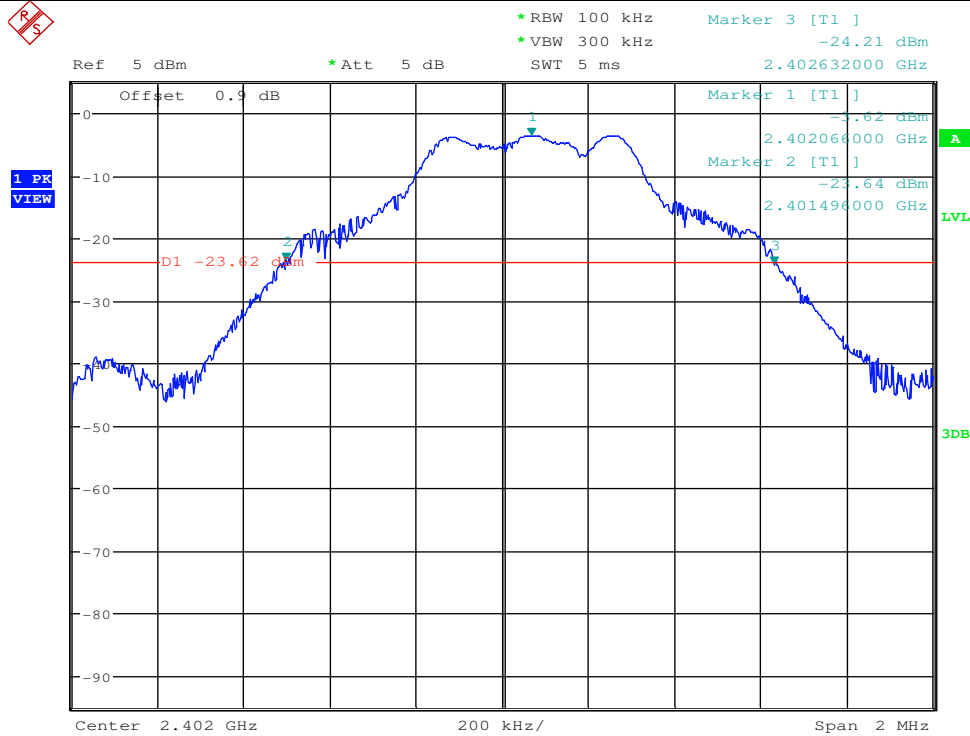




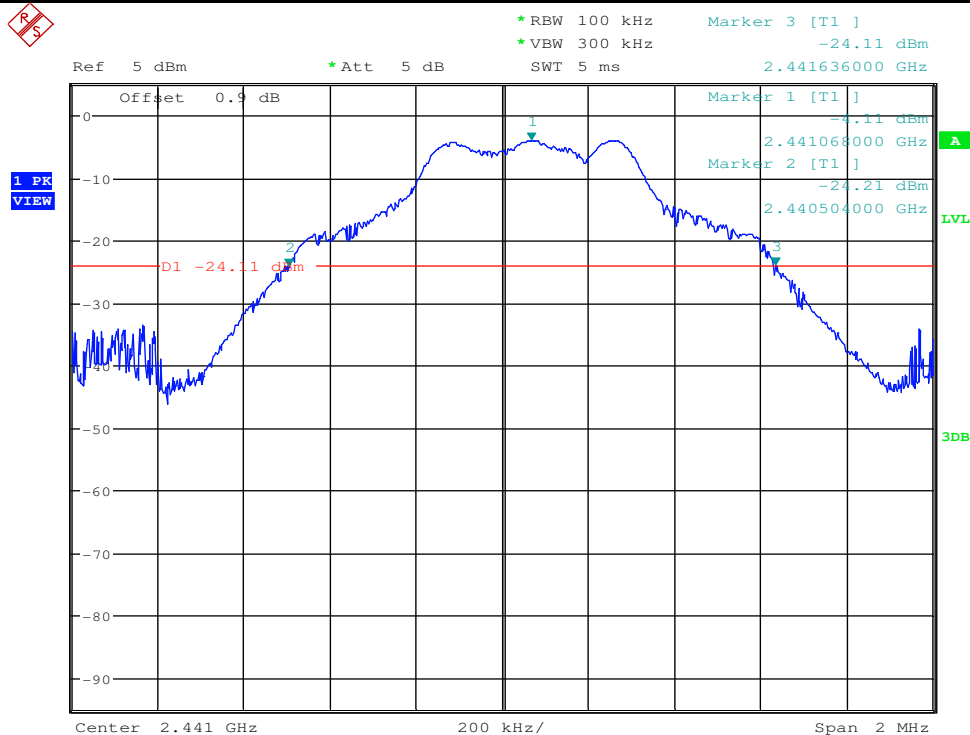


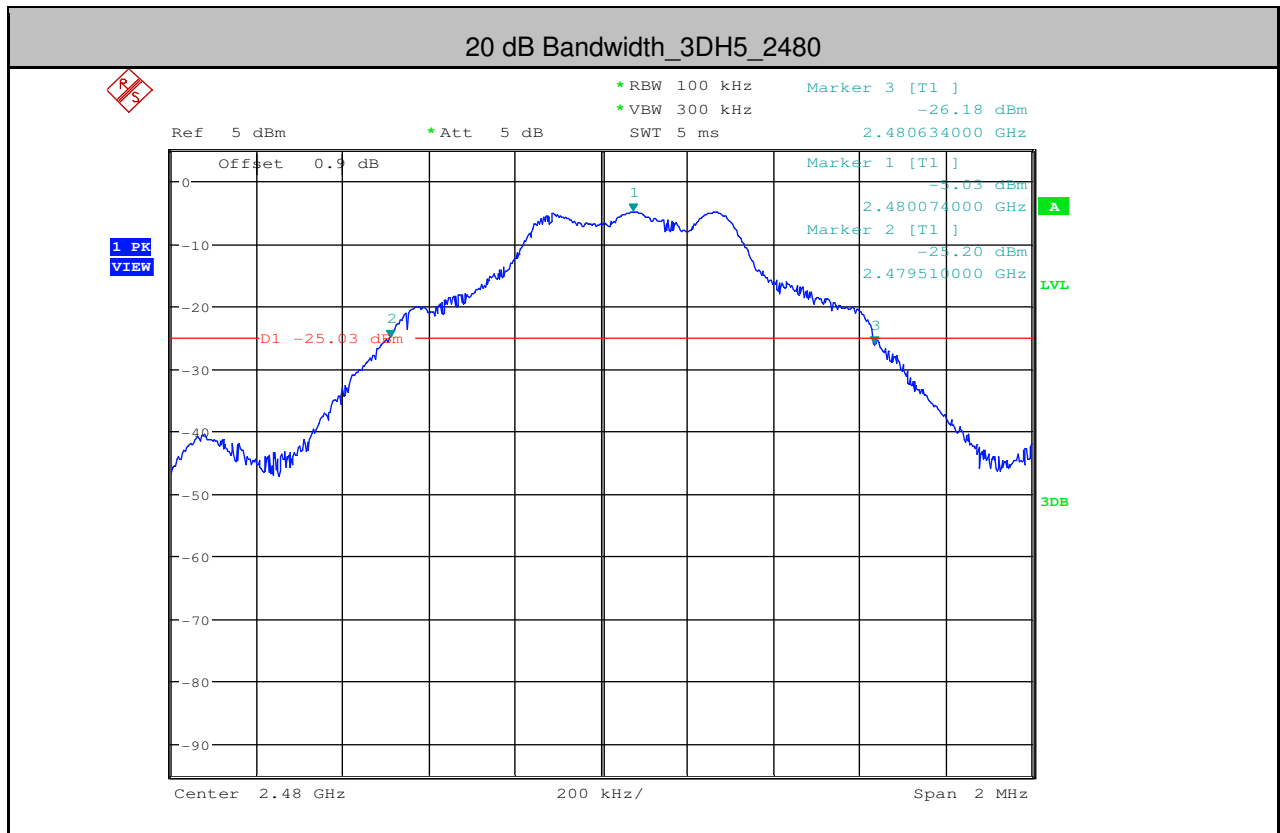


20 dB Bandwidth_3DH5_2402



20 dB Bandwidth_3DH5_2441

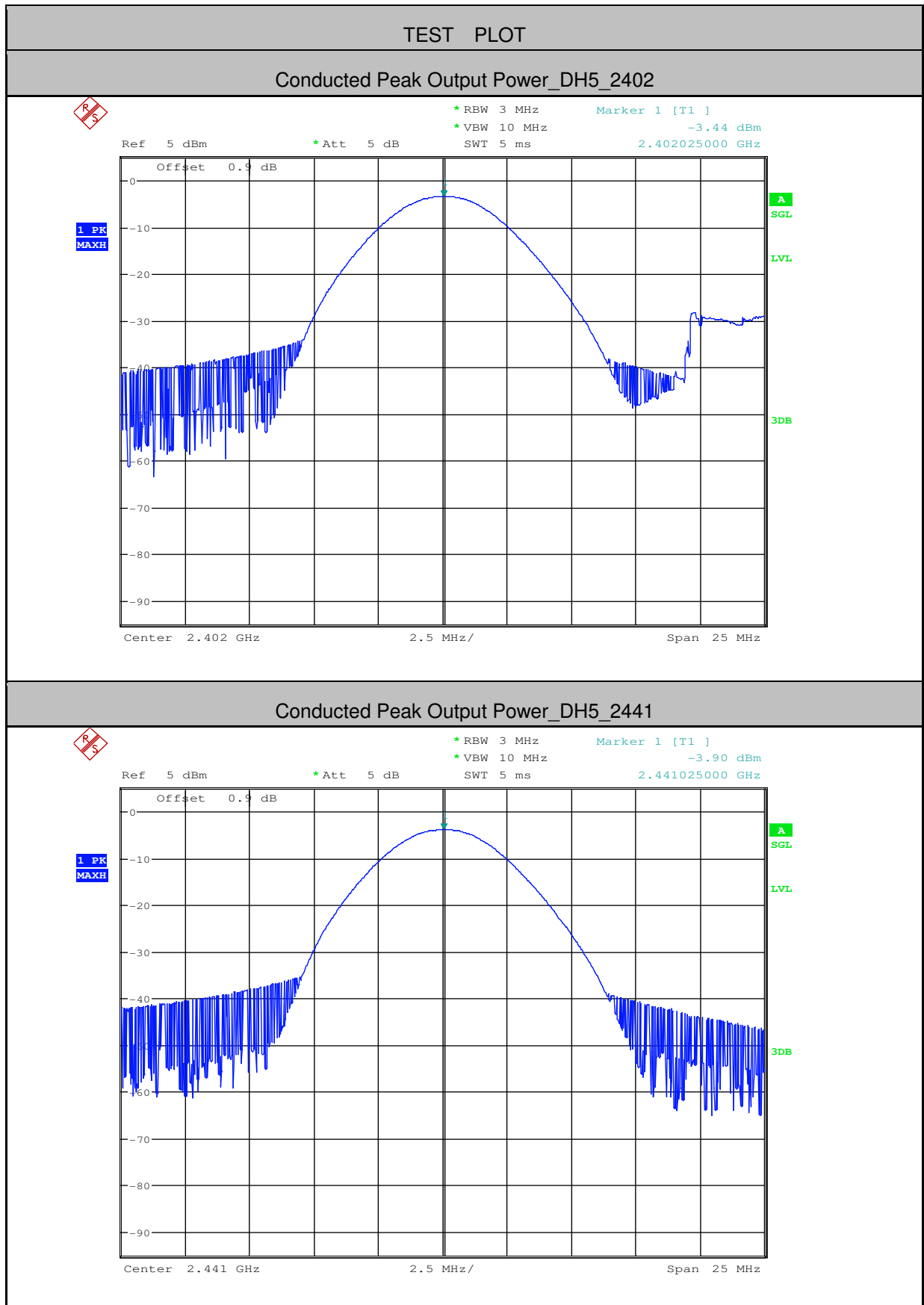






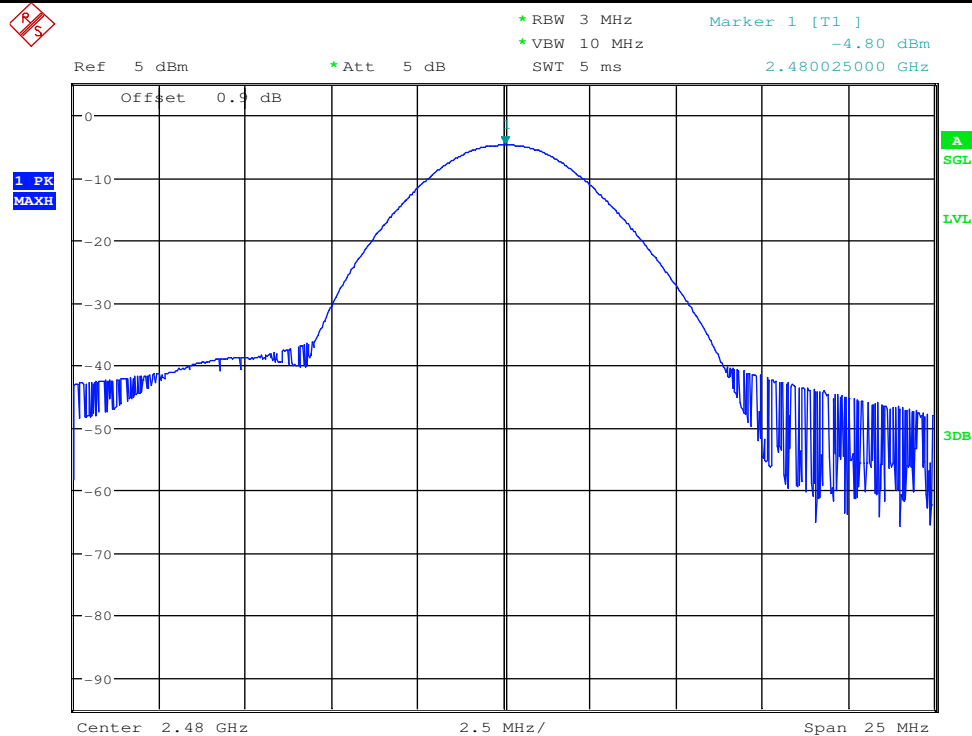
2. Conducted Peak Output Power

Test Mode	Test Channel	Power[dBm]	Limit[dBm]	Verdict
DH5	2402	-3.44	<20.97	PASS
DH5	2441	-3.9	<20.97	PASS
DH5	2480	-4.8	<20.97	PASS
2DH5	2402	-3.42	<20.97	PASS
2DH5	2441	-3.88	<20.97	PASS
2DH5	2480	-4.78	<20.97	PASS
3DH5	2402	-3.41	<20.97	PASS
3DH5	2441	-3.67	<20.97	PASS
3DH5	2480	-4.8	<20.97	PASS

