

TEST REPORT

Application No.: SZEM1907016369CR
Applicant: Voxx Accessories Corp.
Address of Applicant: 3502 Woodview Trace suite 220, Indianapolis, Indiana 46268, United States
Manufacturer: Shenzhen Great Power Innovation and Technology Enterpriese Co., Ltd
Address of Manufacturer: Building E, Xinxulong Industrial Area, Kukeng Village, Guanlan Town, Longhua New District, Shenzhen, China
Factory: Shenzhen Great Power Innovation and Technology Enterpriese Co., Ltd
Address of Factory: Building E, Xinxulong Industrial Area, Kukeng Village, Guanlan Town, Longhua New District, Shenzhen, China
Equipment Under Test (EUT):
EUT Name: Karaoke System
Model No.: SPKA25
Trade mark: SINGSATION
FCC ID: VIXSPKA25
Standard(s) : 47 CFR Part 15, Subpart C 15.247
Date of Receipt: 2019-07-15
Date of Test: 2019-07-17 to 2019-07-29
Date of Issue: 2019-07-31

Test Result:	Pass*
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* In the configuration tested, the EUT complied with the standards specified above.

Keny Xu

Keny Xu
EMC Laboratory Manager



Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2019-07-31		Original

Authorized for issue by:			
			
		Leo Li /Project Engineer	
			
		Eric Fu /Reviewer	

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(b)(4)	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 Emissions 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	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
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
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 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
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 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
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

3 Contents

	Page
1 COVER PAGE	1
2 TEST SUMMARY	3
3 CONTENTS	4
4 GENERAL INFORMATION	6
4.1 DETAILS OF E.U.T.	6
4.2 DESCRIPTION OF SUPPORT UNITS	6
4.3 MEASUREMENT UNCERTAINTY	6
4.4 TEST LOCATION.....	7
4.5 TEST FACILITY.....	7
4.6 DEVIATION FROM STANDARDS.....	7
4.7 ABNORMALITIES FROM STANDARD CONDITIONS	7
5 EQUIPMENT LIST.....	8
6 RADIO SPECTRUM TECHNICAL REQUIREMENT	13
6.1 ANTENNA REQUIREMENT	13
6.1.1 Test Requirement:	13
6.1.2 Conclusion	13
6.2 OTHER REQUIREMENTS FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM HOPPING SEQUENCE	14
6.2.1 Test Requirement:	14
6.2.2 Conclusion	14
7 RADIO SPECTRUM MATTER TEST RESULTS.....	16
7.1 CONDUCTED EMISSIONS AT AC POWER LINE (150KHZ-30MHZ).....	16
7.1.1 E.U.T. Operation	17
7.1.2 Test Setup Diagram.....	17
7.1.3 Measurement Procedure and Data.....	17
7.2 CONDUCTED PEAK OUTPUT POWER.....	20
7.2.1 E.U.T. Operation	21
7.2.2 Test Setup Diagram.....	21
7.2.3 Measurement Procedure and Data.....	21
7.3 20DB BANDWIDTH	22
7.3.1 E.U.T. Operation	22
7.3.2 Test Setup Diagram.....	22
7.3.3 Measurement Procedure and Data.....	22
7.4 CARRIER FREQUENCIES SEPARATION.....	23
7.4.1 E.U.T. Operation	24
7.4.2 Test Setup Diagram.....	24
7.4.3 Measurement Procedure and Data.....	24
7.5 HOPPING CHANNEL NUMBER.....	25
7.5.1 E.U.T. Operation	26
7.5.2 Test Setup Diagram.....	26
7.5.3 Measurement Procedure and Data.....	26
7.6 DWELL TIME.....	27



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7.6.1	E.U.T. Operation	28
7.6.2	Test Setup Diagram	28
7.6.3	Measurement Procedure and Data	28
7.7	CONDUCTED BAND EDGES MEASUREMENT	29
7.7.1	E.U.T. Operation	30
7.7.2	Test Setup Diagram	30
7.7.3	Measurement Procedure and Data	30
7.8	CONDUCTED SPURIOUS EMISSIONS	31
7.8.1	E.U.T. Operation	32
7.8.2	Test Setup Diagram	32
7.8.3	Measurement Procedure and Data	32
7.9	RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS	33
7.9.1	E.U.T. Operation	34
7.9.2	Test Setup Diagram	34
7.9.3	Measurement Procedure and Data	35
7.10	RADIATED SPURIOUS EMISSIONS	40
7.10.1	E.U.T. Operation	41
7.10.2	Test Setup Diagram	41
7.10.3	Measurement Procedure and Data	42
8	PHOTOGRAPHS	51
8.1	TEST SETUP	51
8.2	EUT CONSTRUCTIONAL DETAILS (EUT PHOTOS)	51
9	APPENDIX	52
9.1	APPENDIX 15.247	52-97

4 General Information

4.1 Details of E.U.T.

Power supply:	DC 9V Adapter Model: HX12H-0901000-AU-001 Input: AC100-240V 50/60Hz 0.5A Max Output: DC 9.0V 1.0A 12V DC (1.5Vx8"AA" Size Batteries)
Cable:	DC cable: 190cm unshielded Microphone cable: 210cm unshielded
Operation Frequency:	2402MHz to 2480MHz
Bluetooth Version:	V5.0 Classic
Spectrum Spread Technology:	Frequency Hopping Spread Spectrum(FHSS)
Modulation Type:	GFSK, $\pi/4$ DQPSK, 8DPSK
Number of Channels:	79
Channel Spacing:	1MHz
Antenna Type:	PCB Antenna
Antenna Gain:	0dBi

4.2 Description of Support Units

The EUT has been tested as an independent unit.

4.3 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	$\pm 7.25 \times 10^{-8}$
2	Occupied Bandwidth	$\pm 3\%$
3	Conduction emission	$\pm 3.0\text{dB}$ (150kHz to 30MHz)
4	RF conducted power	$\pm 0.75\text{dB}$
5	Conducted Spurious emissions	$\pm 0.75\text{dB}$
6	Radiated Spurious emission test	$\pm 4.5\text{dB}$ (Below 1GHz)
		$\pm 4.8\text{dB}$ (Above 1GHz)
7	Temperature test	$\pm 1^\circ\text{C}$
8	Humidity test	$\pm 3\%$
9	Supply voltages	$\pm 1.5\%$
10	Time	$\pm 3\%$

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 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

- **FCC –Designation Number: CN1178**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

- **Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None

5 Equipment List

Conducted Emissions 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	2019-06-13	2024-06-12
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM024-01	2019-07-11	2020-07-10
LISN	Rohde & Schwarz	ENV216	SEM007-01	2018-09-25	2019-09-24
LISN	ETS-LINDGREN	3816/2	SEM007-02	2019-04-01	2020-03-31
EMI Test Receiver	Rohde & Schwarz	ESCI	SEM004-02	2019-04-01	2020-03-31

Conducted Peak Output Power					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Shielding Room	SAEMC	MSR733	SEM001-09	2019-06-13	2024-06-12
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2018-09-25	2019-09-24
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2018-09-27	2019-09-26
Measurement Software	JS Tonscend	JS1120-2 BT/WIFI V2.	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM031-02	2019-07-11	2020-07-10
Attenuator	Weinschel Associates	WA41	SEM021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM006-05	2018-09-27	2019-09-26
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2018-09-25	2019-09-24
Electric and Magnetic Field Analyzer	Narda	NBM-550/EHP-50F	EMC2143	2018-02-07	2020-02-06
Electric Field Probe (100KHz-3GHz)	WANDEL & GOLTERMANN	EMR-20	EMC0907	2019-05-21	2020-05-20
EMF Tester	Narda	ELT-400	SZE039-4	2019-07-08	2020-07-07