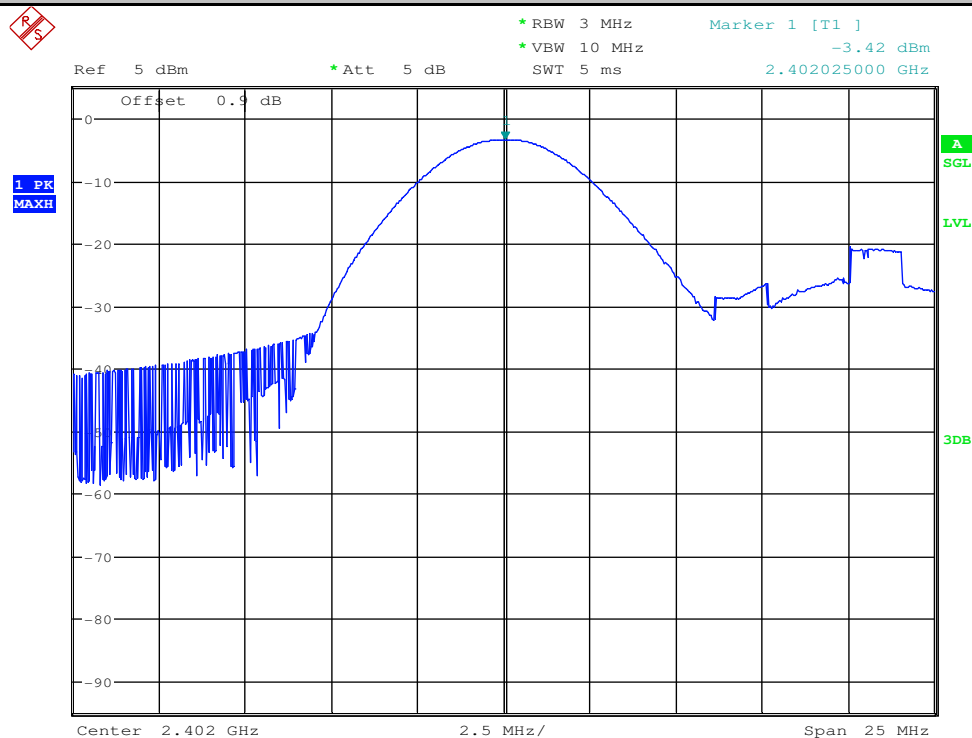




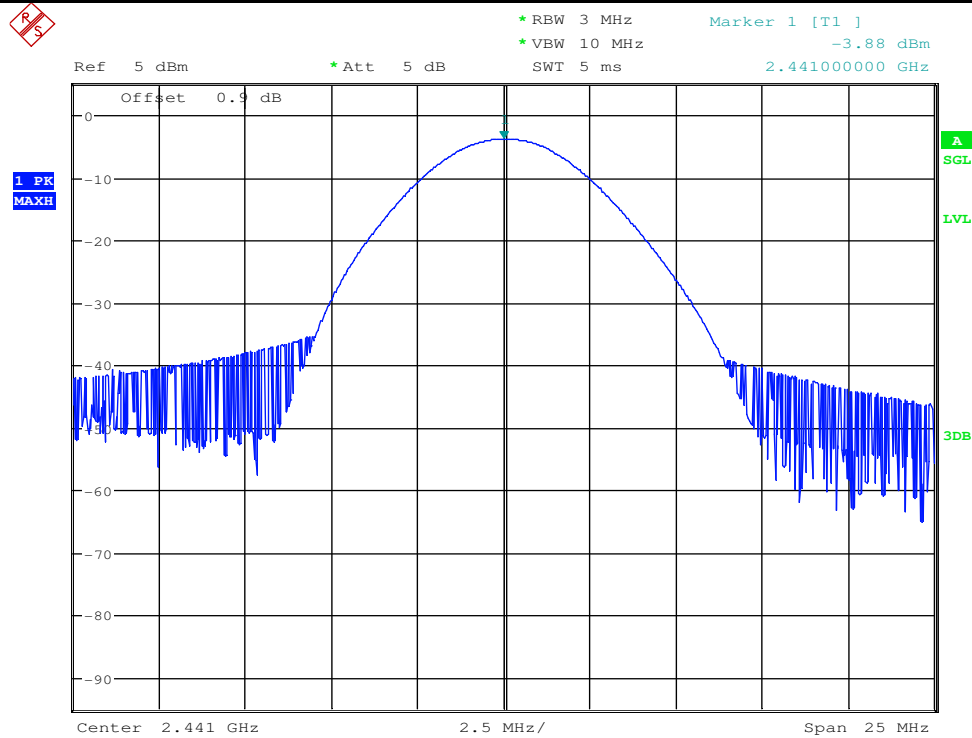
Conducted Peak Output Power_DH5_2480



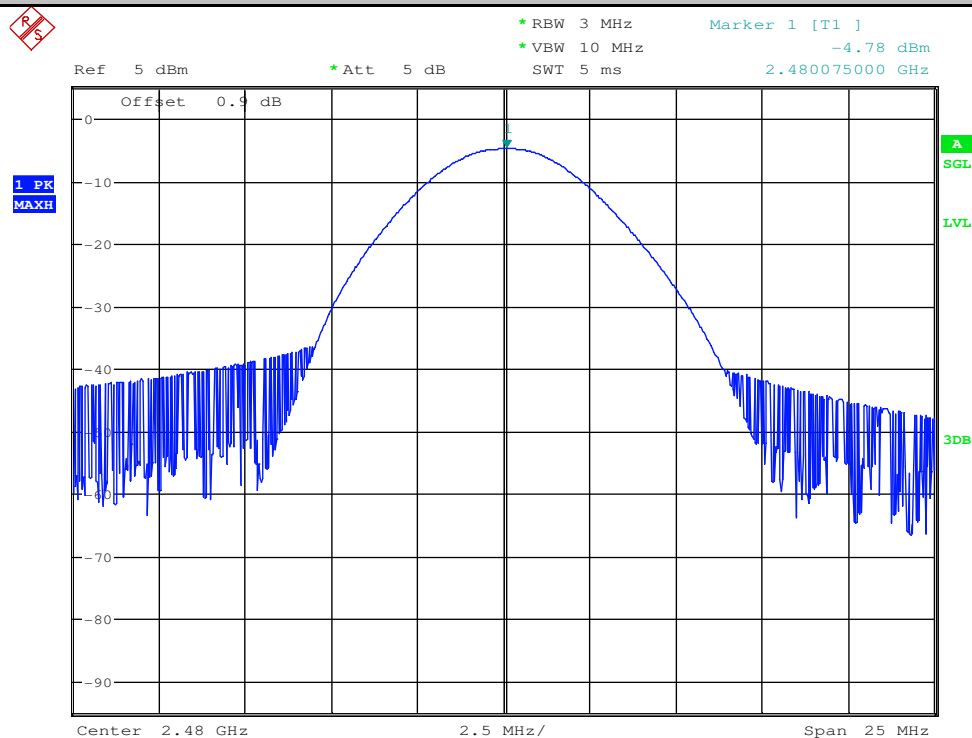
Conducted Peak Output Power_2DH5_2402



Conducted Peak Output Power_2DH5_2441

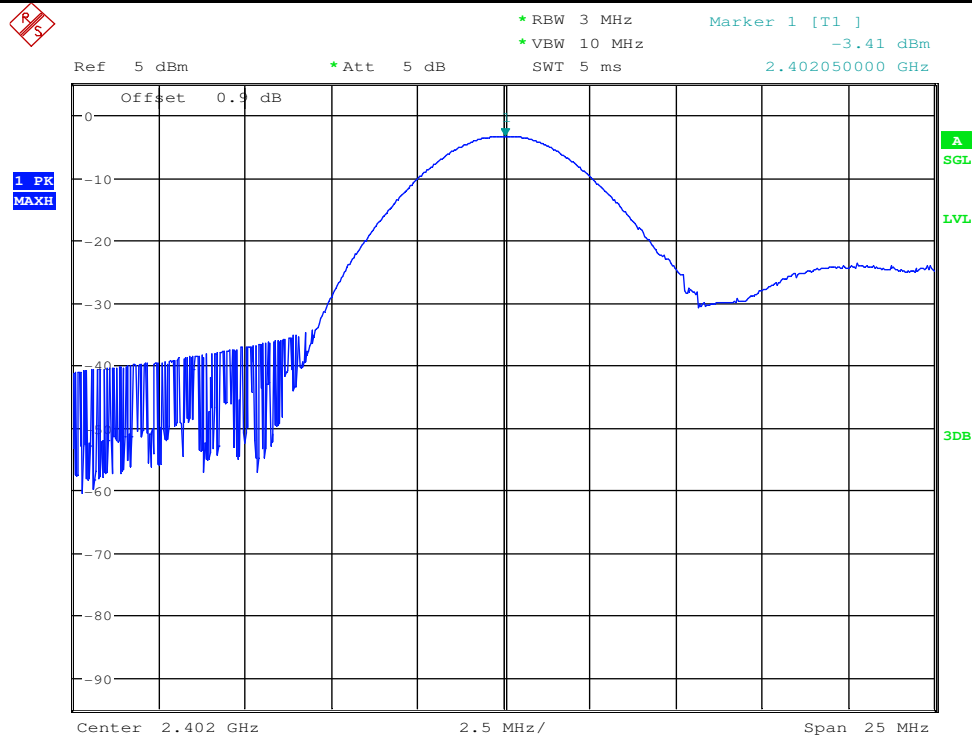


Conducted Peak Output Power_2DH5_2480

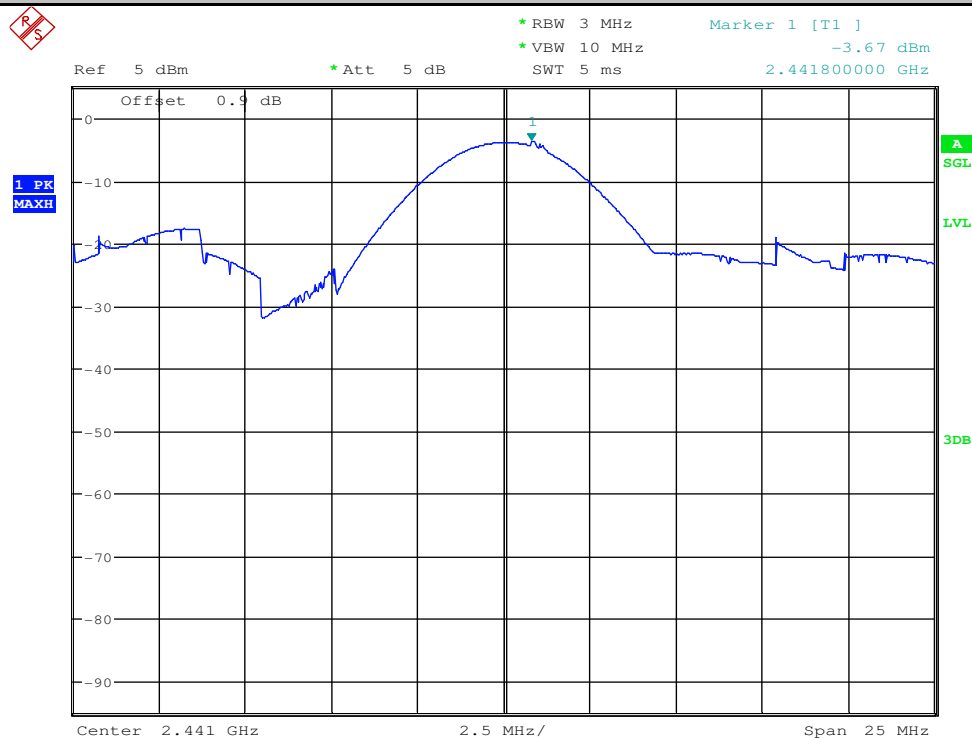


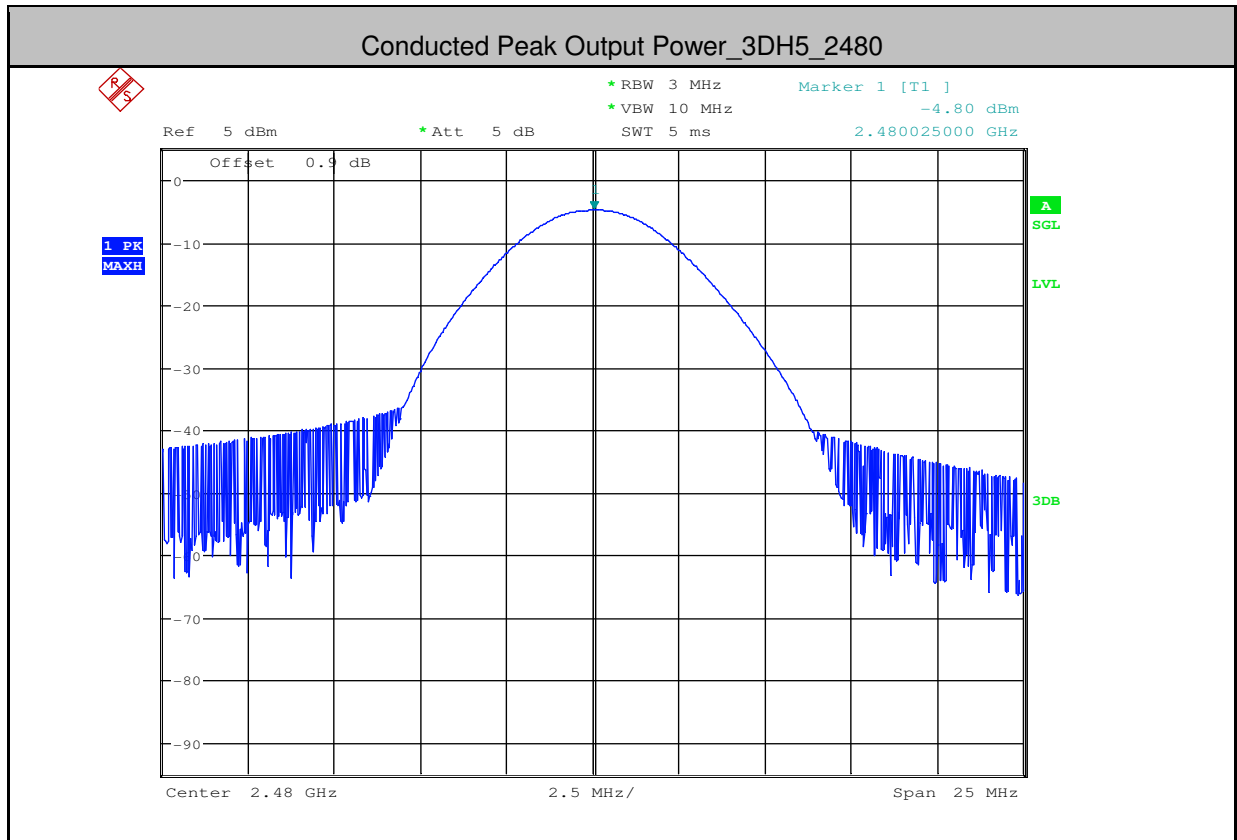


Conducted Peak Output Power_3DH5_2402



Conducted Peak Output Power_3DH5_2441

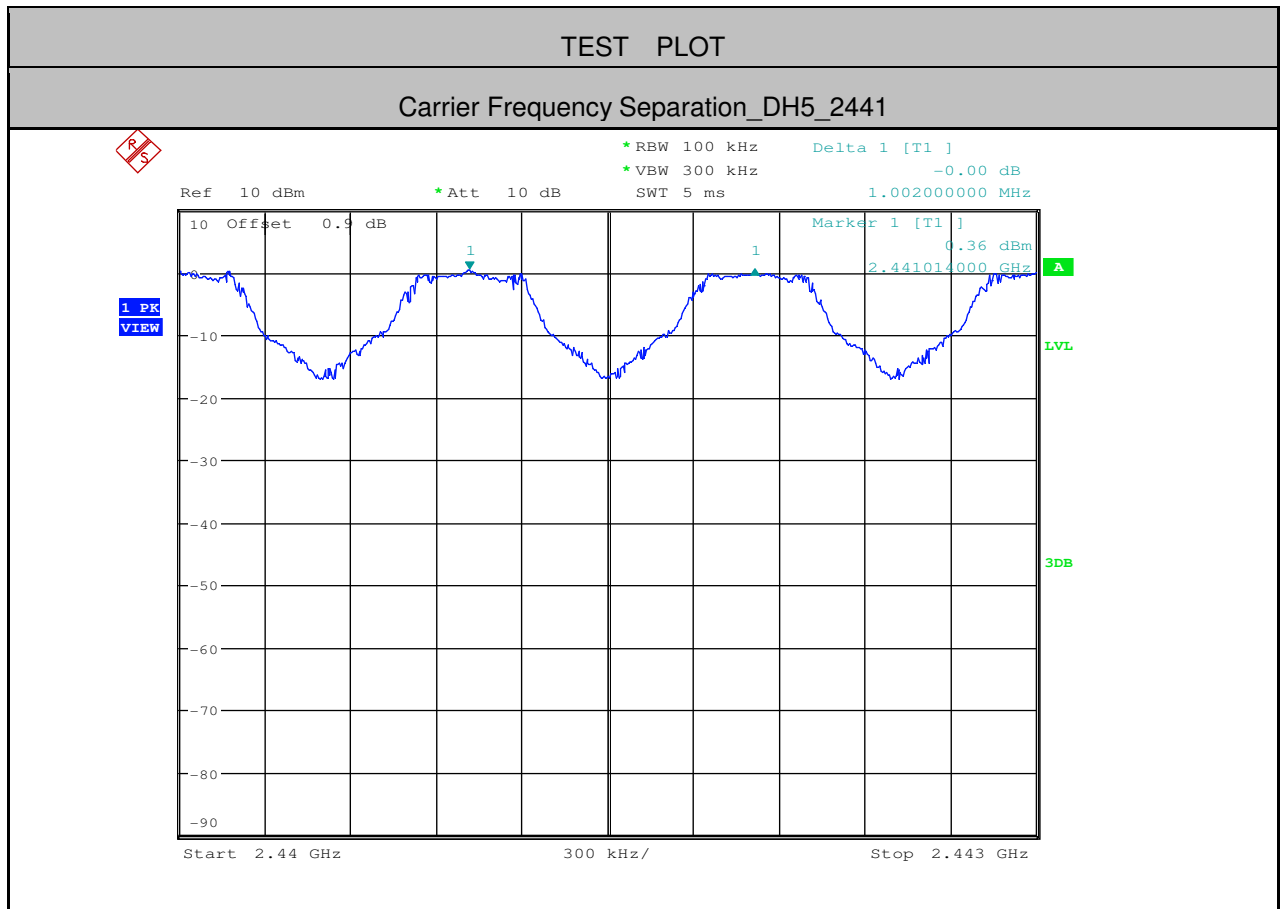


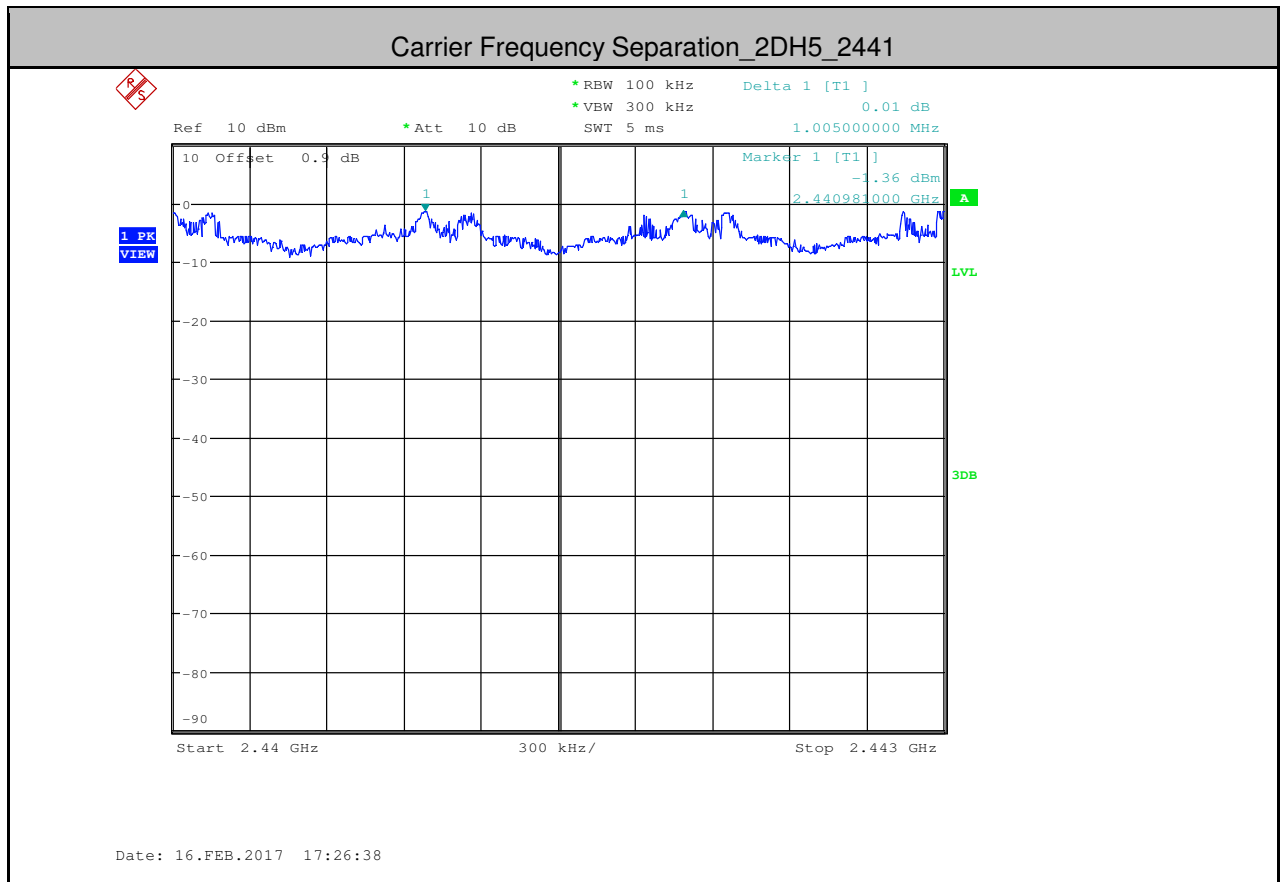




3.Carrier Frequency Separation

Test Mode	Test Channel	Result[MHz]	Limit[MHz]	Verdict
DH5	2441	1.002	≥ 0.759	PASS
2DH5	2441	1.005	≥ 0.760	PASS
3DH5	2441	0.996	≥ 0.757	PASS







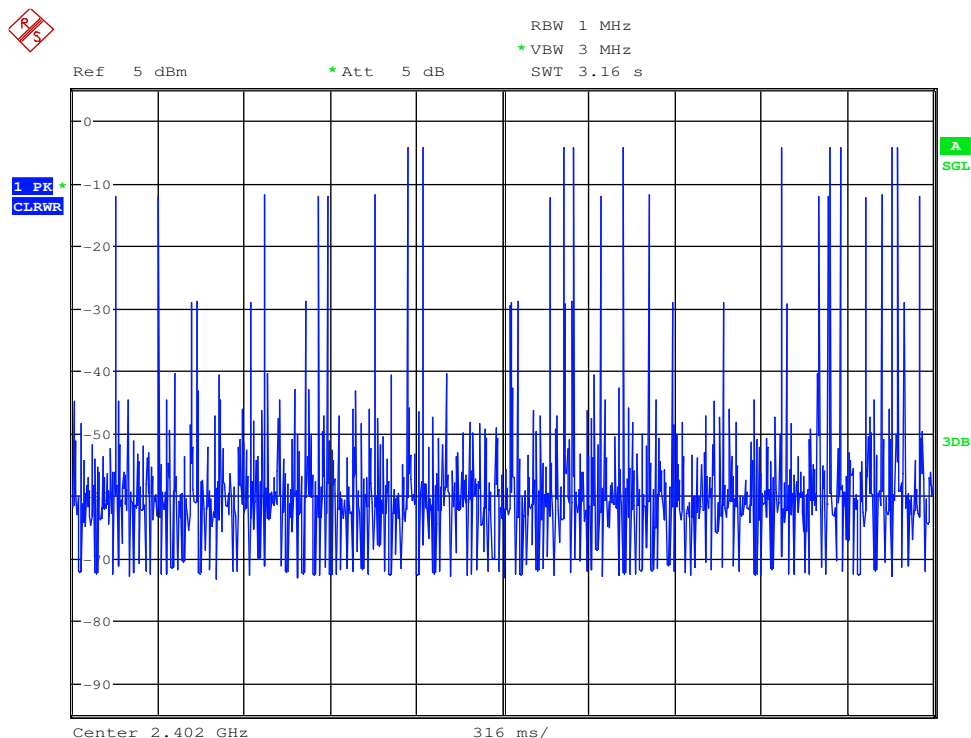
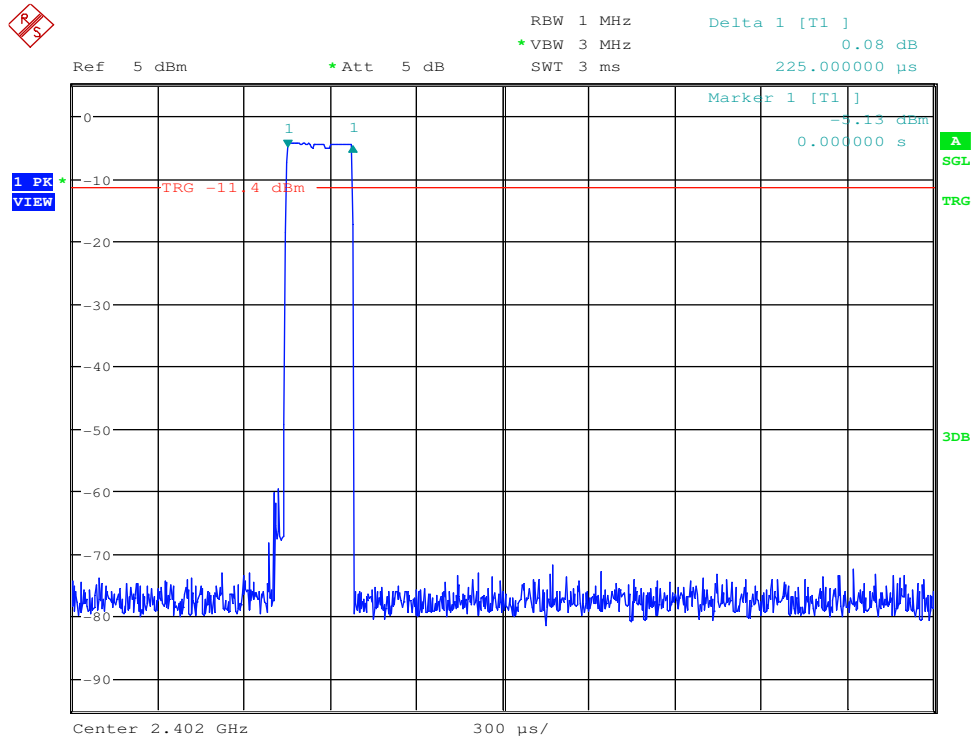
4.Dwell Time