20dB Bandwidth					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Shielding Room	SAEMC	MSR733	SEM001-09	2019-06-13	2024-06-12
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2018-09-25	2019-09-24
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2018-09-27	2019-09-26
Measurement Software	JS Tonscend	JS1120-2 BT/WIFI V2.	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM031-02	2019-07-11	2020-07-10
Attenuator	Weinschel Associates	WA41	SEM021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM006-05	2018-09-27	2019-09-26
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2018-09-25	2019-09-24
Electric and Magnetic Field Analyzer	Narda	NBM-550/EHP-50F	EMC2143	2018-02-07	2020-02-06



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Electric Field Probe (100KHz-3GHz)	WANDEL & GOLTERMANN	EMR-20	EMC0907	2019-05-21	2020-05-20
EMF Tester	Narda	ELT-400	SZE039-4	2019-07-08	2020-07-07

Carrier Frequencies Separation

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Shielding Room	SAEMC	MSR733	SEM001-09	2019-06-13	2024-06-12
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2018-09-25	2019-09-24
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2018-09-27	2019-09-26
Measurement Software	JS Tonscend	JS1120-2 BT/WIFI V2.	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM031-02	2019-07-11	2020-07-10
Attenuator	Weinschel Associates	WA41	SEM021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM006-05	2018-09-27	2019-09-26
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2018-09-25	2019-09-24
Electric and Magnetic Field Analyzer	Narda	NBM- 550/EHP-50F	EMC2143	2018-02-07	2020-02-06
Electric Field Probe (100KHz-3GHz)	WANDEL & GOLTERMANN	EMR-20	EMC0907	2019-05-21	2020-05-20
EMF Tester	Narda	ELT-400	SZE039-4	2019-07-08	2020-07-07

Hopping Channel Number

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Shielding Room	SAEMC	MSR733	SEM001-09	2019-06-13	2024-06-12
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2018-09-25	2019-09-24
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2018-09-27	2019-09-26
Measurement Software	JS Tonscend	JS1120-2 BT/WIFI V2.	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM031-02	2019-07-11	2020-07-10
Attenuator	Weinschel Associates	WA41	SEM021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM006-05	2018-09-27	2019-09-26
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2018-09-25	2019-09-24
Electric and Magnetic Field Analyzer	Narda	NBM- 550/EHP-50F	EMC2143	2018-02-07	2020-02-06
Electric Field Probe (100KHz-3GHz)	WANDEL & GOLTERMANN	EMR-20	EMC0907	2019-05-21	2020-05-20
EMF Tester	Narda	ELT-400	SZE039-4	2019-07-08	2020-07-07

Dwell Time					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Shielding Room	SAEMC	MSR733	SEM001-09	2019-06-13	2024-06-12
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2018-09-25	2019-09-24
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2018-09-27	2019-09-26
Measurement Software	JS Tonscend	JS1120-2 BT/WIFI V2.	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM031-02	2019-07-11	2020-07-10
Attenuator	Weinschel Associates	WA41	SEM021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM006-05	2018-09-27	2019-09-26
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2018-09-25	2019-09-24
Electric and Magnetic Field Analyzer	Narda	NBM- 550/EHP-50F	EMC2143	2018-02-07	2020-02-06
Electric Field Probe (100KHz-3GHz)	WANDEL & GOLTERMANN	EMR-20	EMC0907	2019-05-21	2020-05-20
EMF Tester	Narda	ELT-400	SZE039-4	2019-07-08	2020-07-07

Conducted Band Edges Measurement					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Shielding Room	SAEMC	MSR733	SEM001-09	2019-06-13	2024-06-12
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2018-09-25	2019-09-24
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2018-09-27	2019-09-26
Measurement Software	JS Tonscend	JS1120-2 BT/WIFI V2.	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM031-02	2019-07-11	2020-07-10
Attenuator	Weinschel Associates	WA41	SEM021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM006-05	2018-09-27	2019-09-26
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2018-09-25	2019-09-24
Electric and Magnetic Field Analyzer	Narda	NBM- 550/EHP-50F	EMC2143	2018-02-07	2020-02-06
Electric Field Probe (100KHz-3GHz)	WANDEL & GOLTERMANN	EMR-20	EMC0907	2019-05-21	2020-05-20
EMF Tester	Narda	ELT-400	SZE039-4	2019-07-08	2020-07-07

Conducted Spurious Emissions					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Shielding Room	SAEMC	MSR733	SEM001-09	2019-06-13	2024-06-12
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2018-09-25	2019-09-24
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2018-09-27	2019-09-26
Measurement Software	JS Tonscend	JS1120-2 BT/WIFI V2.	N/A	N/A	N/A



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Coaxial Cable	SGS	N/A	SEM031-02	2019-07-11	2020-07-10
Attenuator	Weinschel Associates	WA41	SEM021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM006-05	2018-09-27	2019-09-26
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2018-09-25	2019-09-24
Electric and Magnetic Field Analyzer	Narda	NBM-550/EHP-50F	EMC2143	2018-02-07	2020-02-06
Electric Field Probe (100KHz-3GHz)	WANDEL & GOLTERMANN	EMR-20	EMC0907	2019-05-21	2020-05-20
EMF Tester	Narda	ELT-400	SZE039-4	2019-07-08	2020-07-07

Radiated Emissions which fall in the restricted bands

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2018-03-13	2021-03-12
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM026-01	2019-07-11	2020-07-10
EXA Spectrum Analyzer	AgilentTechnologies Inc	N9010A	SEM004-12	2019-04-12	2020-04-11
Horn Antenna (1-18GHz)	Rohde & Schwarz	HF907	SEM003-07	2018-04-13	2021-04-12
Horn Antenna (15GHz-40GHz)	Schwarzbeck	BBHA 9170	SEM003-15	2017-10-17	2020-10-16
Pre-Amplifier (0.1-26.5GHz)	Compliance Directions Systems Inc.	PAP-0126	SEM004-11	2018-11-12	2019-11-11
Pre-amplifier(18-26GHz)	Rohde & Schwarz	CH14-H052	SEM005-17	2019-04-01	2020-03-31
Pre-amplifier (26GHz-40GHz)	Compliance Directions Systems Inc.	PAP-2640-50	SEM005-08	2019-04-01	2020-03-31
DC Power Supply	Zhao Xin	RXN-305D	SEM011-02	2018-09-25	2019-09-24
Active Loop Antenna	ETS-Lindgren	6502	SEM003-08	2017-08-22	2020-08-21

Radiated Spurious Emissions (Above 1GHz)

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2018-03-13	2021-03-12
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM026-01	2019-07-11	2020-07-10
EXA Spectrum Analyzer	AgilentTechnologies Inc	N9010A	SEM004-12	2019-04-12	2020-04-11
Horn Antenna (1-18GHz)	Rohde & Schwarz	HF907	SEM003-07	2018-04-13	2021-04-12



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Horn Antenna (15GHz-40GHz)	Schwarzbeck	BBHA 9170	SEM003-15	2017-10-17	2020-10-16
Pre-Amplifier (0.1-26.5GHz)	Compliance Directions Systems Inc.	PAP-0126	SEM004-11	2018-11-12	2019-11-11
Pre-amplifier(18-26GHz)	Rohde & Schwarz	CH14-H052	SEM005-17	2019-04-01	2020-03-31
Pre-amplifier (26GHz-40GHz)	Compliance Directions Systems Inc.	PAP-2640-50	SEM005-08	2019-04-01	2020-03-31
DC Power Supply	Zhao Xin	RXN-305D	SEM011-02	2018-09-25	2019-09-24
Active Loop Antenna	ETS-Lindgren	6502	SEM003-08	2017-08-22	2020-08-21