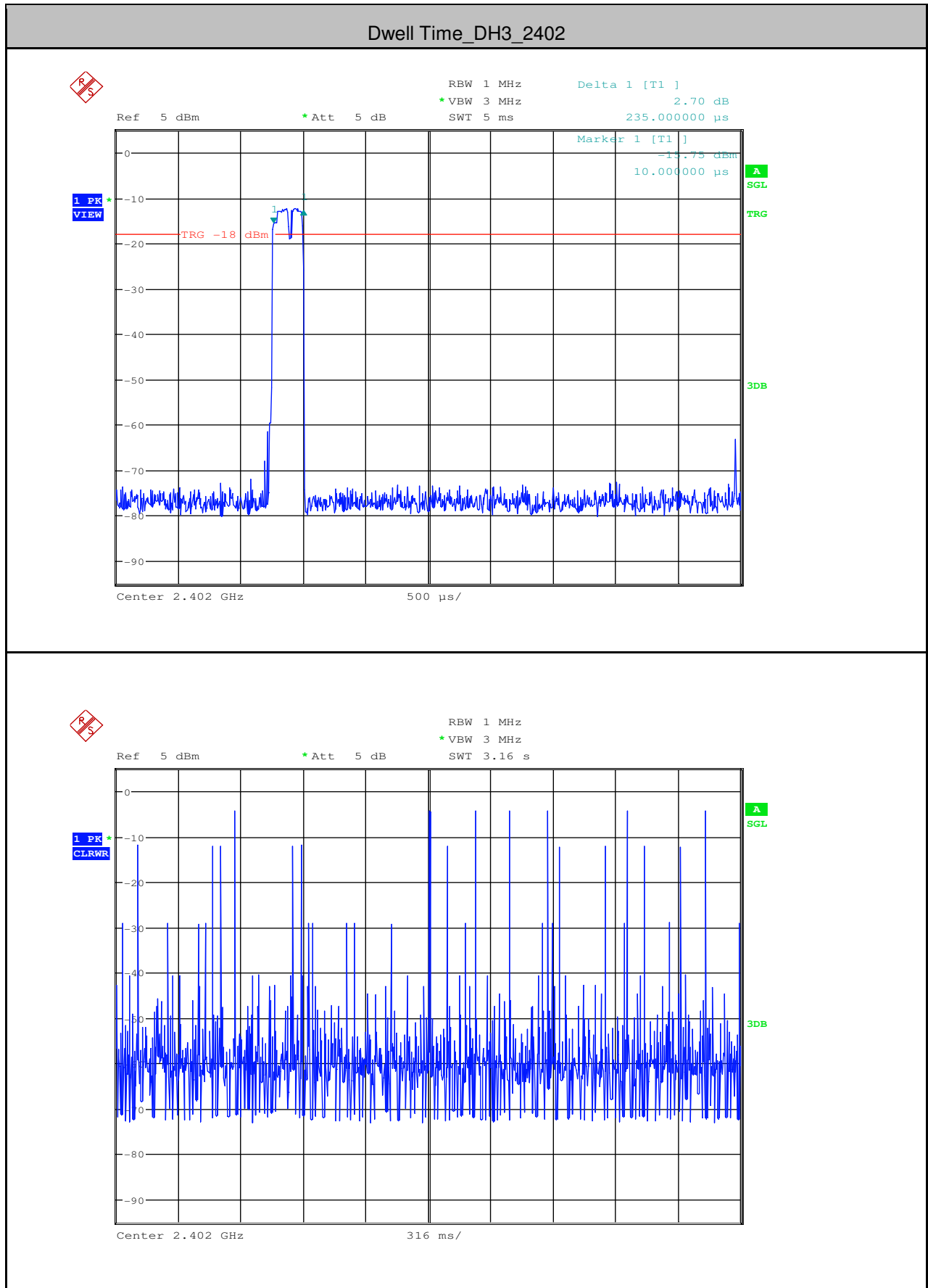
Test Mode	Test Channel	Burst Width[ms/hop/ch]	Total	Dwell Time[s]	Limit[s]	Verdict
DH1	2402	0.23	100	0.023	<0.4	PASS
DH3	2402	0.24	70	0.017	<0.4	PASS
DH5	2402	0.34	90	0.031	<0.4	PASS
2DH1	2402	0.27	140	0.038	<0.4	PASS
2DH3	2402	0.28	110	0.031	<0.4	PASS
2DH5	2402	0.29	160	0.046	<0.4	PASS
3DH1	2402	0.28	40	0.011	<0.4	PASS
3DH3	2402	0.28	130	0.036	<0.4	PASS
3DH5	2402	0.28	120	0.034	<0.4	PASS



TEST PLOT

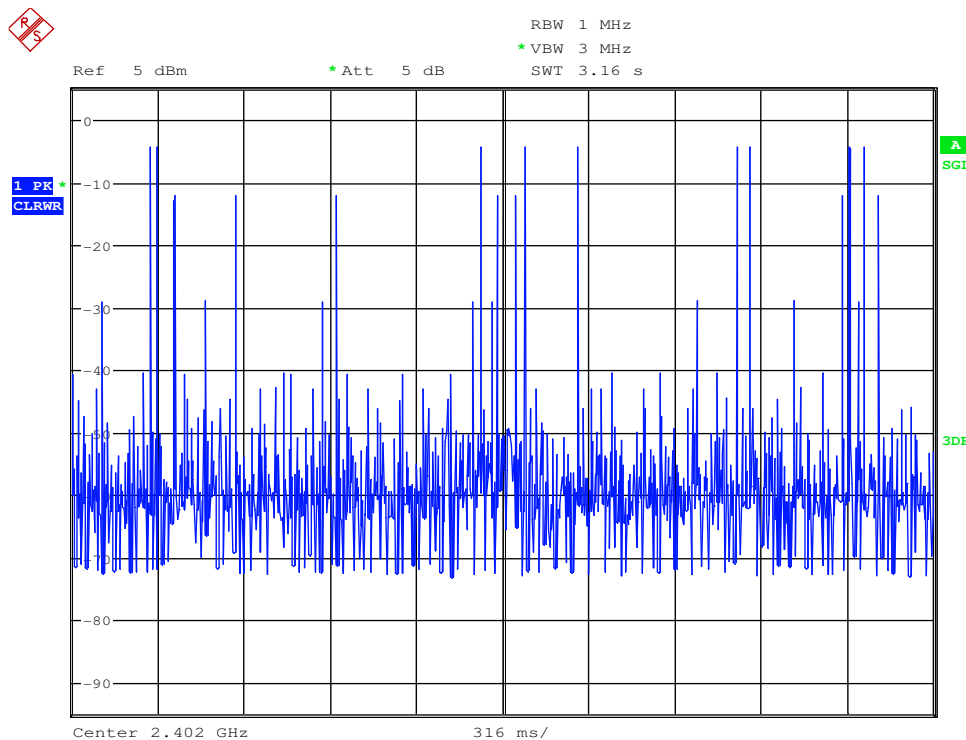
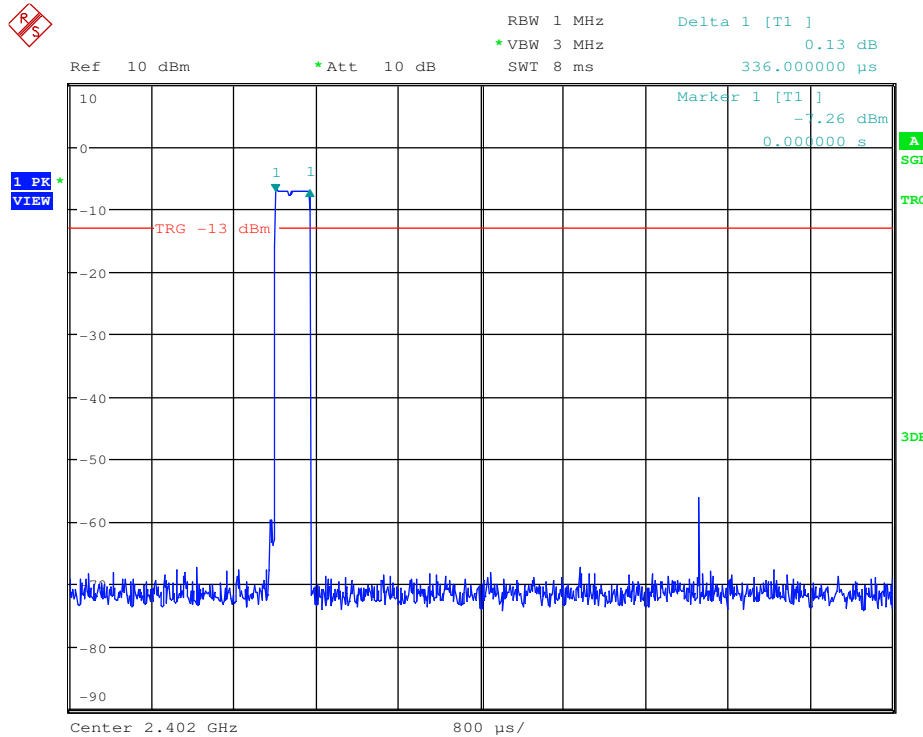
Dwell Time_DH1_2402

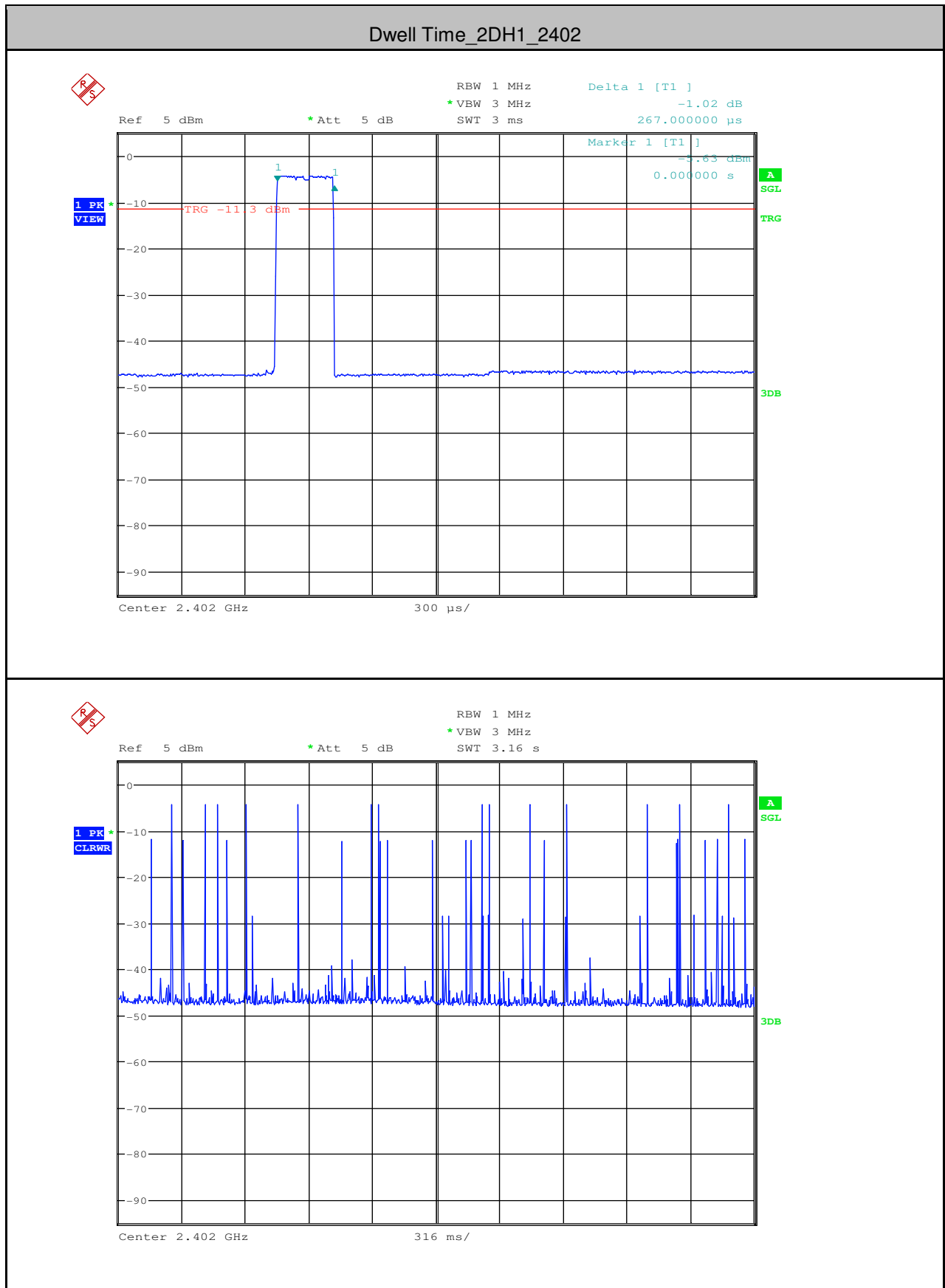


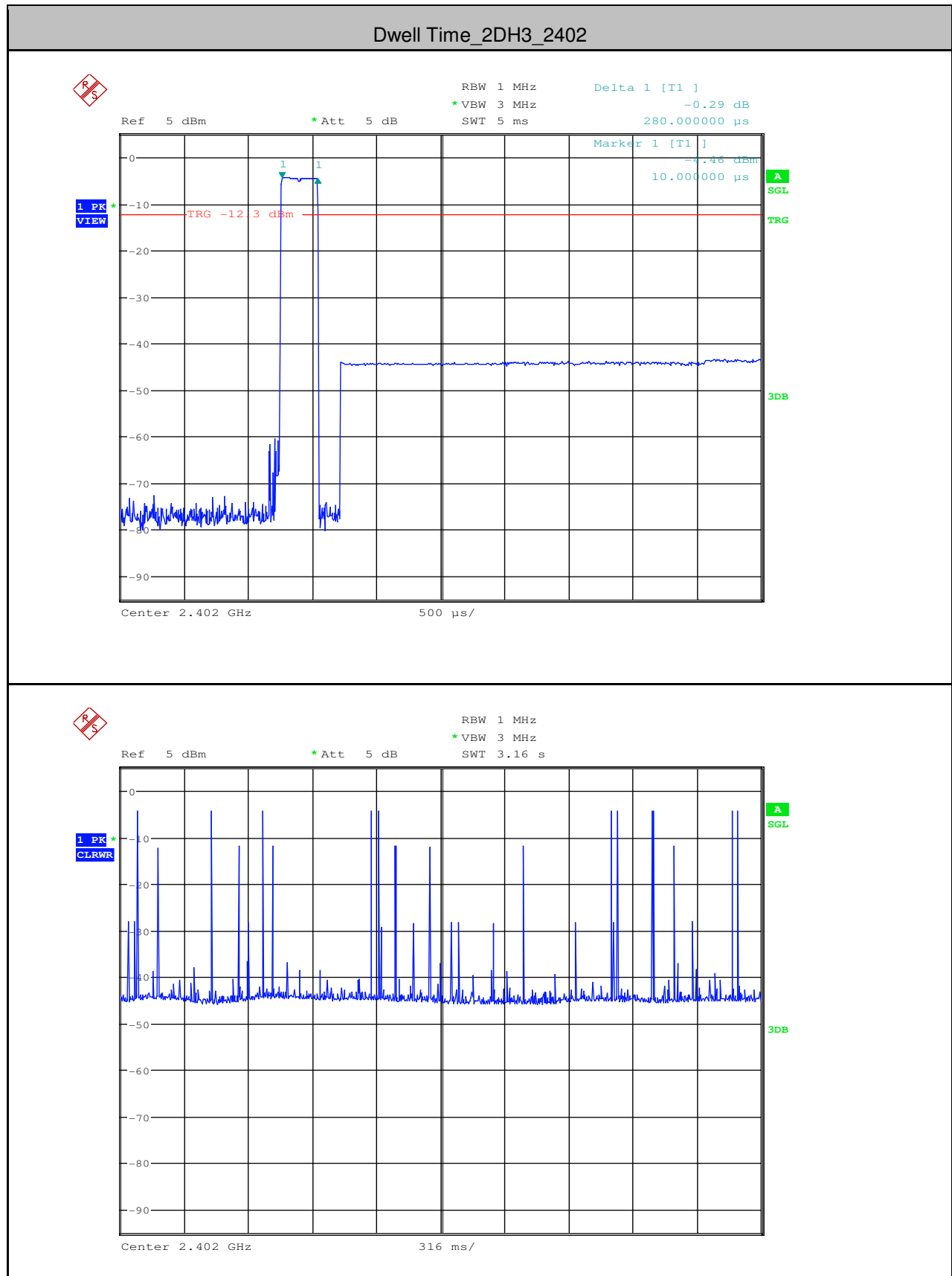


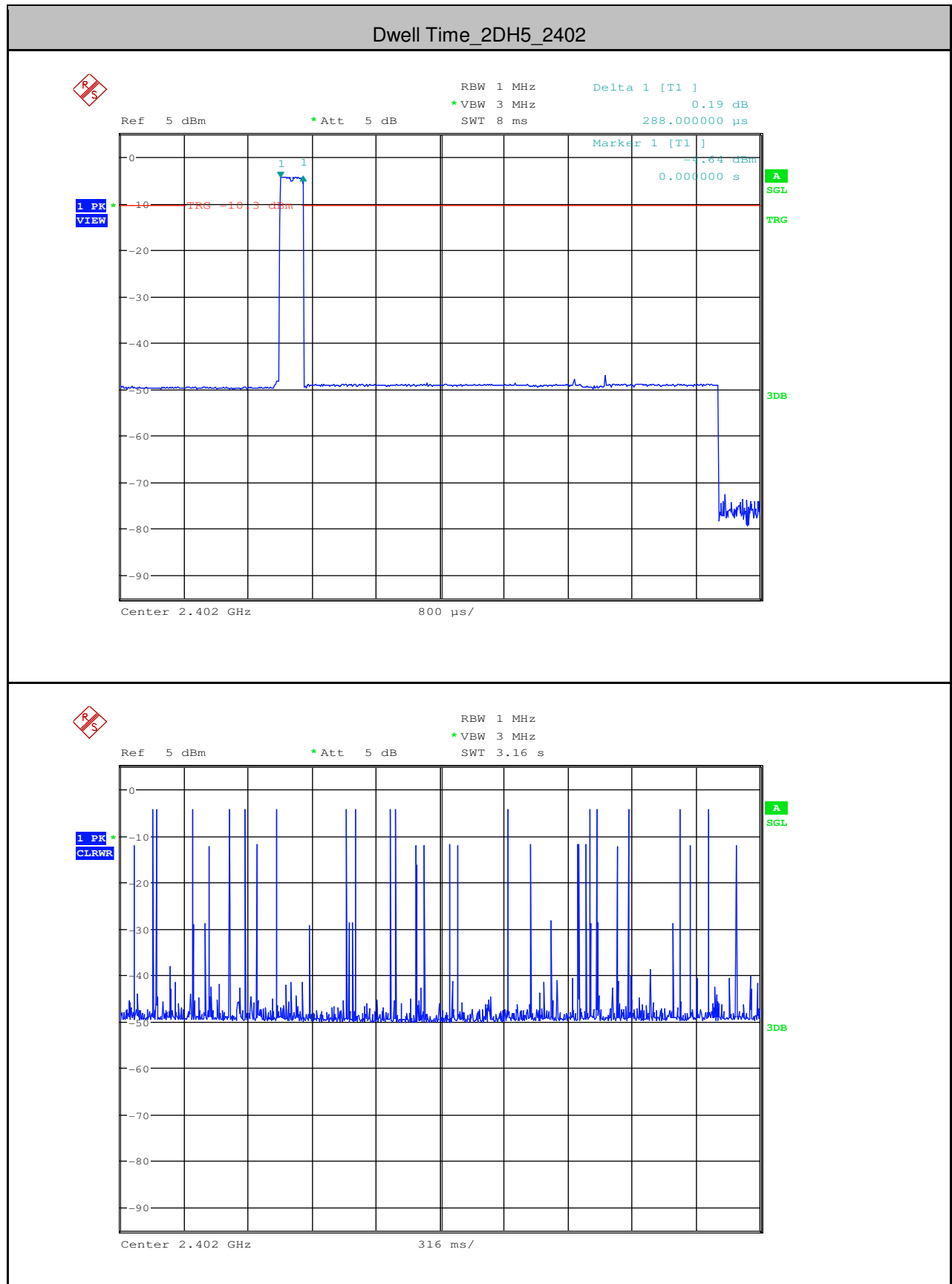


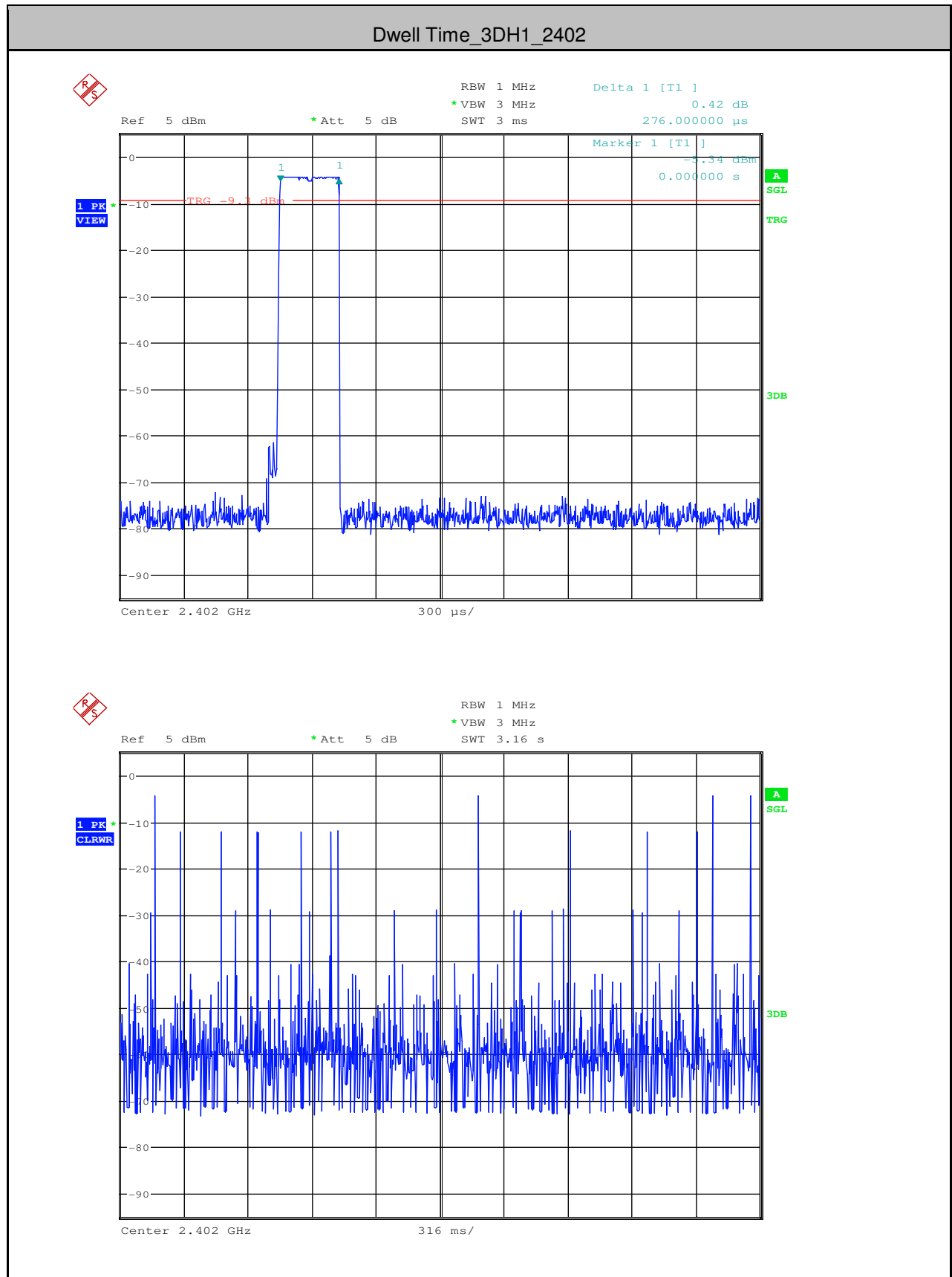
Dwell Time_DH5_2402

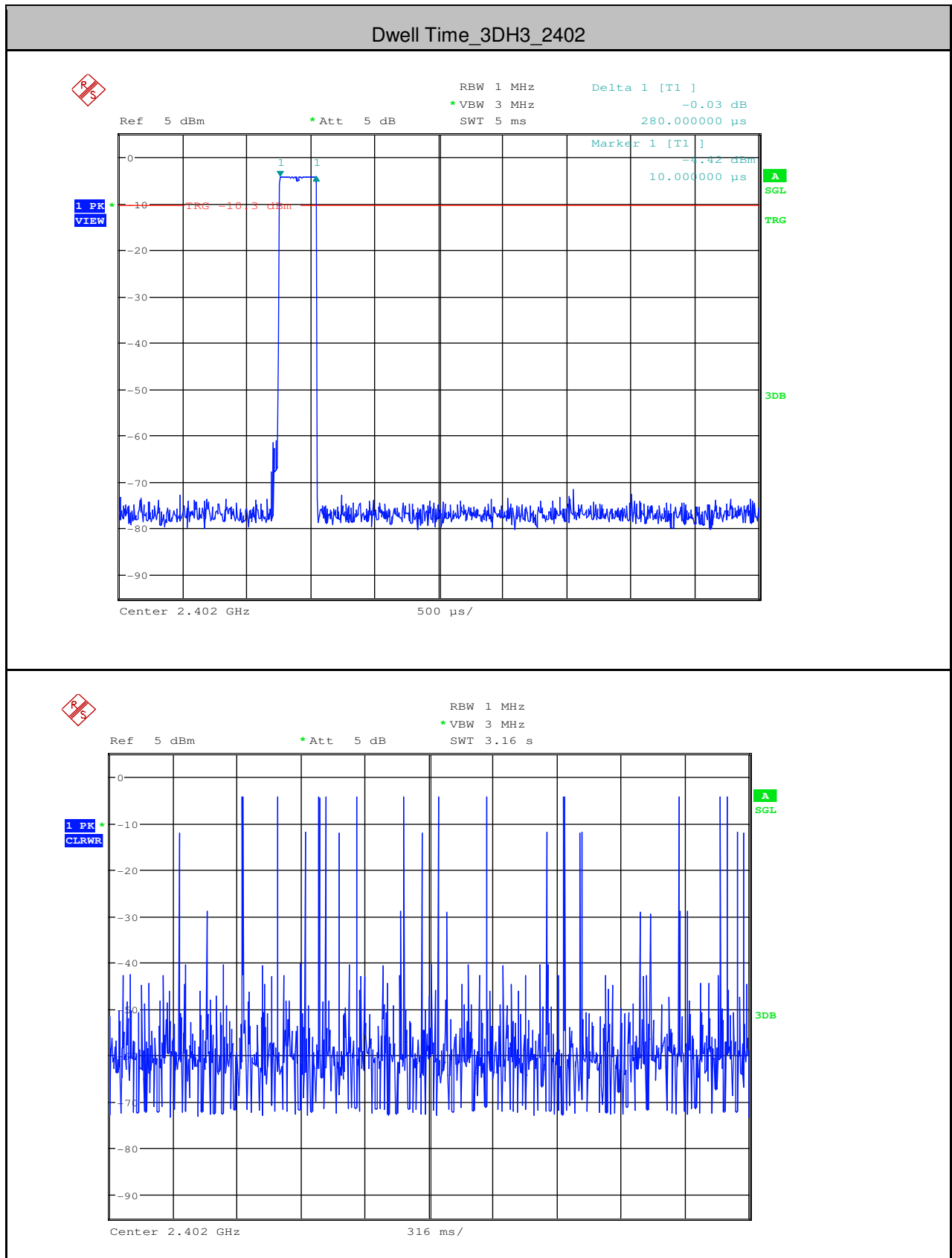


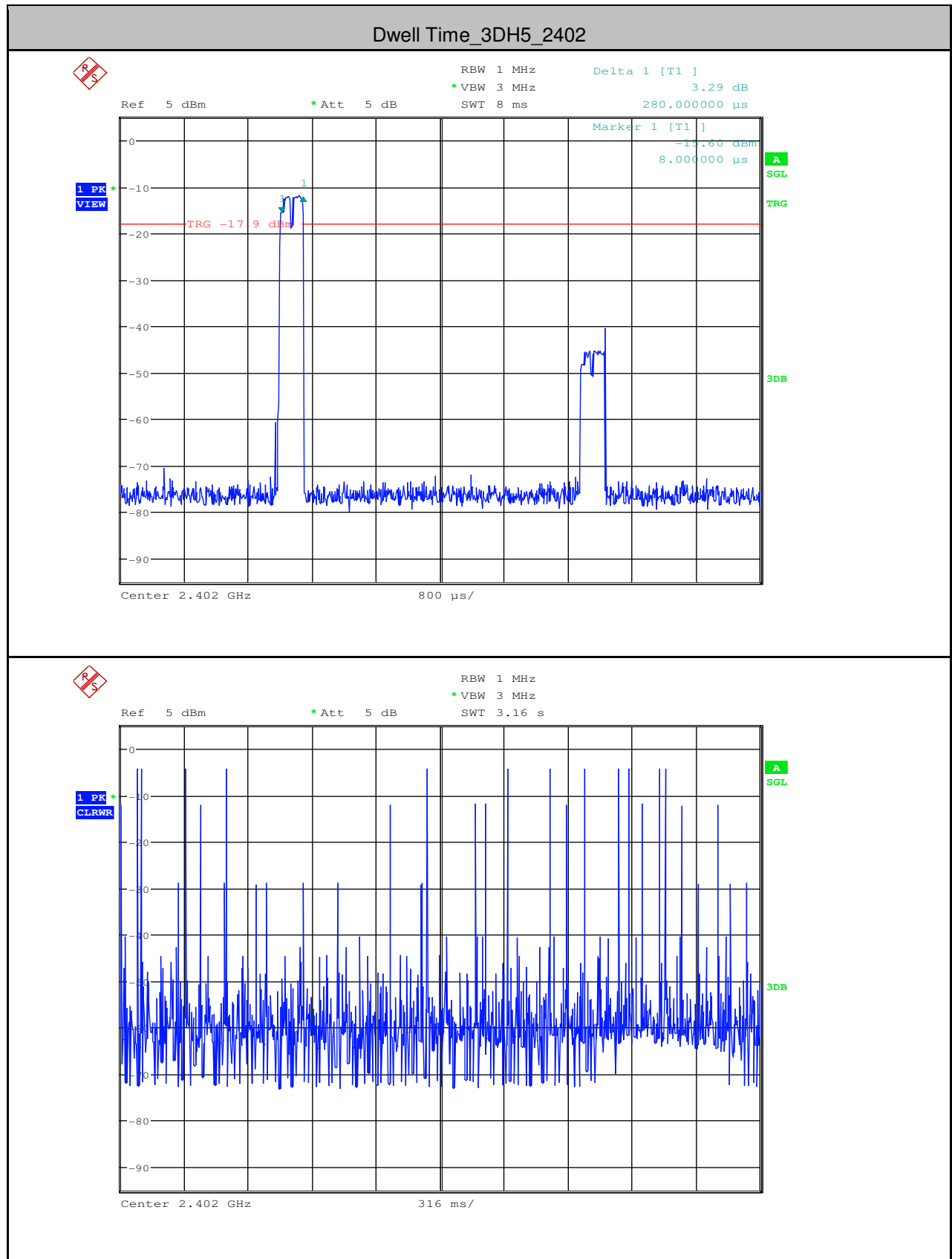








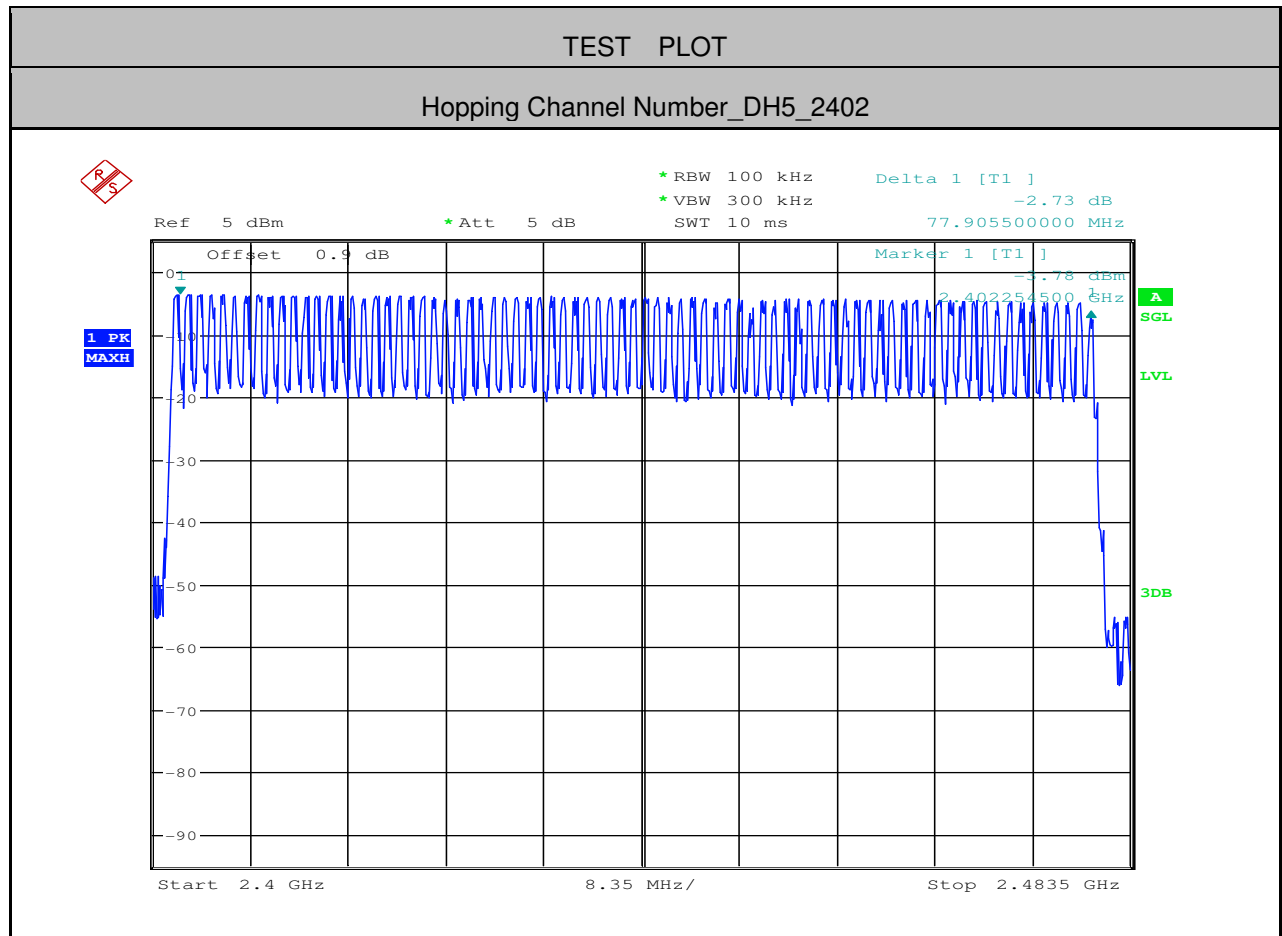






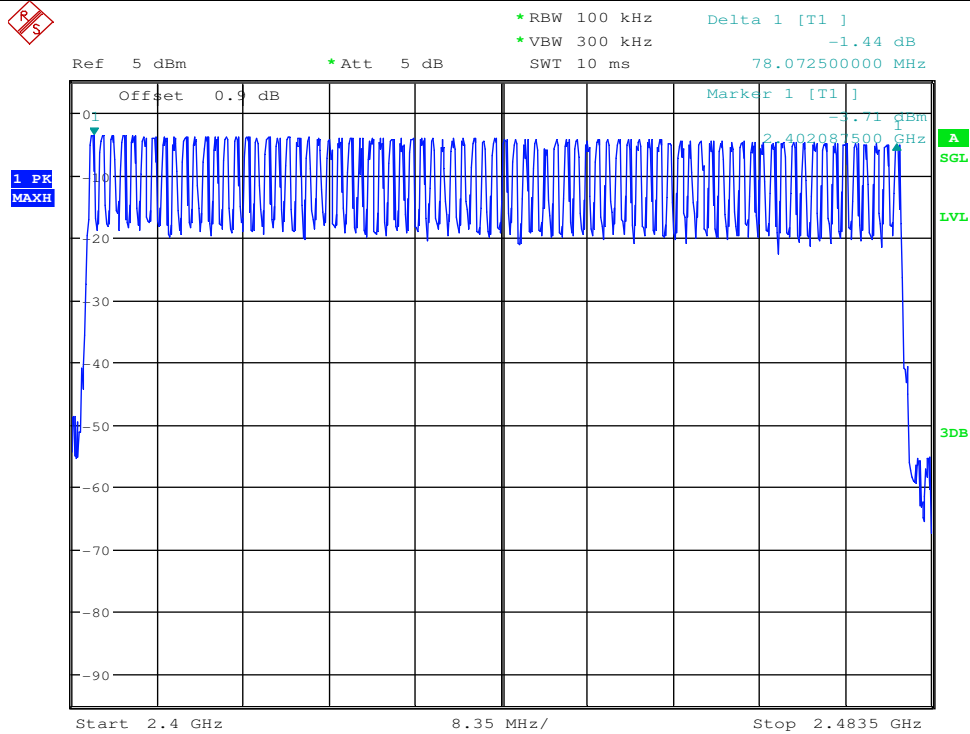
5.Hopping Channel Number

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

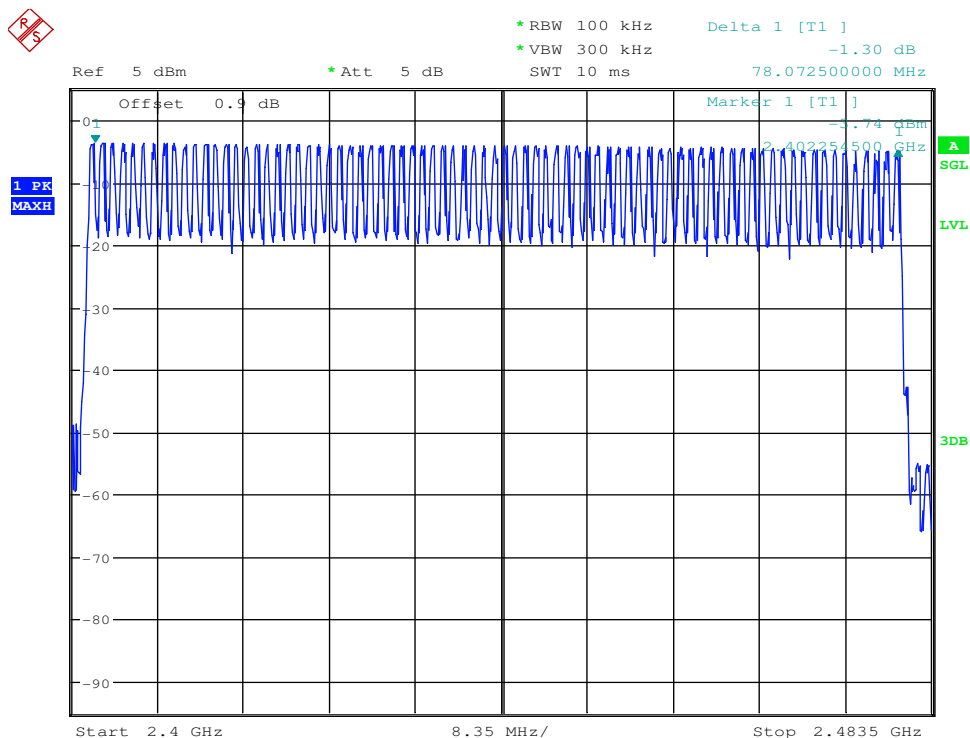




Hopping Channel Number_2DH5_2402



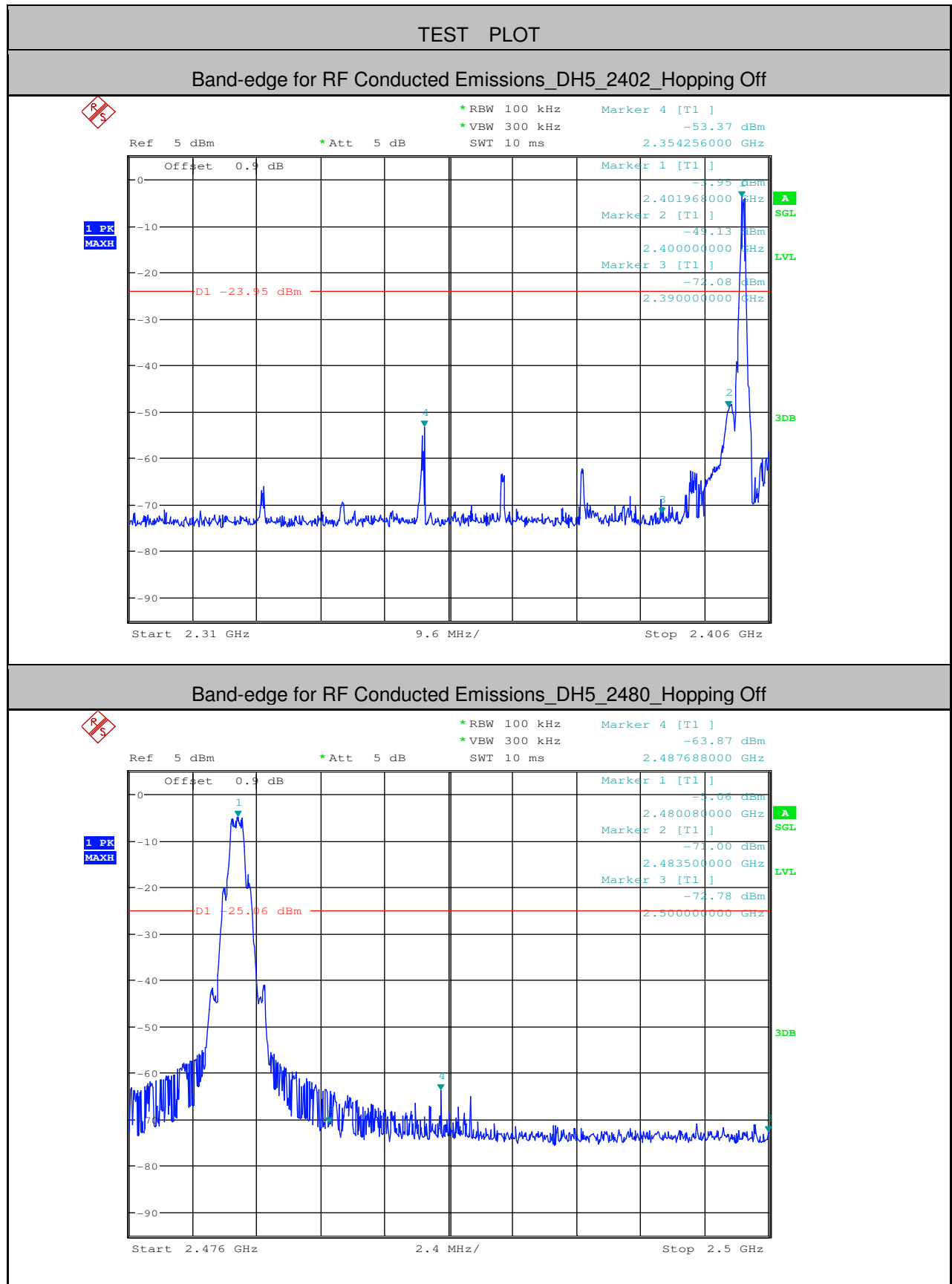
Hopping Channel Number_3DH5_2402



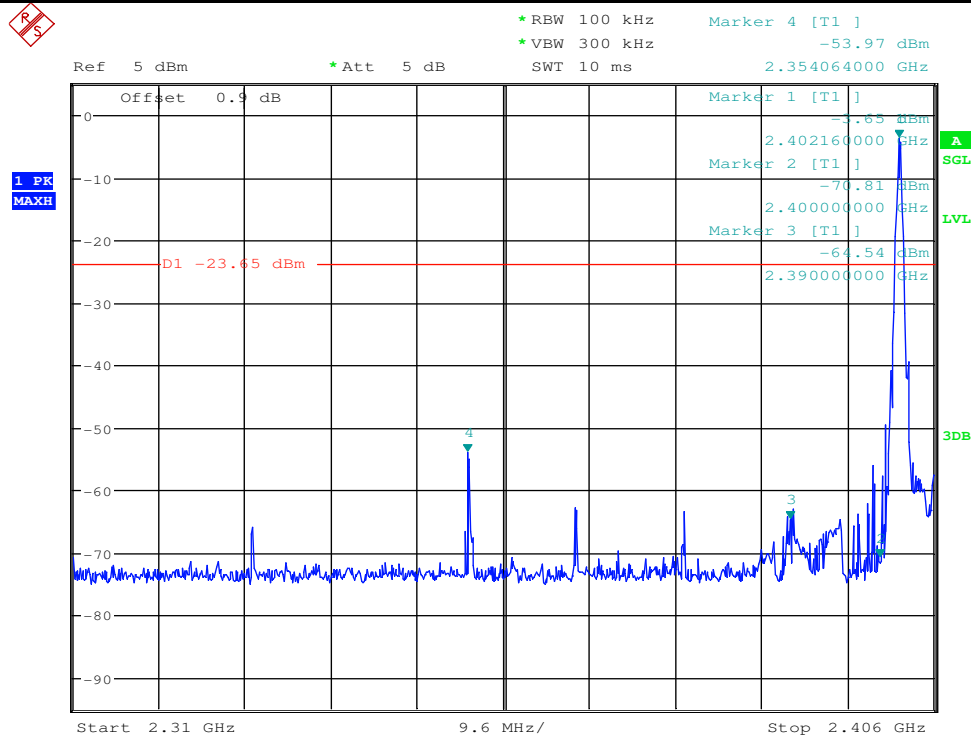