Radiated Emissions (30MHz-1GHz)

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
3m Semi-Anechoic Chamber	ETS-LINDGREN	N/A	SEM001-01	2017-08-05	2020-08-04
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM025-01	2019-07-11	2020-07-10
EMI Test Receiver	Agilent Technologies	N9038A	SEM004-05	2018-09-25	2019-09-24
BiConiLog Antenna (26-3000MHz)	ETS-LINDGREN	3142C	SEM003-01	2017-06-27	2020-06-26
Pre-amplifier (0.1-1300MHz)	Agilent Technologies	8447D	SEM005-01	2019-04-01	2020-03-31

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	2018-09-27	2019-09-26
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	ZJ1-2B	SEM002-04	2018-09-27	2019-09-26
Humidity/ Temperature Indicator	Mingle	N/A	SEM002-08	2018-09-27	2019-09-26
Barometer	Changchun Meteorological Industry Factory	DYM3	SEM002-01	2019-04-04	2020-04-03



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6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)

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.

Antenna location: Refer to Appendix(Internal photos)



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6.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence

6.2.1 Test Requirement:

47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)

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.

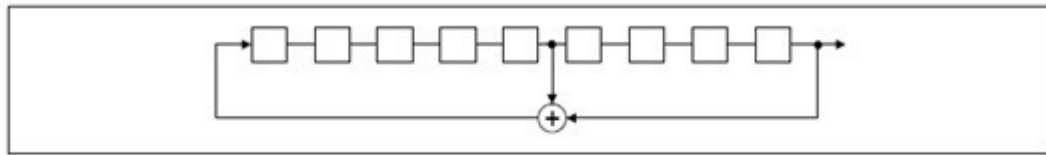
Compliance for section 15.247(a)(1):

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)

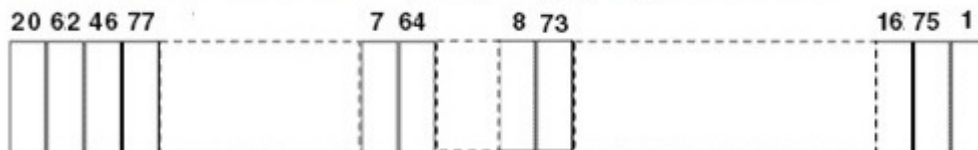
Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



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 individually and independently to avoid hopping on the occupied channels.

The system is designed not have the ability to coordinated with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.





7 Radio Spectrum Matter Test Results

7.1 Conducted Emissions at AC Power Line (150kHz-30MHz)

Test Requirement 47 CFR Part 15, Subpart C 15.207
Test Method: ANSI C63.10 (2013) Section 6.2
Limit:

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

*Decreases with the logarithm of the frequency.



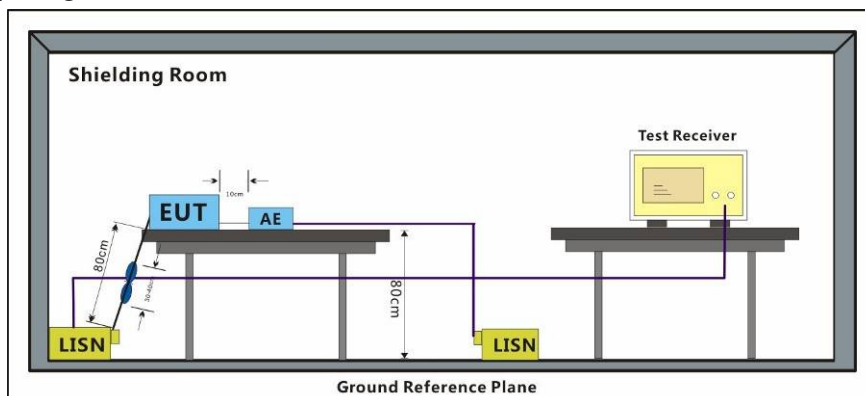
7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 20.5 °C Humidity: 57.7 % RH Atmospheric Pressure: 1005 mbar

Test mode f:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

7.1.2 Test Setup Diagram

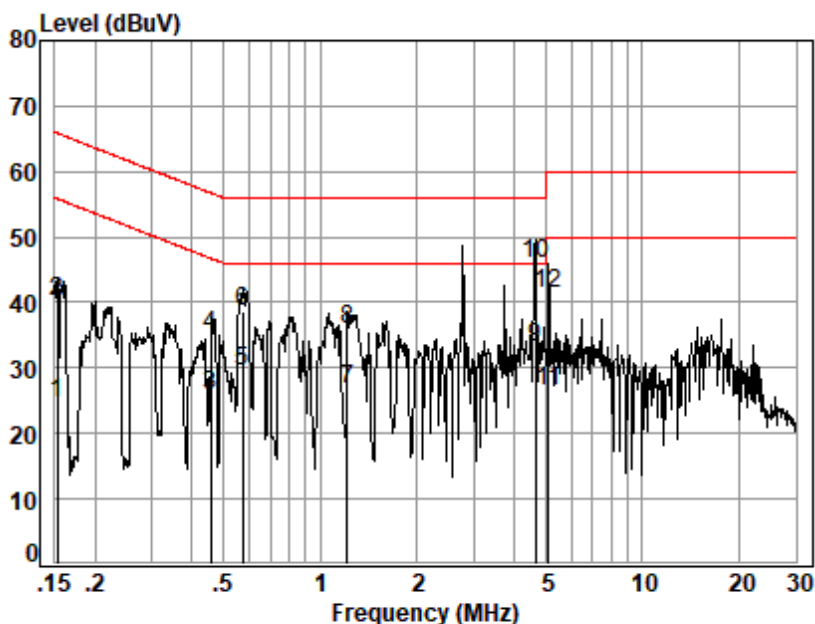


7.1.3 Measurement Procedure and Data

- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50ohm/50 μ H + 50hm linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Remark: LISN=Read Level+ Cable Loss+ LISN Factor