6. Band-edge for RF Conducted Emissions

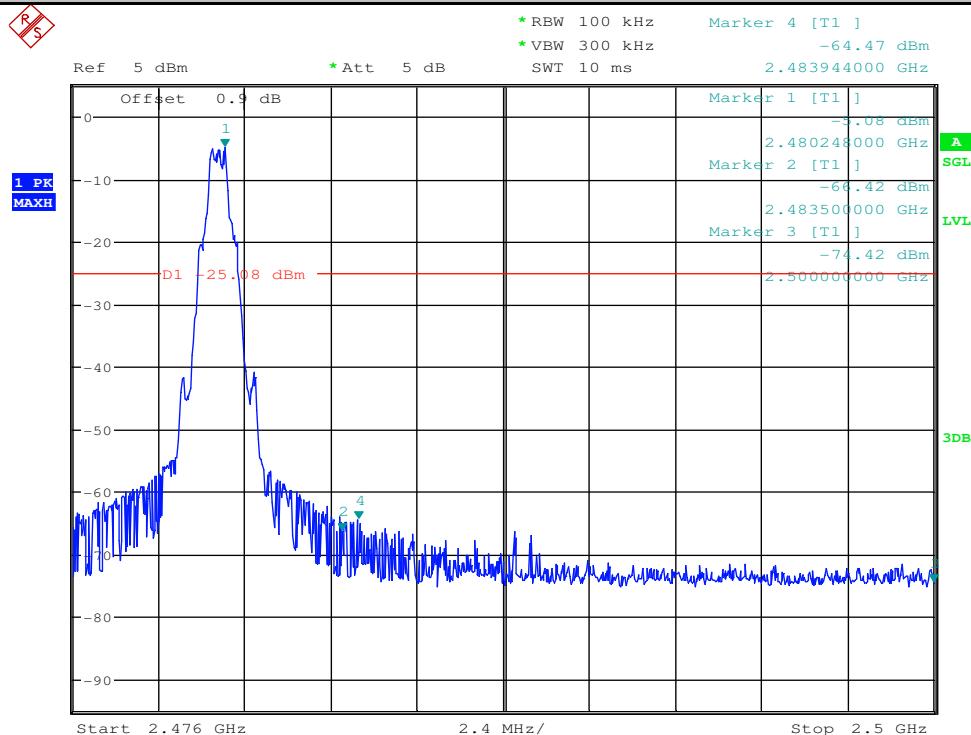
Test Mode	Test Channel	Hopping	Carrier Power[dBm]	Max. Spurious Level [dBm]	Limit[dBm]	Verdict
DH5	2402	Off	-3.950	-53.366	<-23.95	PASS
DH5	2480	Off	-5.060	-63.874	<-25.06	PASS
2DH5	2402	Off	-3.650	-53.966	<-23.65	PASS
2DH5	2480	Off	-5.080	-64.473	<-25.08	PASS
3DH5	2402	Off	-3.890	-63.607	<-23.89	PASS
3DH5	2480	Off	-5.070	-64.283	<-25.07	PASS
DH5	2402	On	-3.570	-52.862	<-23.57	PASS
DH5	2480	On	-4.930	-54.874	<-24.93	PASS
2DH5	2402	On	-3.640	-52.934	<-23.64	PASS
2DH5	2480	On	-4.960	-55.166	<-24.96	PASS
3DH5	2402	On	-3.520	-52.662	<-23.52	PASS
3DH5	2480	On	-4.800	-54.962	<-24.8	PASS