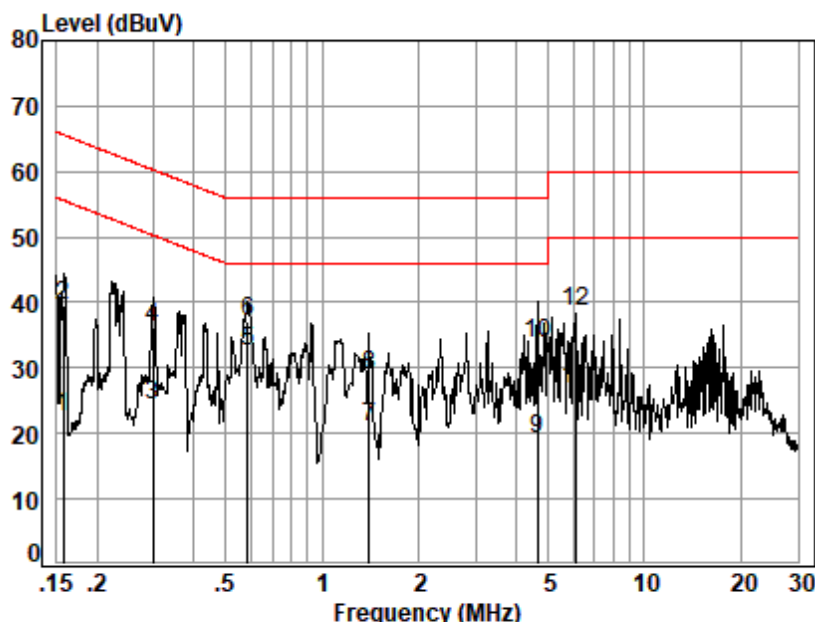
Mode:f; Line:Live Line



Site : Shielding Room
Condition: Line
Job No. : 16369CR
Test mode: f

	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1	0.1532	0.01	9.66	15.03	24.70	55.82	-31.12	Average
2	0.1532	0.01	9.66	30.48	40.15	65.82	-25.67	QP
3	0.4588	0.06	9.67	16.00	25.73	46.71	-20.98	Average
4	0.4588	0.06	9.67	25.28	35.01	56.71	-21.70	QP
5	0.5762	0.07	9.67	19.75	29.49	46.00	-16.51	Average
6	0.5762	0.07	9.67	28.88	38.62	56.00	-17.38	QP
7	1.2162	0.11	9.73	16.87	26.71	46.00	-19.29	Average
8	1.2162	0.11	9.73	25.97	35.81	56.00	-20.19	QP
9	4.6469	0.17	9.73	23.38	33.28	46.00	-12.72	Average
10	4.6469	0.17	9.73	36.07	45.97	56.00	-10.03	QP
11	5.1118	0.17	9.74	16.44	26.35	50.00	-23.65	Average
12	5.1118	0.17	9.74	31.56	41.47	60.00	-18.53	QP

Mode:f; Line:Neutral Line



Site : Shielding Room
Condition: Neutral
Job No. : 16369CR
Test mode: f

	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1	0.1573	0.01	9.63	12.99	22.63	55.60	-32.97	Average
2	0.1573	0.01	9.63	29.87	39.51	65.60	-26.09	QP
3	0.2987	0.04	9.64	14.76	24.44	50.28	-25.84	Average
4	0.2987	0.04	9.64	26.46	36.14	60.28	-24.14	QP
5	0.5885	0.07	9.64	22.74	32.45	46.00	-13.55	Average
6	0.5885	0.07	9.64	27.26	36.97	56.00	-19.03	QP
7	1.3958	0.12	9.70	11.14	20.96	46.00	-25.04	Average
8	1.3958	0.12	9.70	19.21	29.03	56.00	-26.97	QP
9	4.6469	0.17	9.70	9.41	19.28	46.00	-26.72	Average
10	4.6469	0.17	9.70	23.75	33.62	56.00	-22.38	QP
11	6.0885	0.17	9.74	16.84	26.75	50.00	-23.25	Average
12	6.0885	0.17	9.74	28.66	38.57	60.00	-21.43	QP



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 ≥ 50 hopping channels
	0.25 for $25 \leq$ hopping channels < 50
	1 for digital modulation
2400-2483.5	1 for ≥ 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



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7.2.1 E.U.T. Operation

Operating Environment:

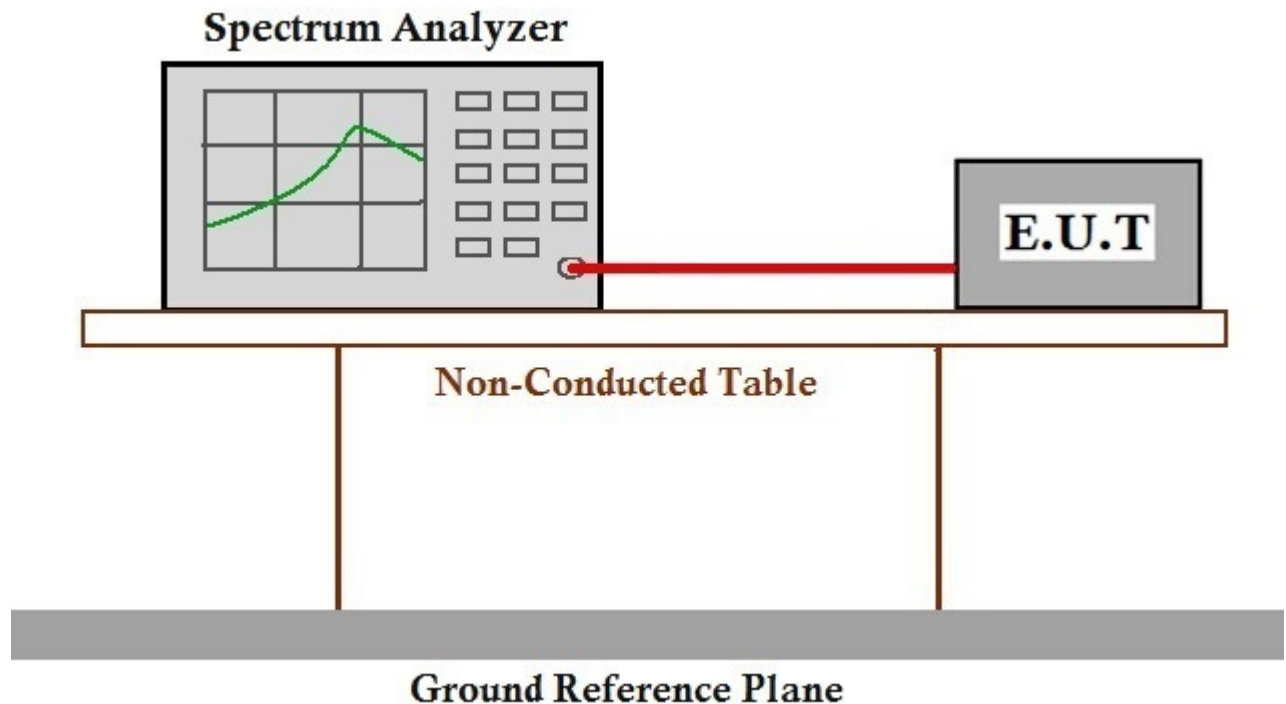
Temperature: 25.2 °C Humidity: 43.8 % RH Atmospheric Pressure: 1005 mbar

Pretest these modes to find the worst case: c:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.(Battery supply)

f:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

The worst case for final test: f:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

7.2.2 Test Setup Diagram



7.2.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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7.3 20dB Bandwidth

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

7.3.1 E.U.T. Operation

Operating Environment:

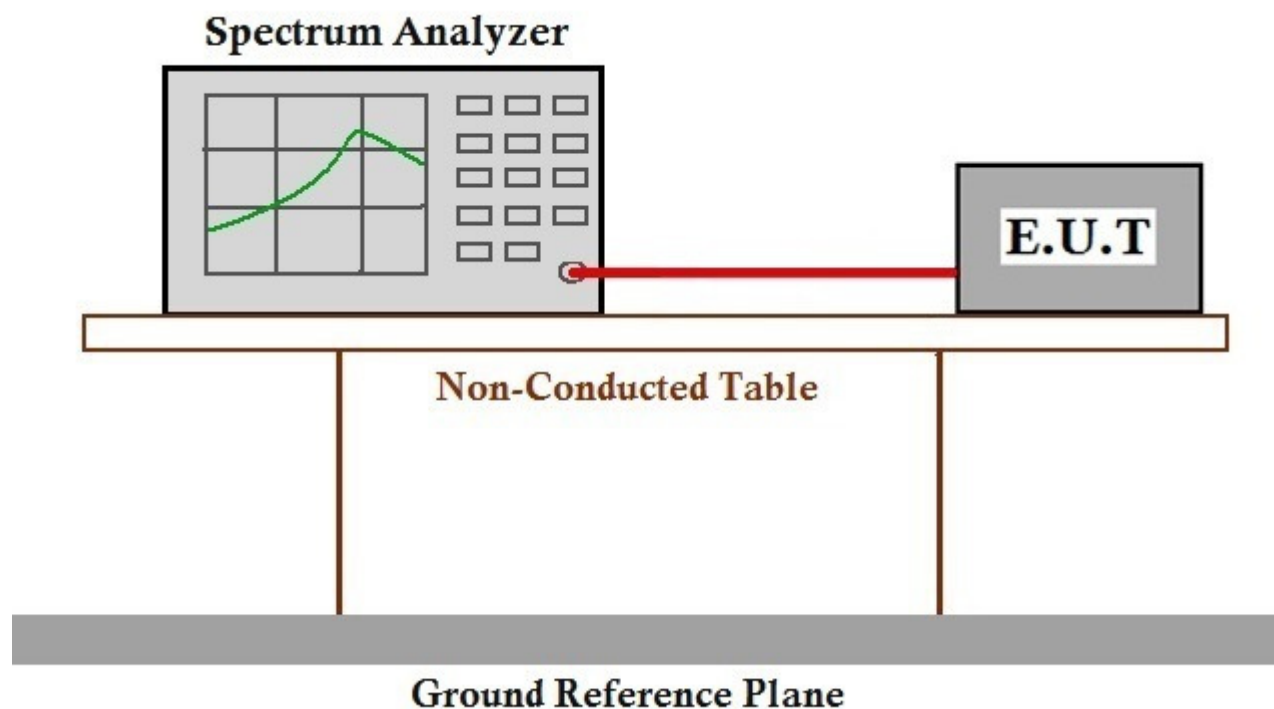
Temperature: 25.2 °C Humidity: 43.8 % RH Atmospheric Pressure: 1005 mbar

Pretest these modes to find the worst case: c:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.(Battery supply)

f:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

The worst case for final test: f:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

7.3.2 Test Setup Diagram



7.3.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

7.4 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



7.4.1 E.U.T. Operation

Operating Environment:

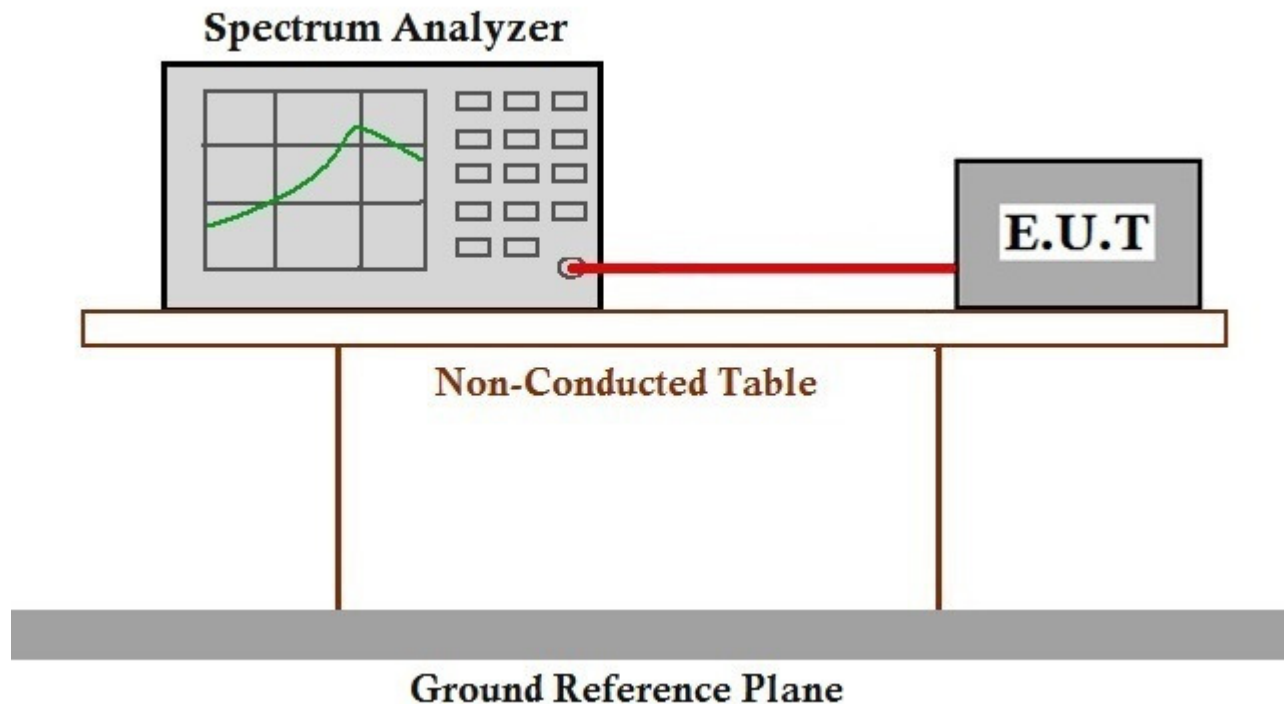
Temperature: 25.2 °C Humidity: 43.8 % RH Atmospheric Pressure: 1005 mbar

Pretest these modes to find the worst case: b:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.(Battery supply)

e:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

The worst case for final test: e:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

7.4.2 Test Setup Diagram



7.4.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



7.5 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



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7.5.1 E.U.T. Operation

Operating Environment:

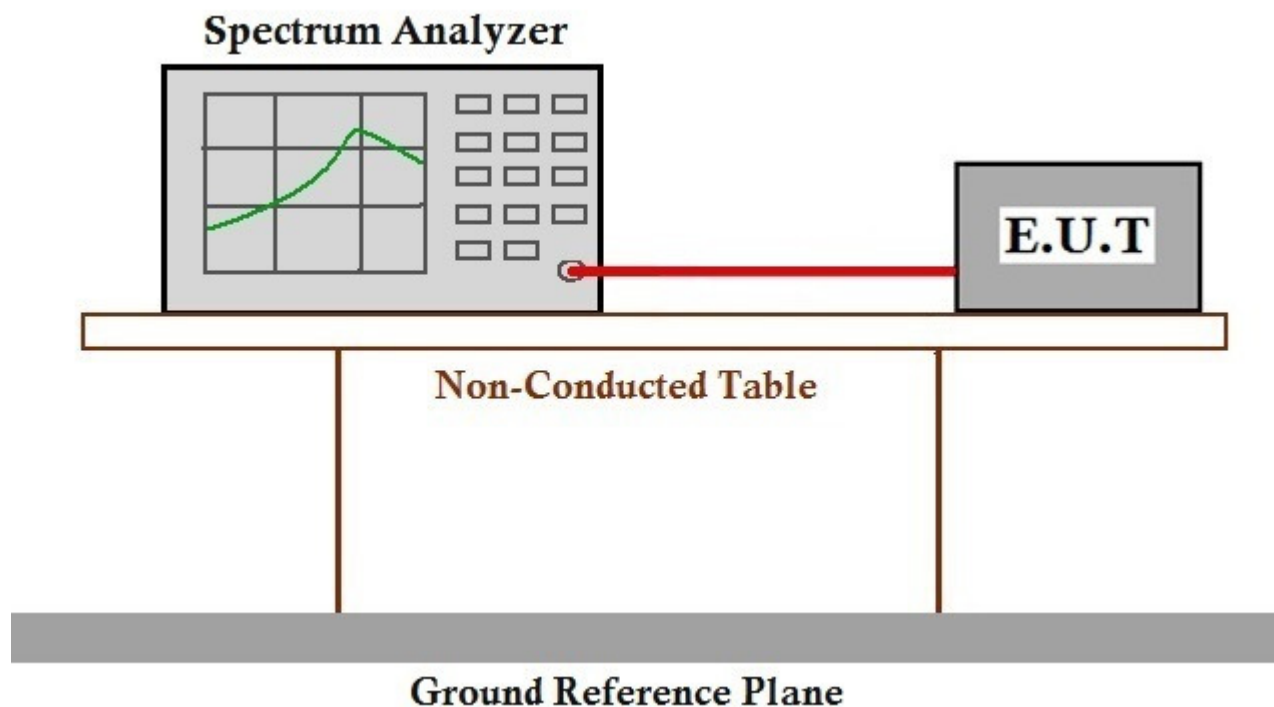
Temperature: 25.2 °C Humidity: 43.8 % RH Atmospheric Pressure: 1005 mbar