Band-edge for RF Conducted Emissions_2DH5_2402_Hopping Off

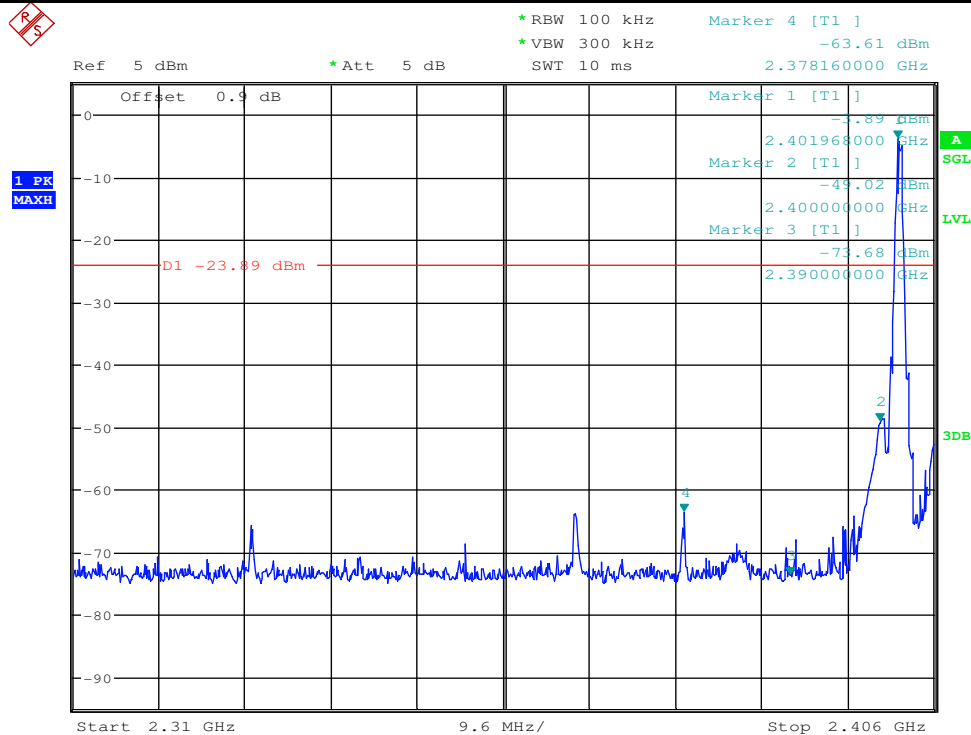


Band-edge for RF Conducted Emissions_2DH5_2480_Hopping Off

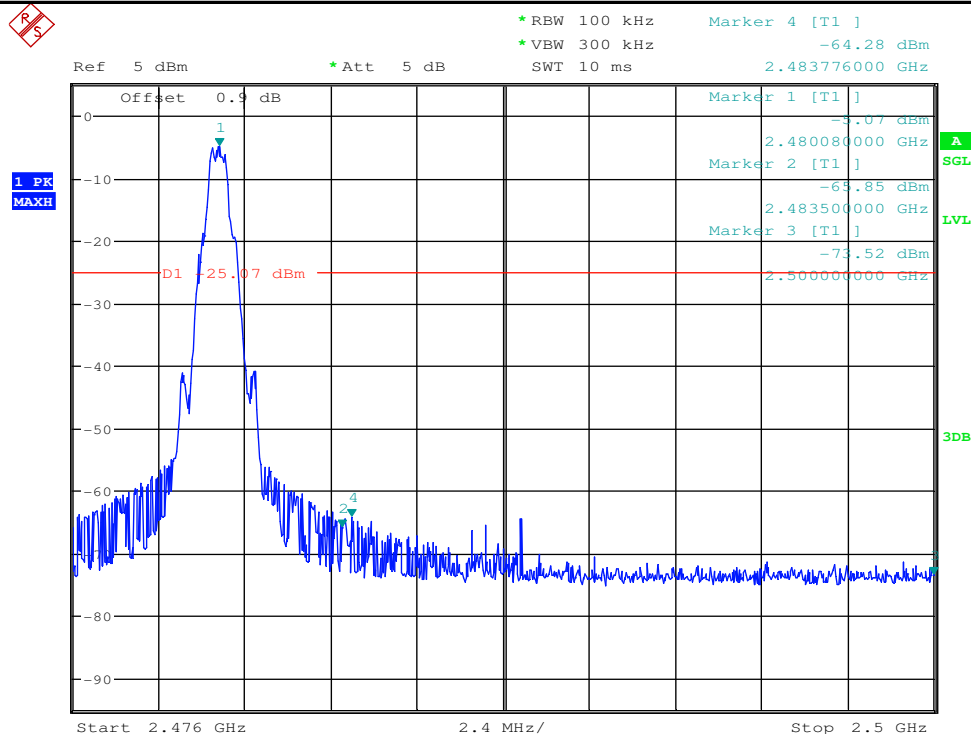




Band-edge for RF Conducted Emissions_3DH5_2402_Hopping Off

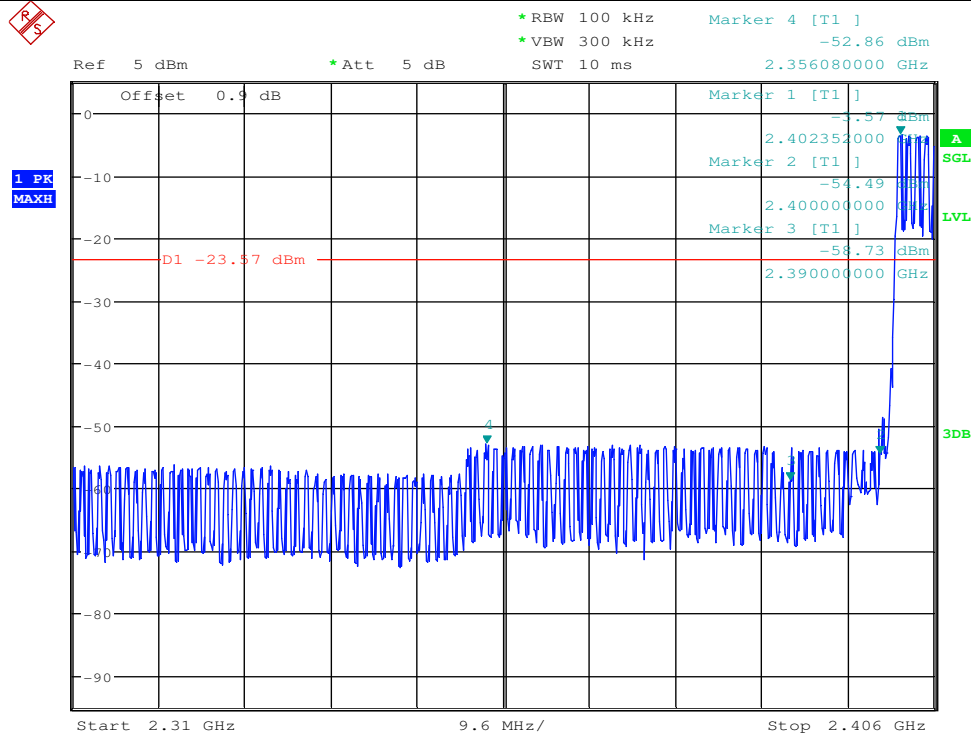


Band-edge for RF Conducted Emissions_3DH5_2480_Hopping Off

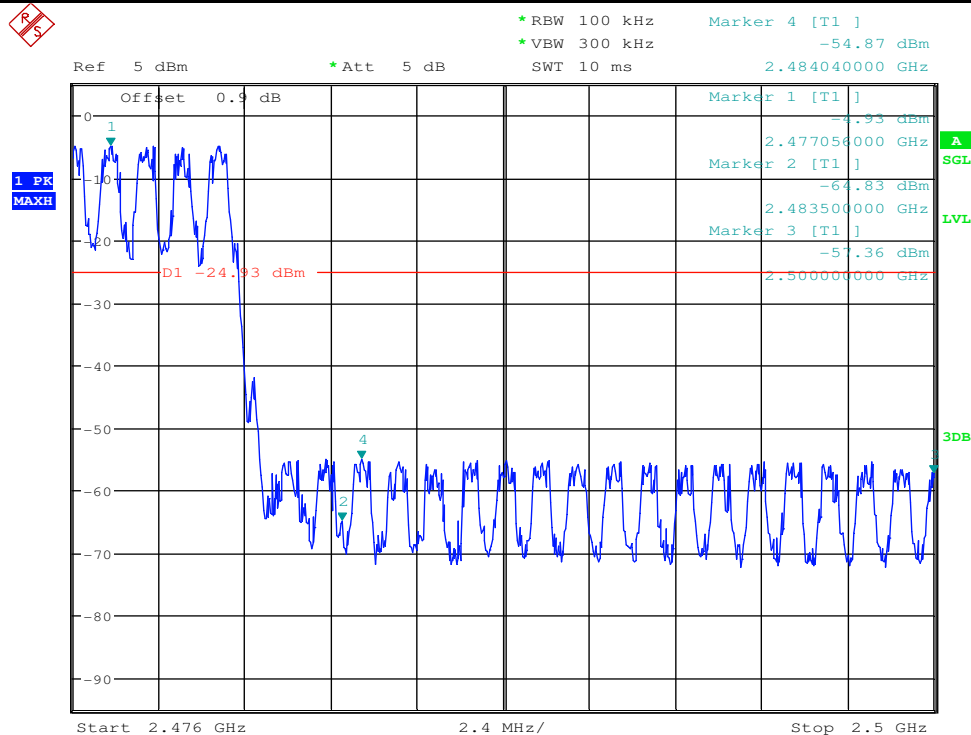




Band-edge for RF Conducted Emissions_DH5_2402_Hopping On

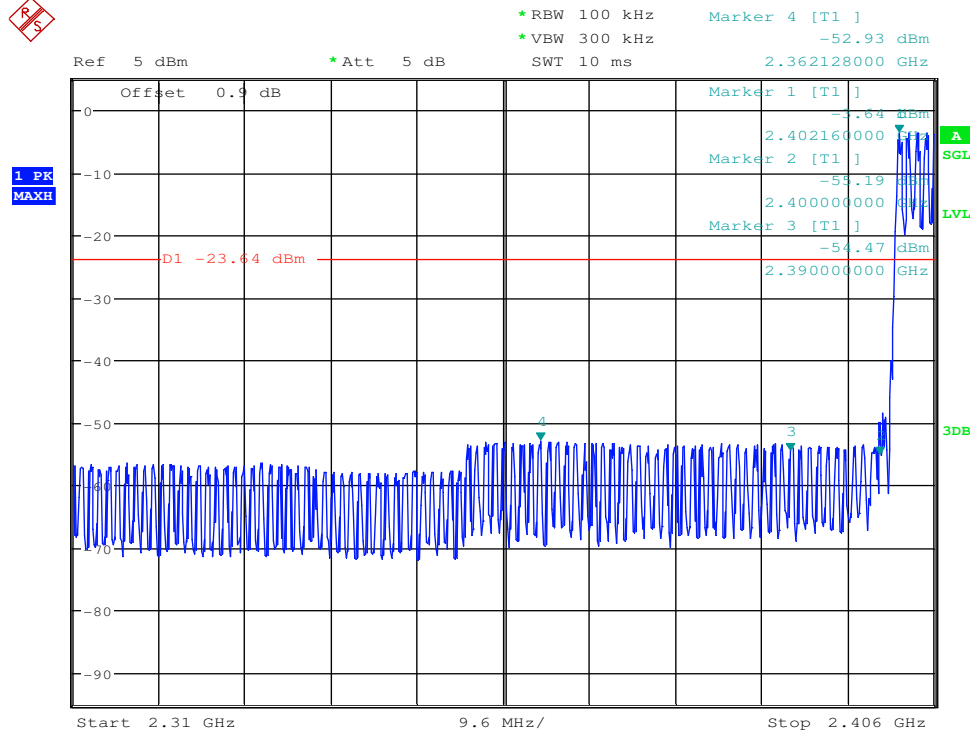


Band-edge for RF Conducted Emissions_DH5_2480_Hopping On

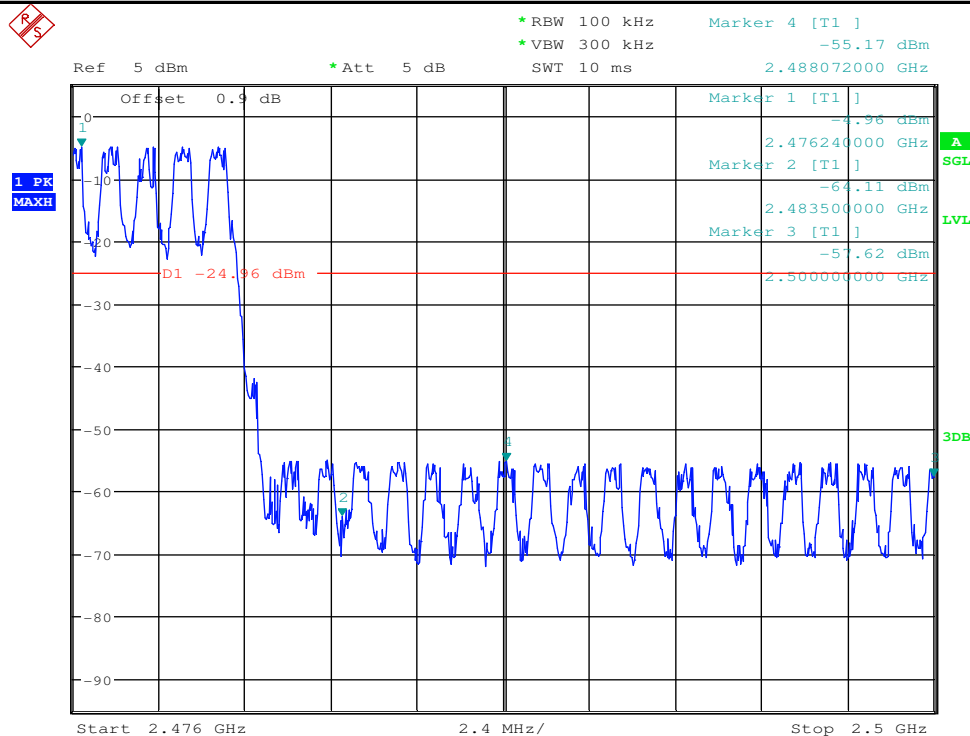




Band-edge for RF Conducted Emissions_2DH5_2402_Hopping On

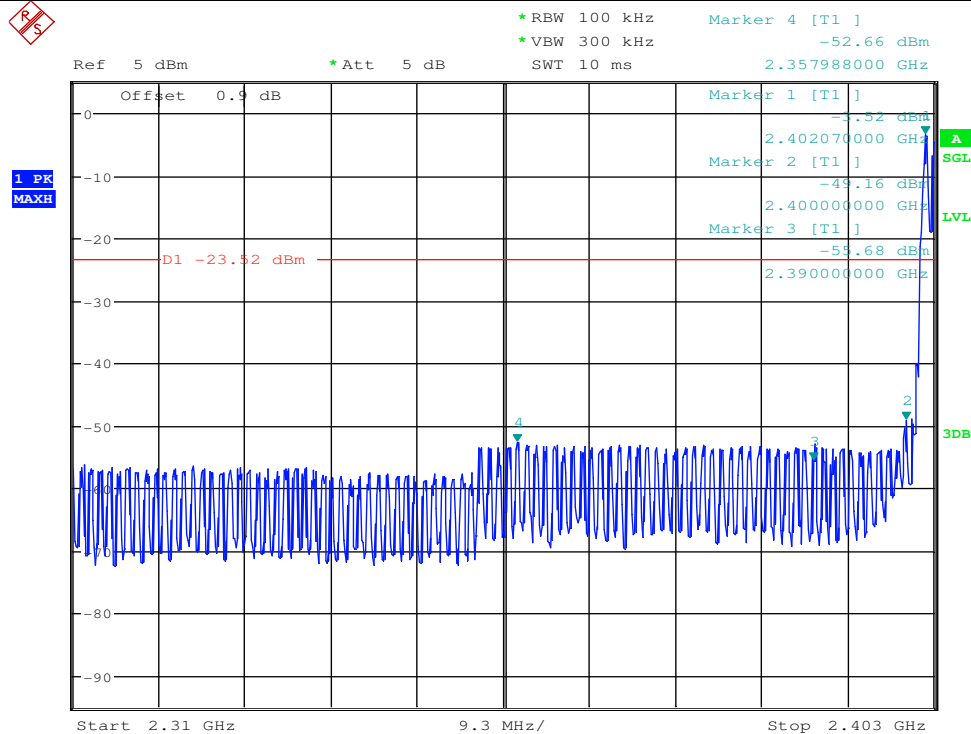


Band-edge for RF Conducted Emissions_2DH5_2480_Hopping On

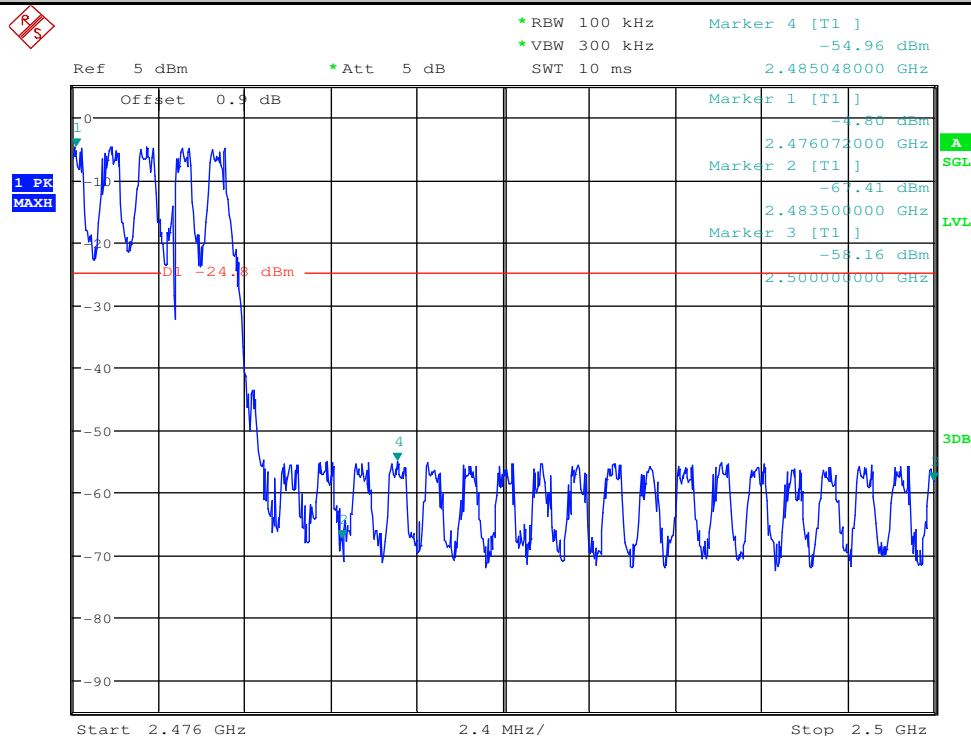




Band-edge for RF Conducted Emissions_3DH5_2402_Hopping On



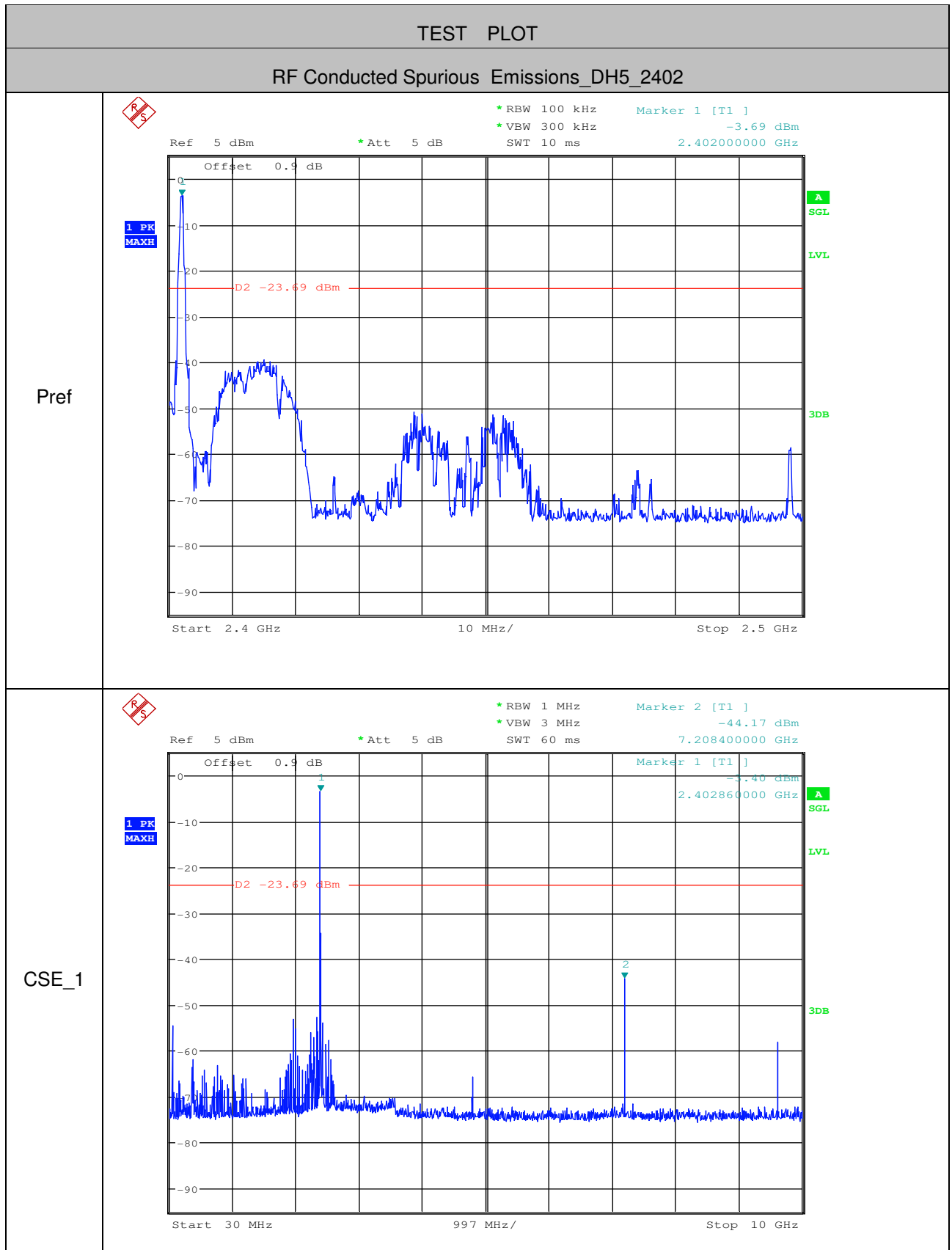
Band-edge for RF Conducted Emissions_3DH5_2480_Hopping On