Pretest these modes to find the worst case: b:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.(Battery supply)

e:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

The worst case for final test: e:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

7.5.2 Test Setup Diagram



7.5.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



7.6 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



7.6.1 E.U.T. Operation

Operating Environment:

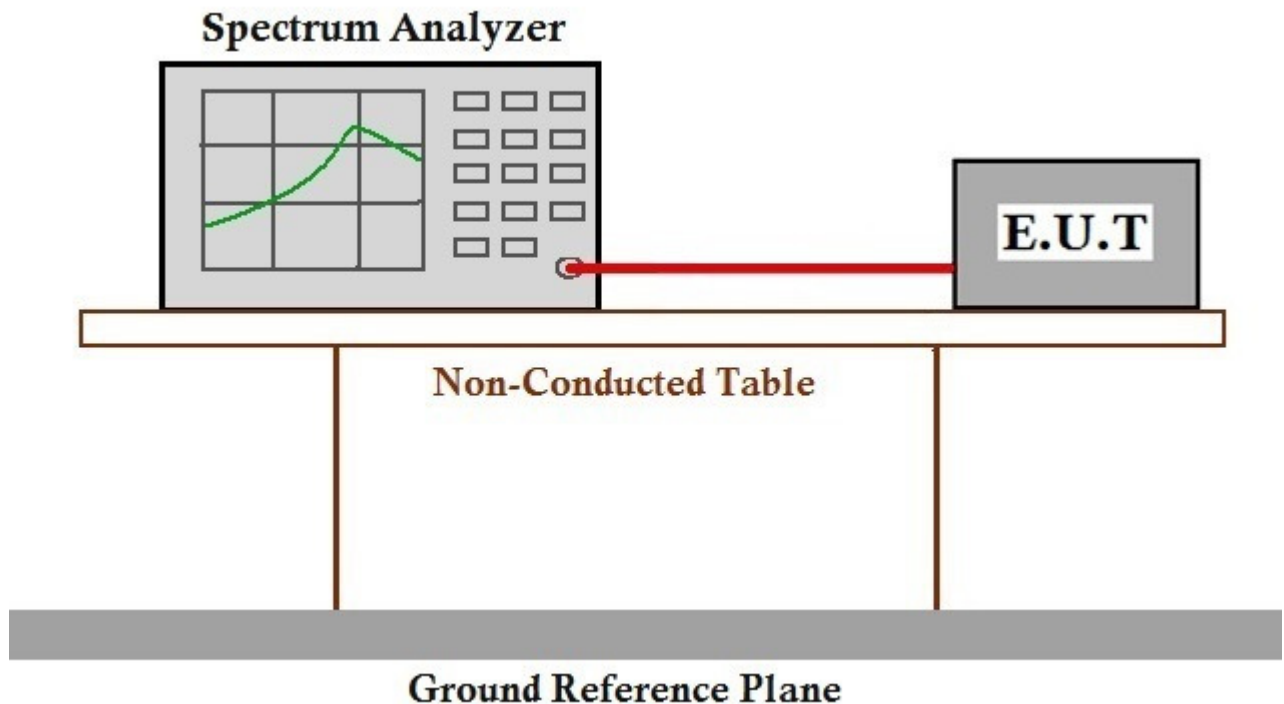
Temperature: 25.2 °C Humidity: 43.8 % RH Atmospheric Pressure: 1005 mbar

Pretest these modes to find the worst case: b:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.(Battery supply)

e:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

The worst case for final test: e:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

7.6.2 Test Setup Diagram



7.6.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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7.7 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

Limit: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))



7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 25.2 °C Humidity: 43.8 % RH Atmospheric Pressure: 1005 mbar

Pretest these modes to find the worst case: b:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.(Battery supply)

c:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.(Battery supply)

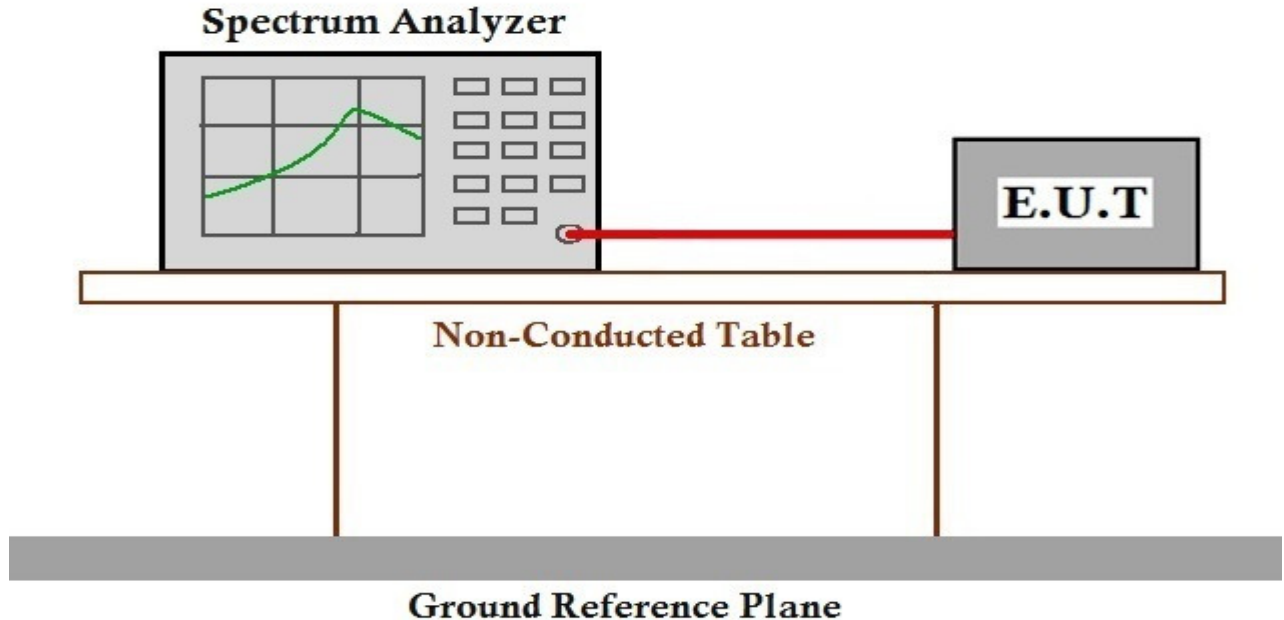
e:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

f:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

The worst case for final test: e:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

f:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

7.7.2 Test Setup Diagram



7.7.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



7.8 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 or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))