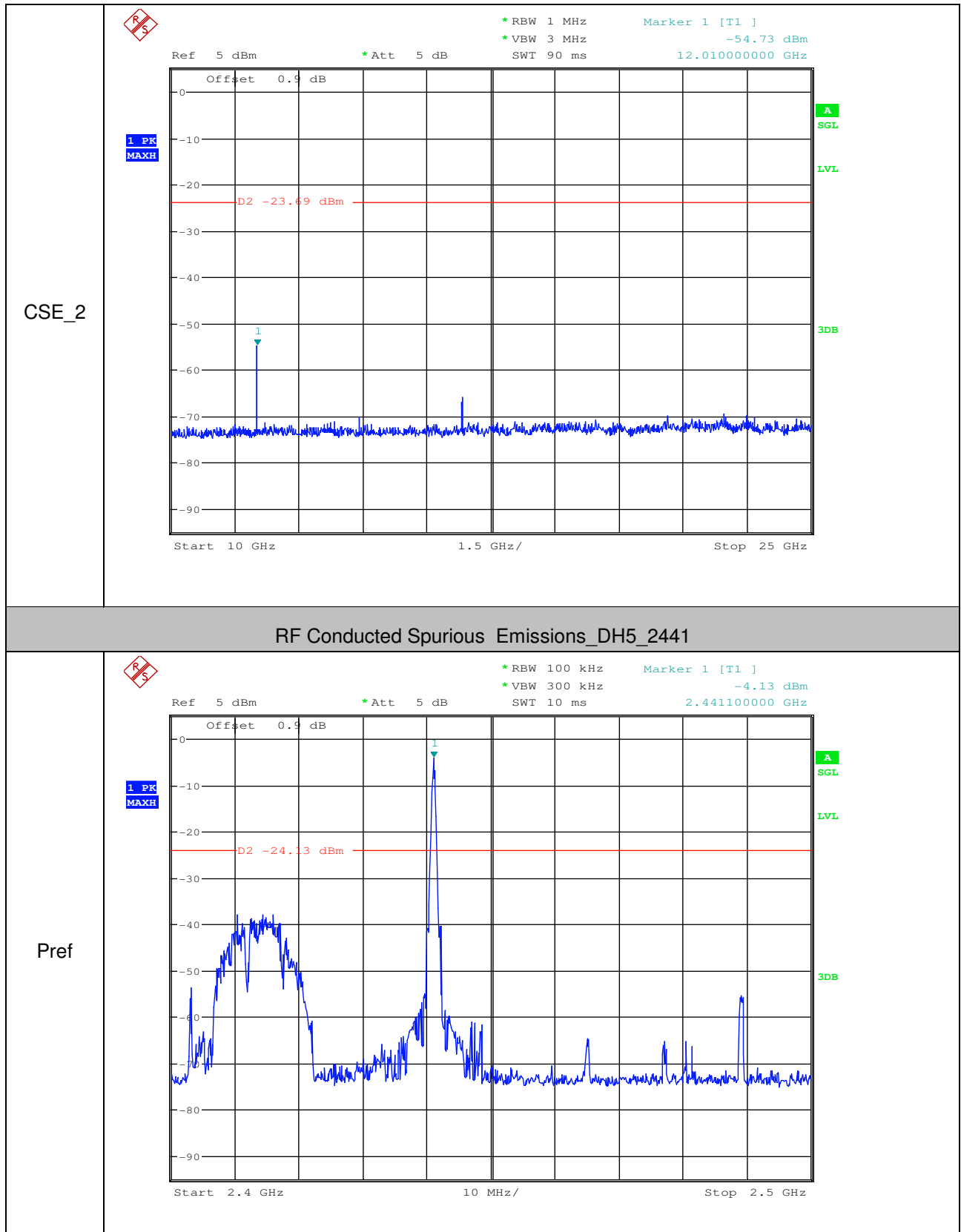


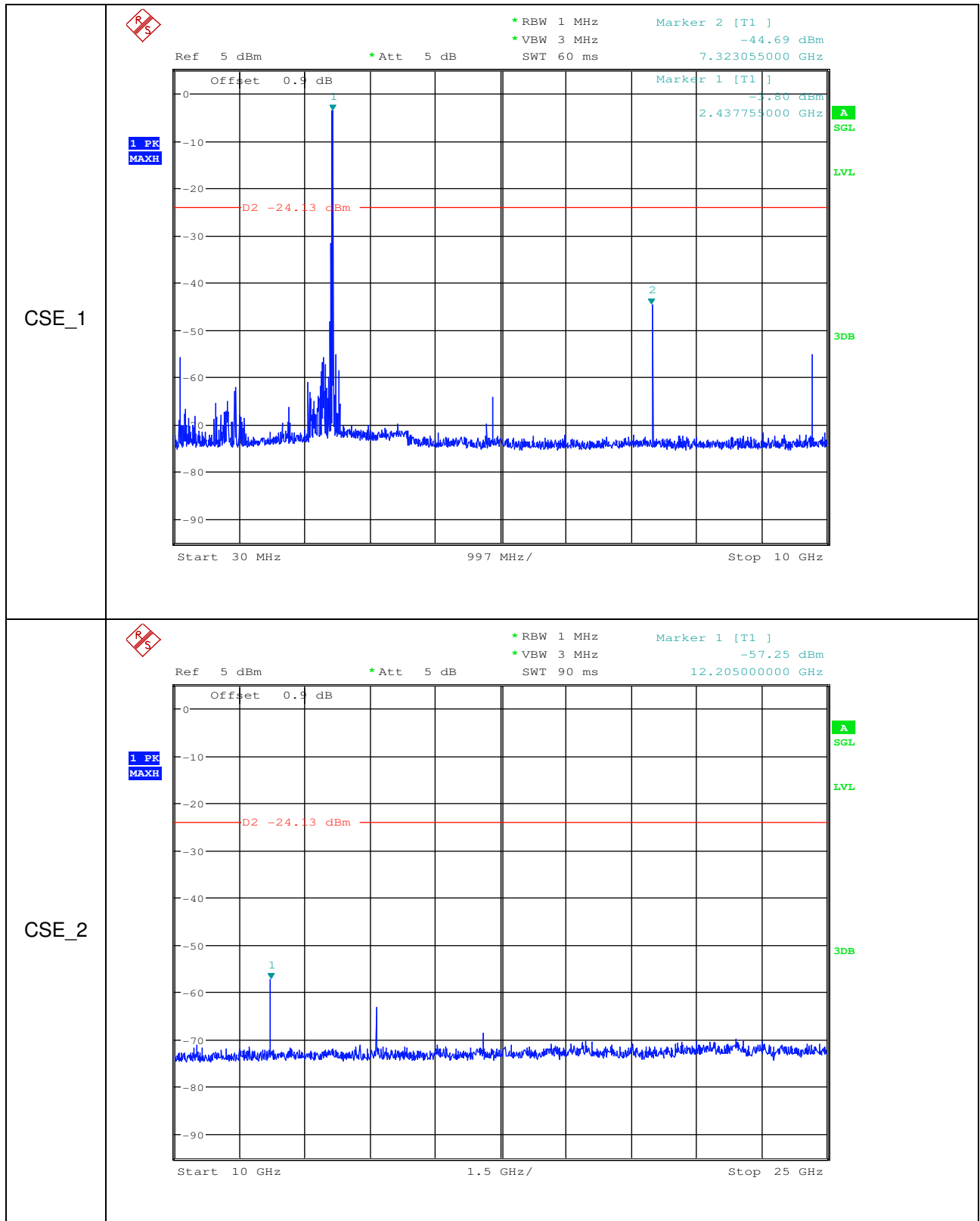


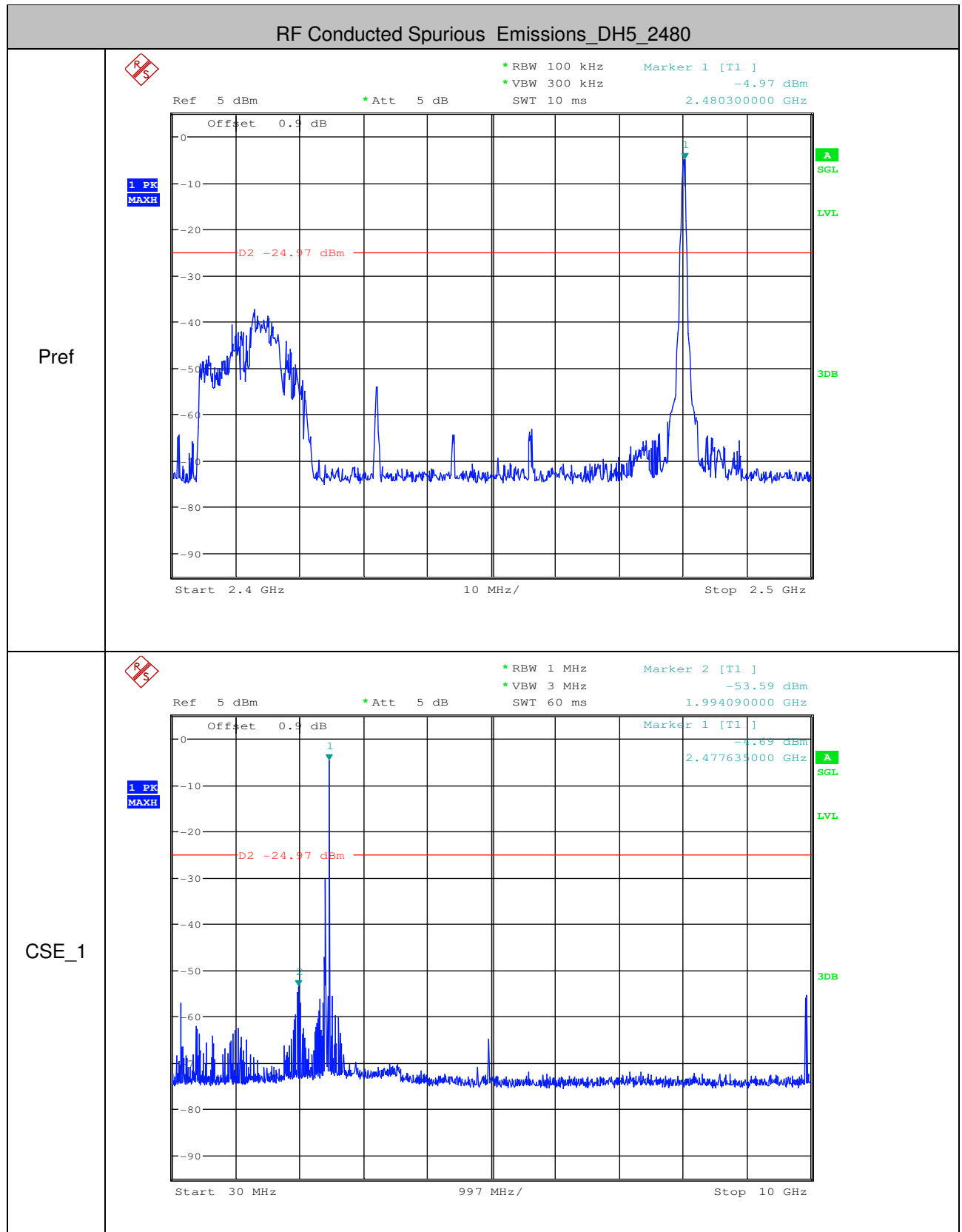
7.RF Conducted Spurious Emissions

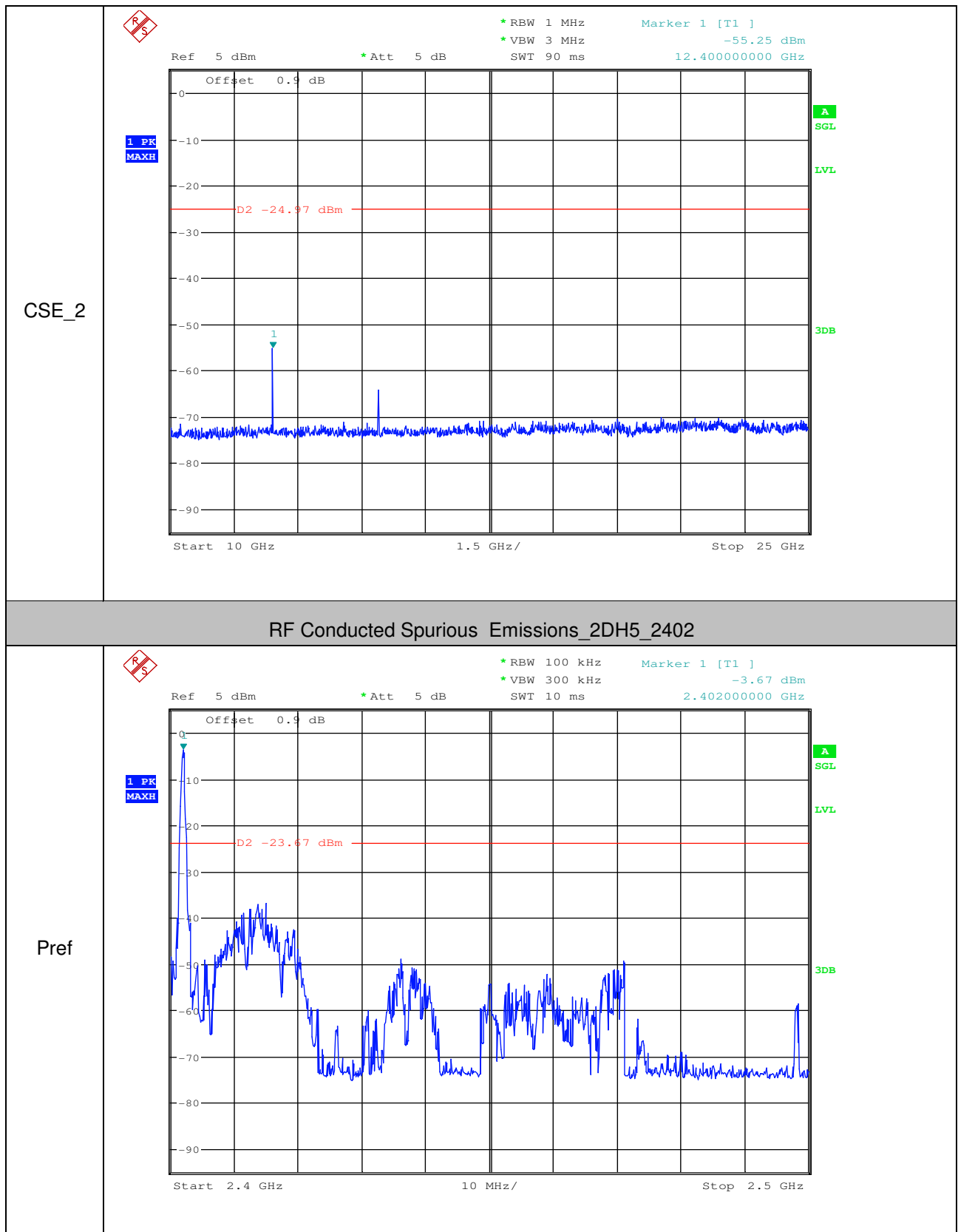
Test Mode	Test Channel	StartFre [MHz]	StopFre [MHz]	RBW [kHz]	VBW [kHz]	Pref[dBm]	Max. Level [dBm]	Limit [dBm]	Verdict
DH5	2402	30	10000	1000	3000	-3.69	-44.170	<-23.69	PASS
DH5	2402	10000	25000	1000	3000	-3.69	-54.730	<-23.69	PASS
DH5	2441	30	10000	1000	3000	-4.13	-44.690	<-24.13	PASS
DH5	2441	10000	25000	1000	3000	-4.13	-57.250	<-24.13	PASS
DH5	2480	30	10000	1000	3000	-4.97	-53.590	<-24.97	PASS
DH5	2480	10000	25000	1000	3000	-4.97	-55.250	<-24.97	PASS
2DH5	2402	30	10000	1000	3000	-3.67	-44.050	<-23.67	PASS
2DH5	2402	10000	25000	1000	3000	-3.67	-55.030	<-23.67	PASS
2DH5	2441	30	10000	1000	3000	-4.09	-38.900	<-24.09	PASS
2DH5	2441	10000	25000	1000	3000	-4.09	-57.160	<-24.09	PASS
2DH5	2480	30	10000	1000	3000	-5.06	-48.340	<-25.06	PASS
2DH5	2480	10000	25000	1000	3000	-5.06	-54.980	<-25.06	PASS
3DH5	2402	30	10000	1000	3000	-3.71	-44.050	<-23.71	PASS
3DH5	2402	10000	25000	1000	3000	-3.71	-54.970	<-23.71	PASS
3DH5	2441	30	10000	1000	3000	-3.97	-44.890	<-23.97	PASS
3DH5	2441	10000	25000	1000	3000	-3.97	-56.930	<-23.97	PASS
3DH5	2480	30	10000	1000	3000	-4.97	-30.610	<-24.97	PASS
3DH5	2480	10000	25000	1000	3000	-4.97	-55.550	<-24.97	PASS