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7.8.1 E.U.T. Operation

Operating Environment:

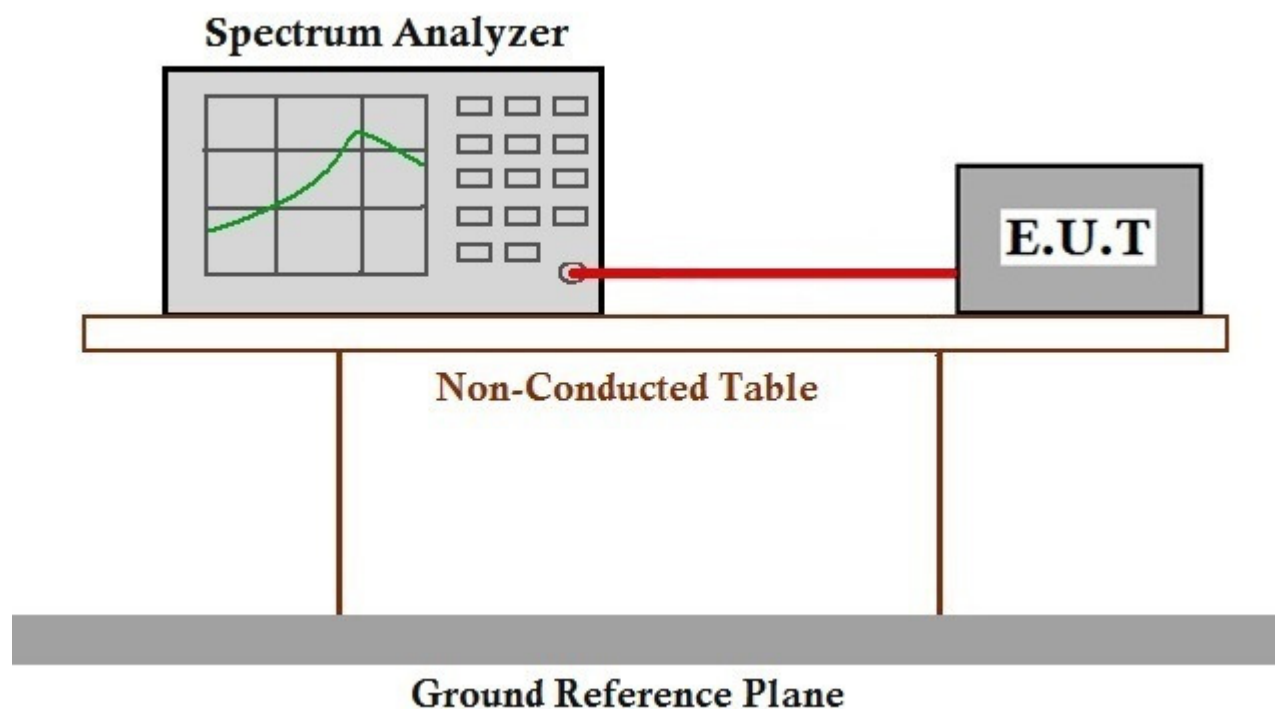
Temperature: 25.2 °C Humidity: 43.8 % RH Atmospheric Pressure: 1005 mbar

Pretest these modes to find the worst case: c:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.(Battery supply)

f:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

The worst case for final test: f:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

7.8.2 Test Setup Diagram



7.8.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



7.9 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
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.



7.9.1 E.U.T. Operation

Operating Environment:

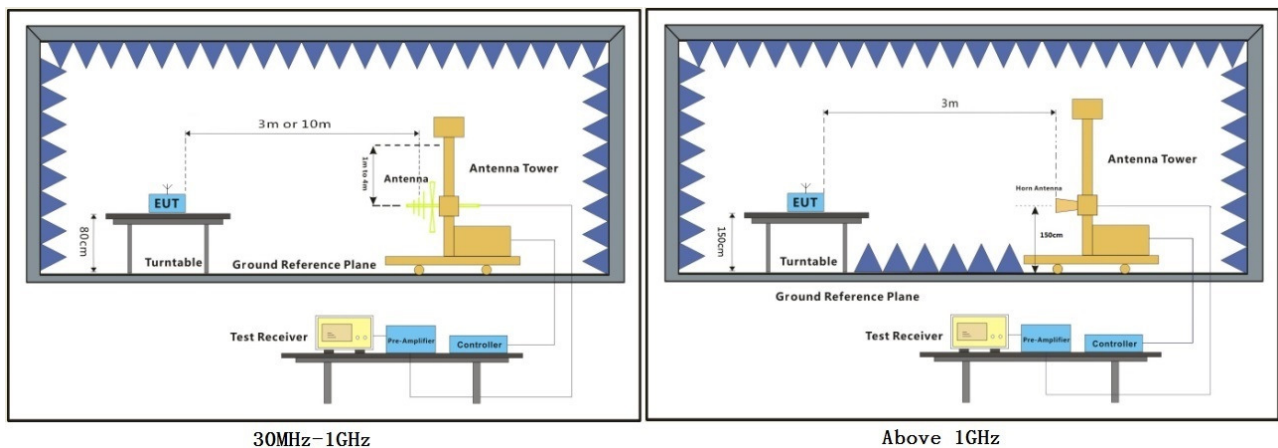
Temperature: 22 °C Humidity: 54 % RH Atmospheric Pressure: 1005 mbar

Pretest these modes to find the worst case: c:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.(Battery supply)

f:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

The worst case for final test: f:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

7.9.2 Test Setup Diagram



30MHz-1GHz

Above 1GHz





7.9.3 Measurement Procedure and 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.

Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

Remark 2: 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. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