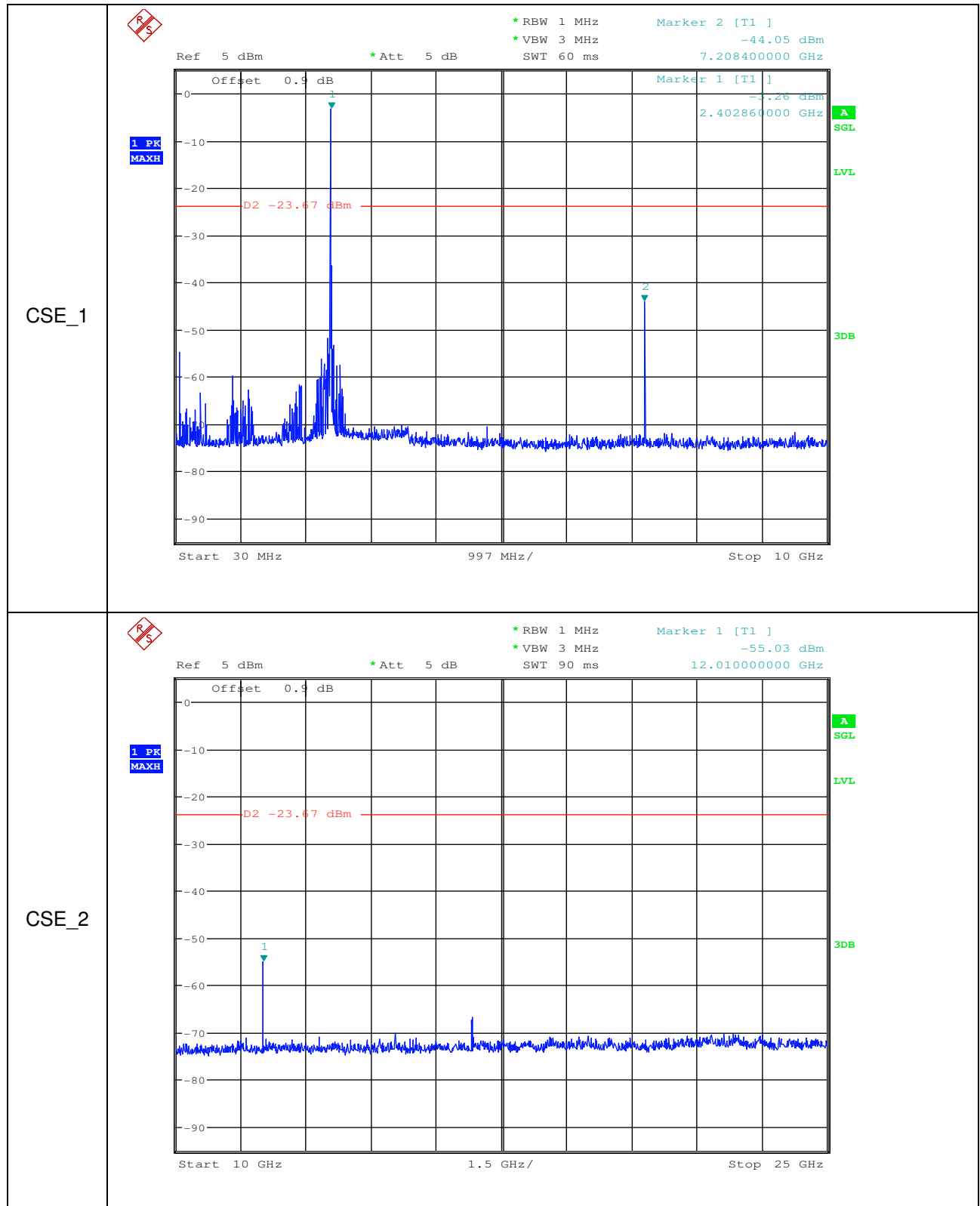


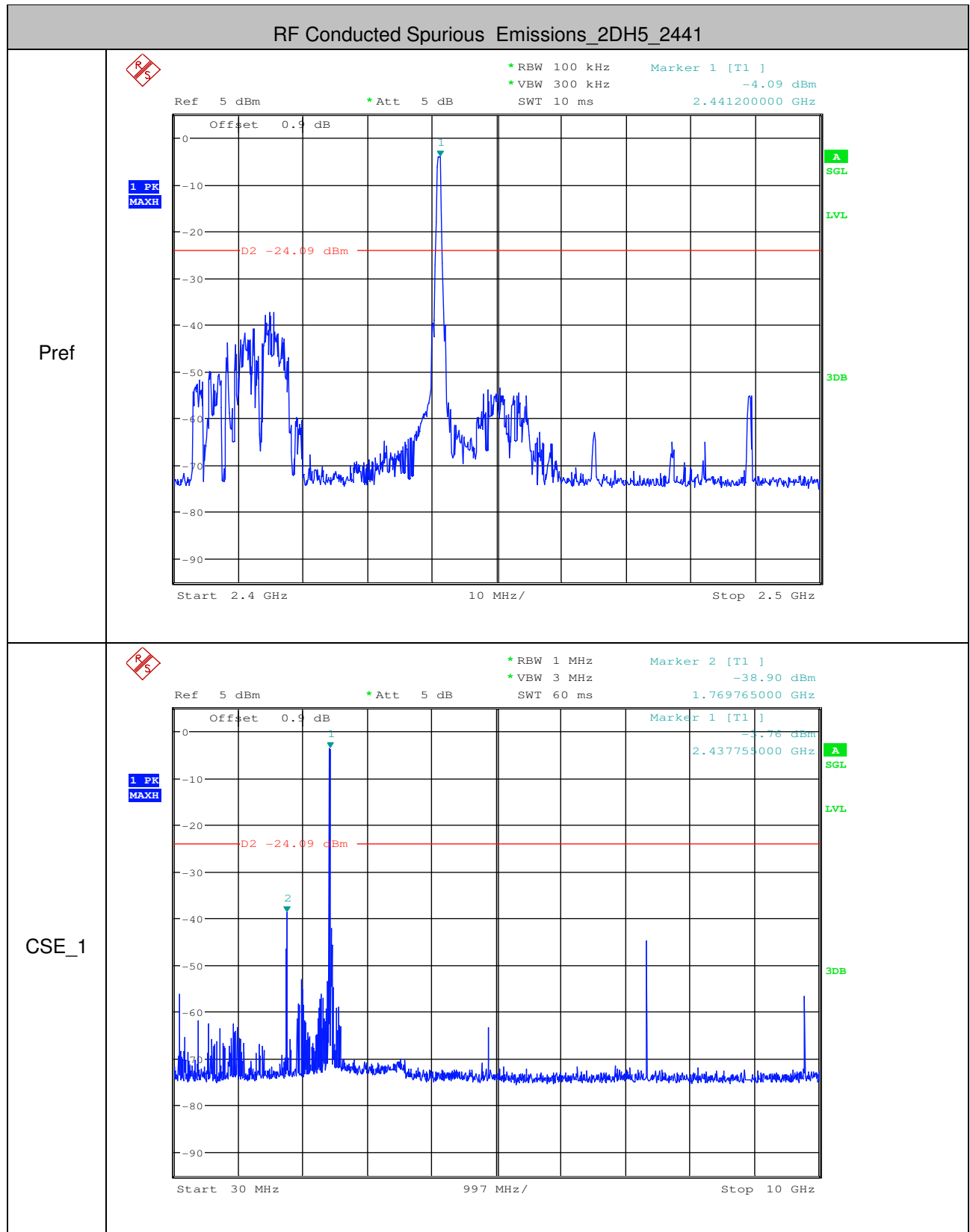


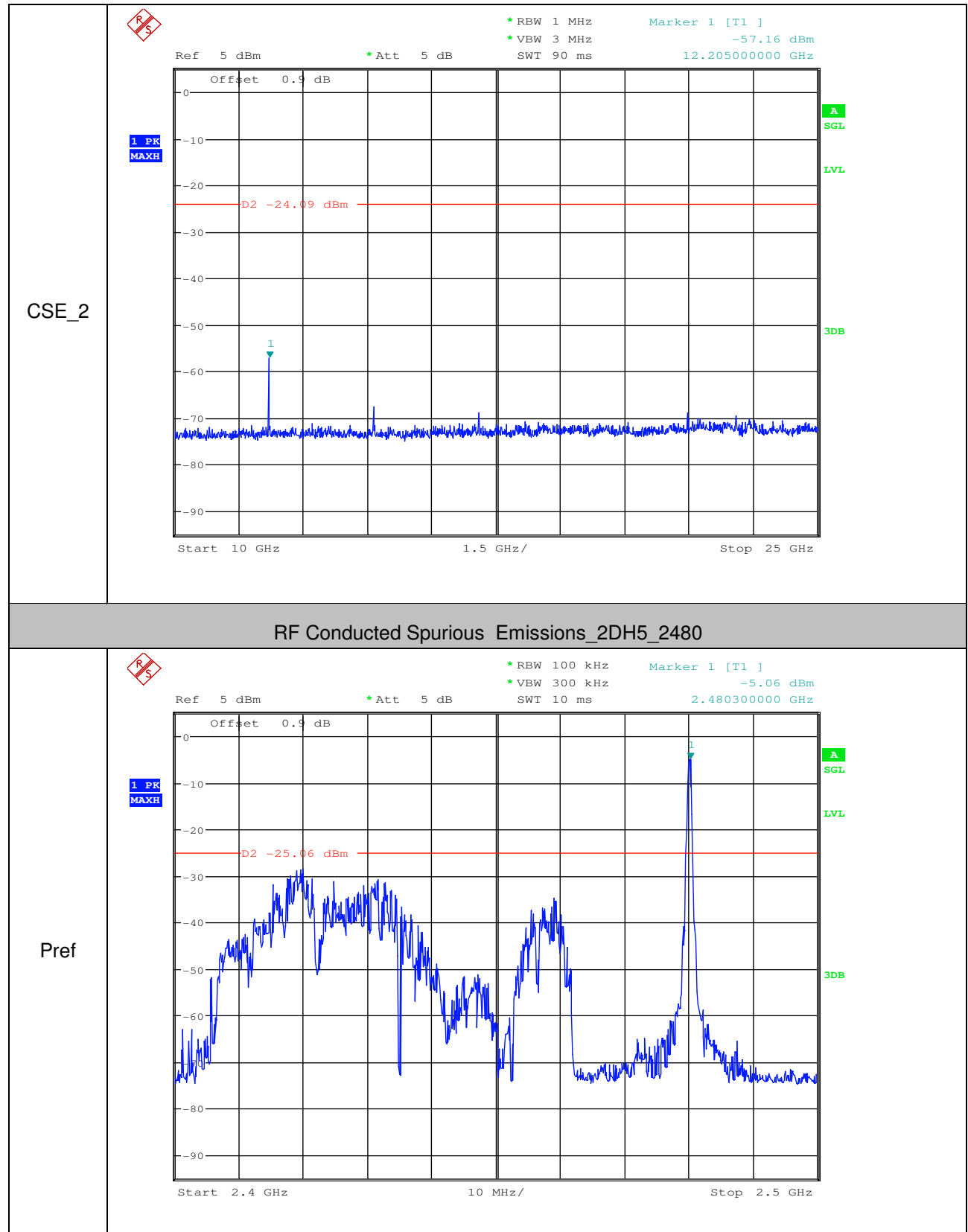


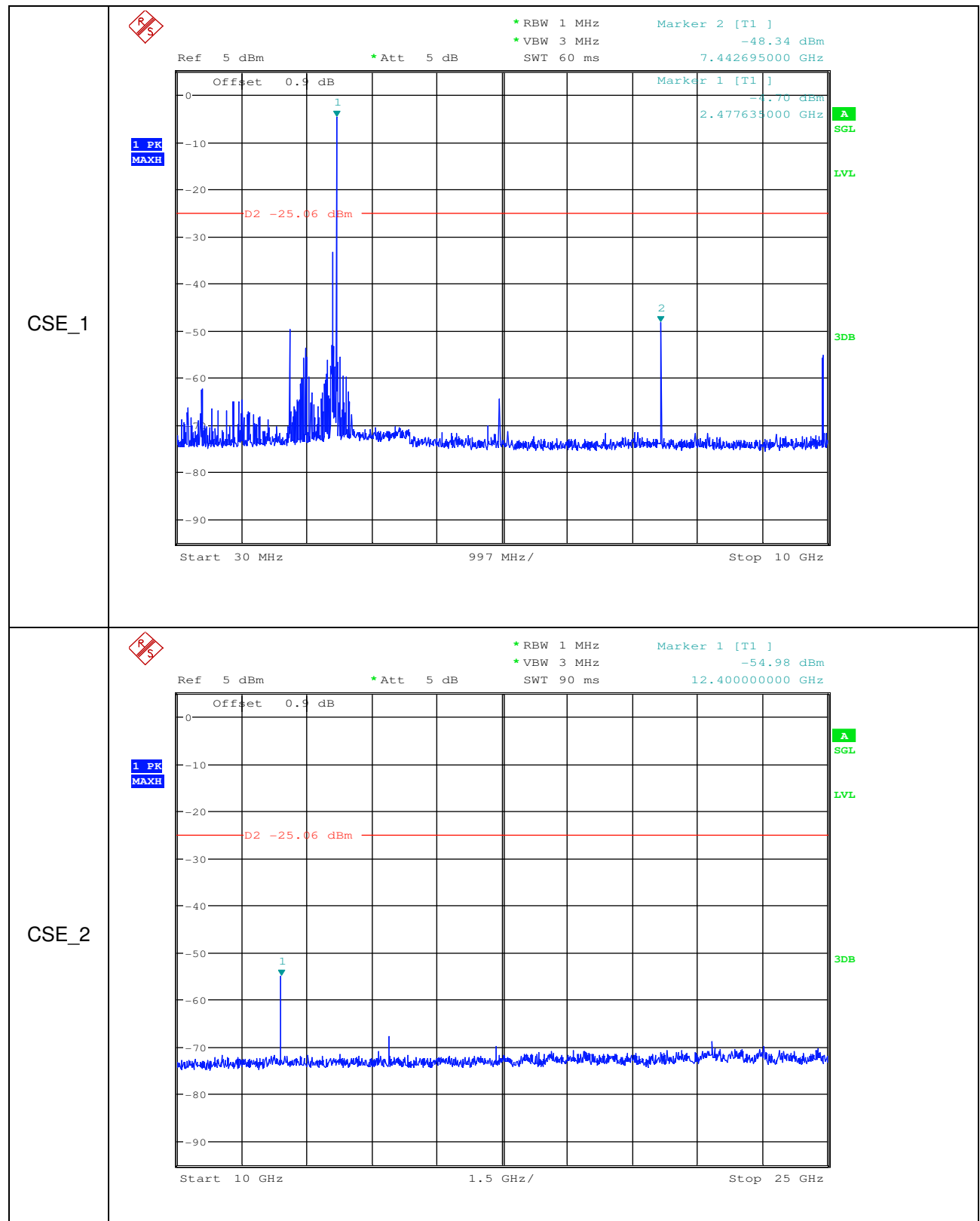


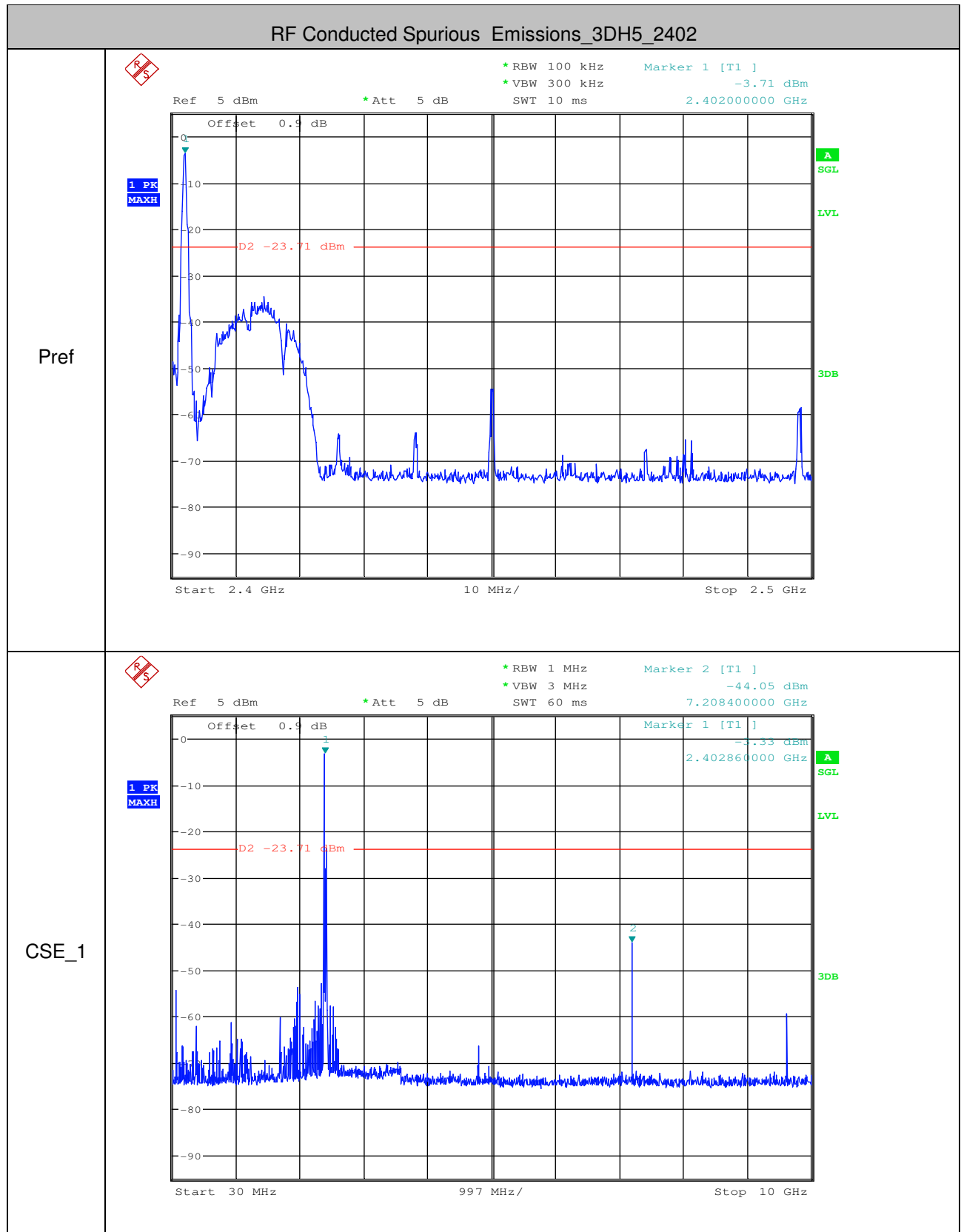


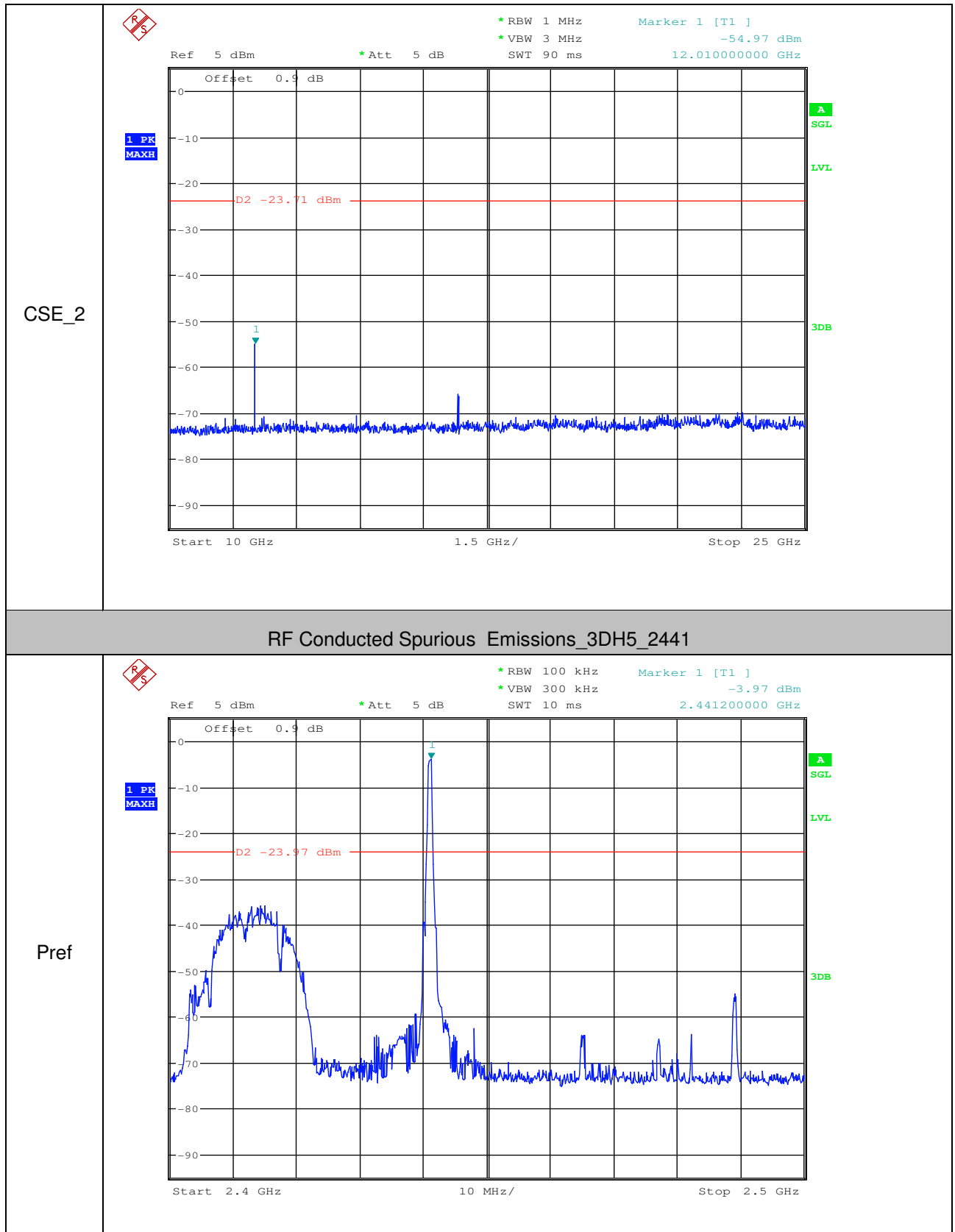


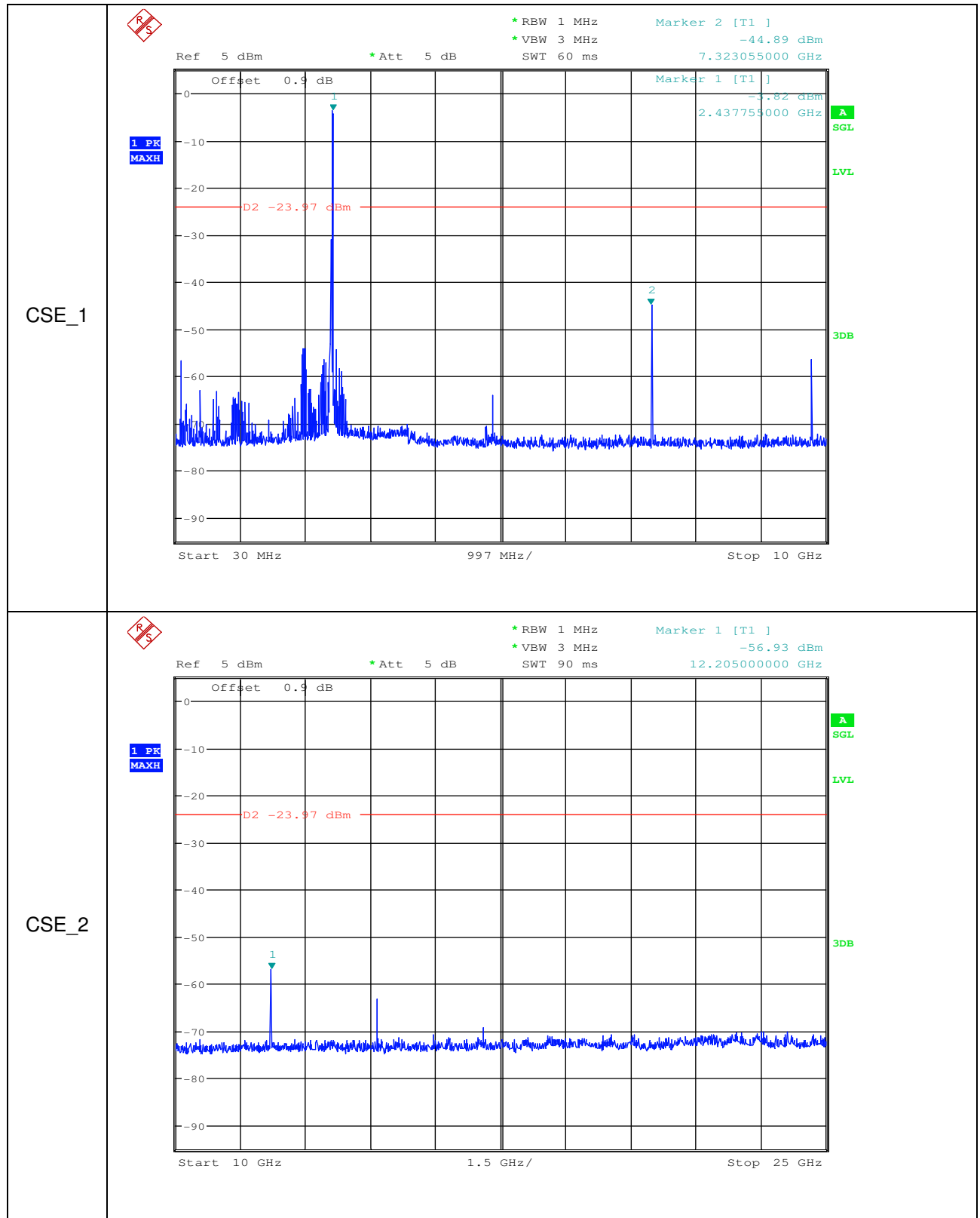


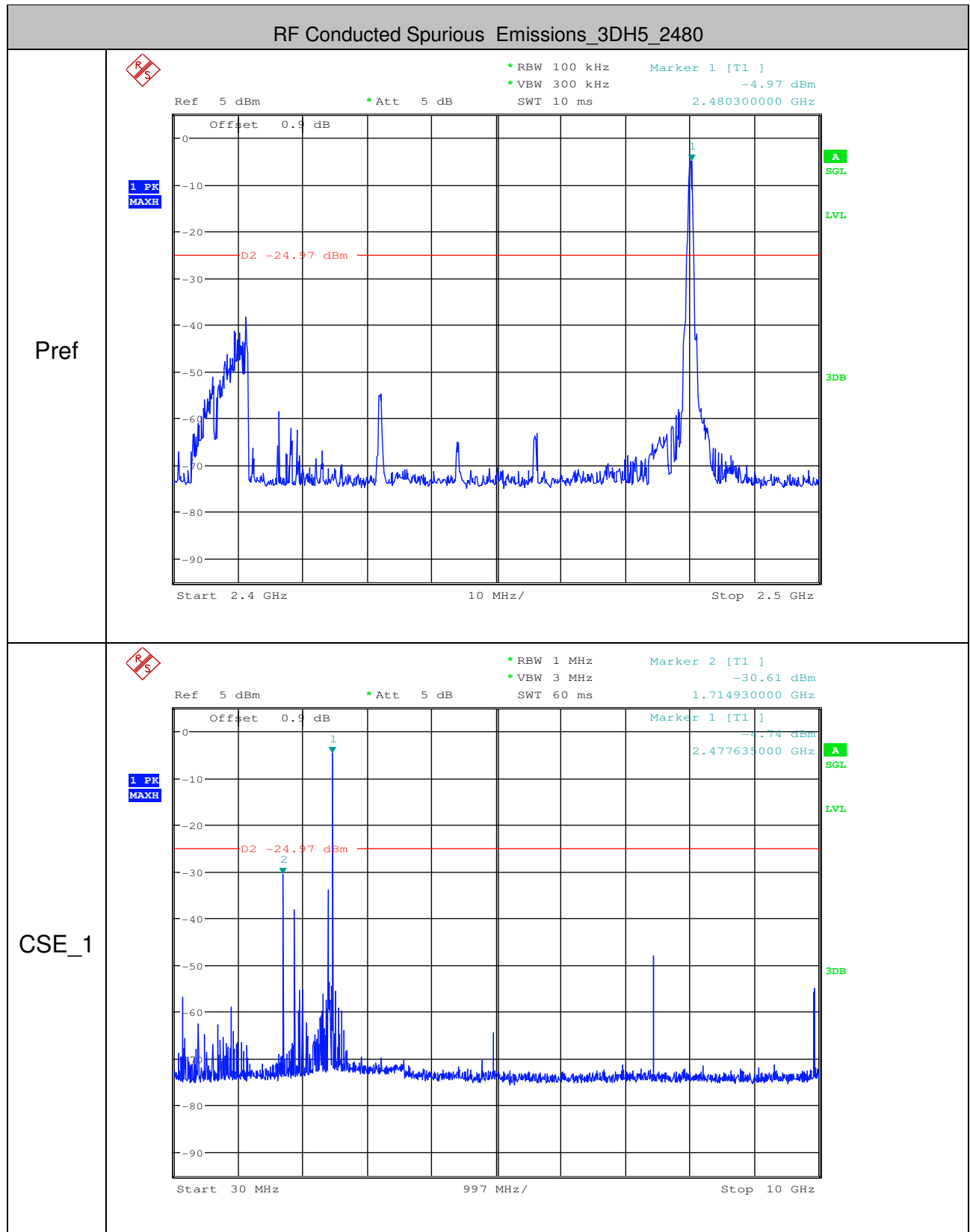














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Shenzhen Branch

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