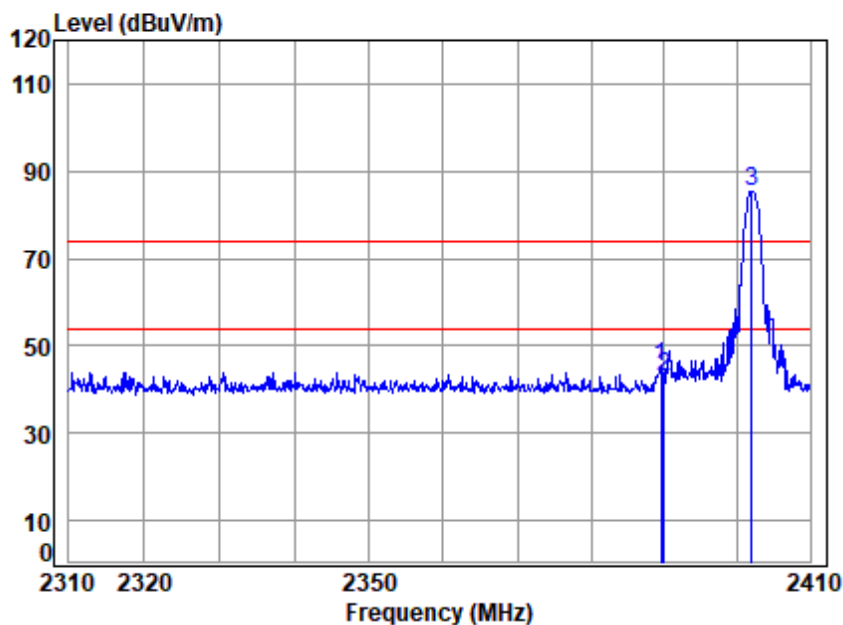


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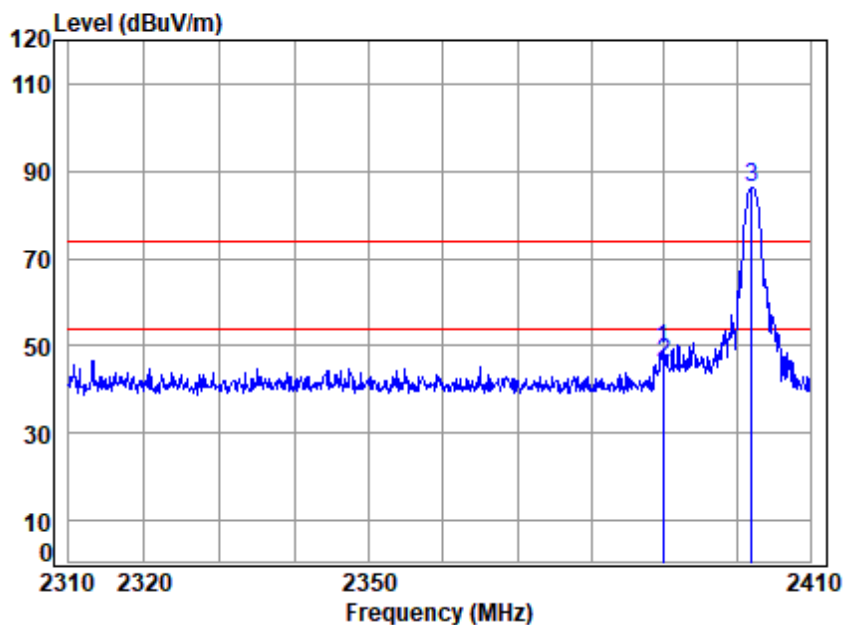
Mode:f; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low



Site : chamber
Condition: 3m HORIZONTAL
Job No : 16369CR\16370CR
Mode : 2402 Band edge
Note : 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	2389.558	5.47	28.52	41.17	52.28	45.10	74.00	-28.90	peak
2	2390.000	5.47	28.52	41.17	50.04	42.86	74.00	-31.14	peak
3 *	2402.000	5.49	28.54	41.18	92.42	85.27	74.00	11.27	peak

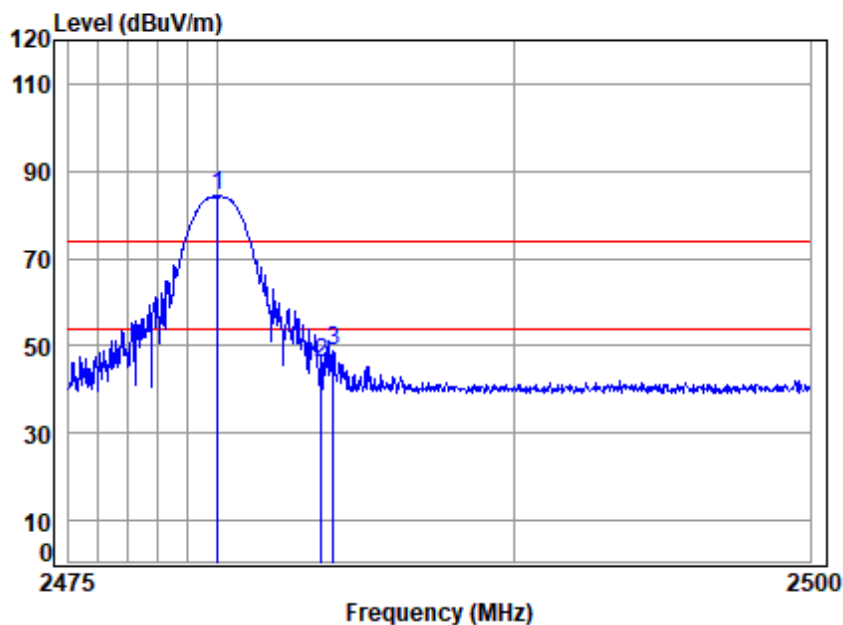
Mode:f; Polarization:Vertical; Modulation:GFSK; ; Channel:Low



Site : chamber
Condition: 3m VERTICAL
Job No : 16369CR\16370CR
Mode : 2402 Band edge
Note : BT

		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	2389.862	5.47	28.52	41.17	56.55	49.37	74.00	-24.63 peak
2	2390.000	5.47	28.52	41.17	53.17	45.99	74.00	-28.01 peak
3 *	2402.000	5.49	28.54	41.18	93.27	86.12	74.00	12.12 peak

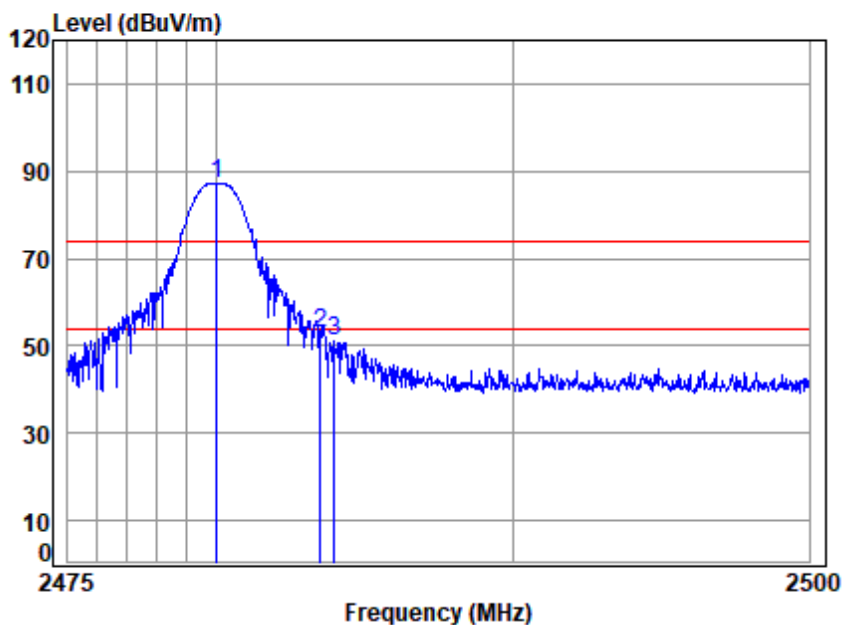
Mode:f; Polarization:Horizontal; Modulation:GFSK; ; Channel:High



Site : chamber
Condition: 3m HORIZONTAL
Job No : 16369CR\16370CR
Mode : 2480 Band edge
Note : BT

	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 * 2480.000	5.59	28.67	41.21	91.18	84.23	74.00	10.23	peak
2 2483.500	5.60	28.67	41.21	52.98	46.04	74.00	-27.96	peak
3 2483.896	5.60	28.67	41.21	55.72	48.78	74.00	-25.22	peak

Mode:f; Polarization:Vertical; Modulation:GFSK; ; Channel:High



Site : chamber
Condition: 3m VERTICAL
Job No : 16369CR\16370CR
Mode : 2480 Band edge
Note : BT

	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 * 2480.000	5.59	28.67	41.21	94.32	87.37	74.00	13.37	peak
2 2483.500	5.60	28.67	41.21	59.86	52.92	74.00	-21.08	peak
3 2483.946	5.60	28.67	41.21	57.96	51.02	74.00	-22.98	peak



7.10 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.



7.10.1 E.U.T. Operation

Operating Environment:

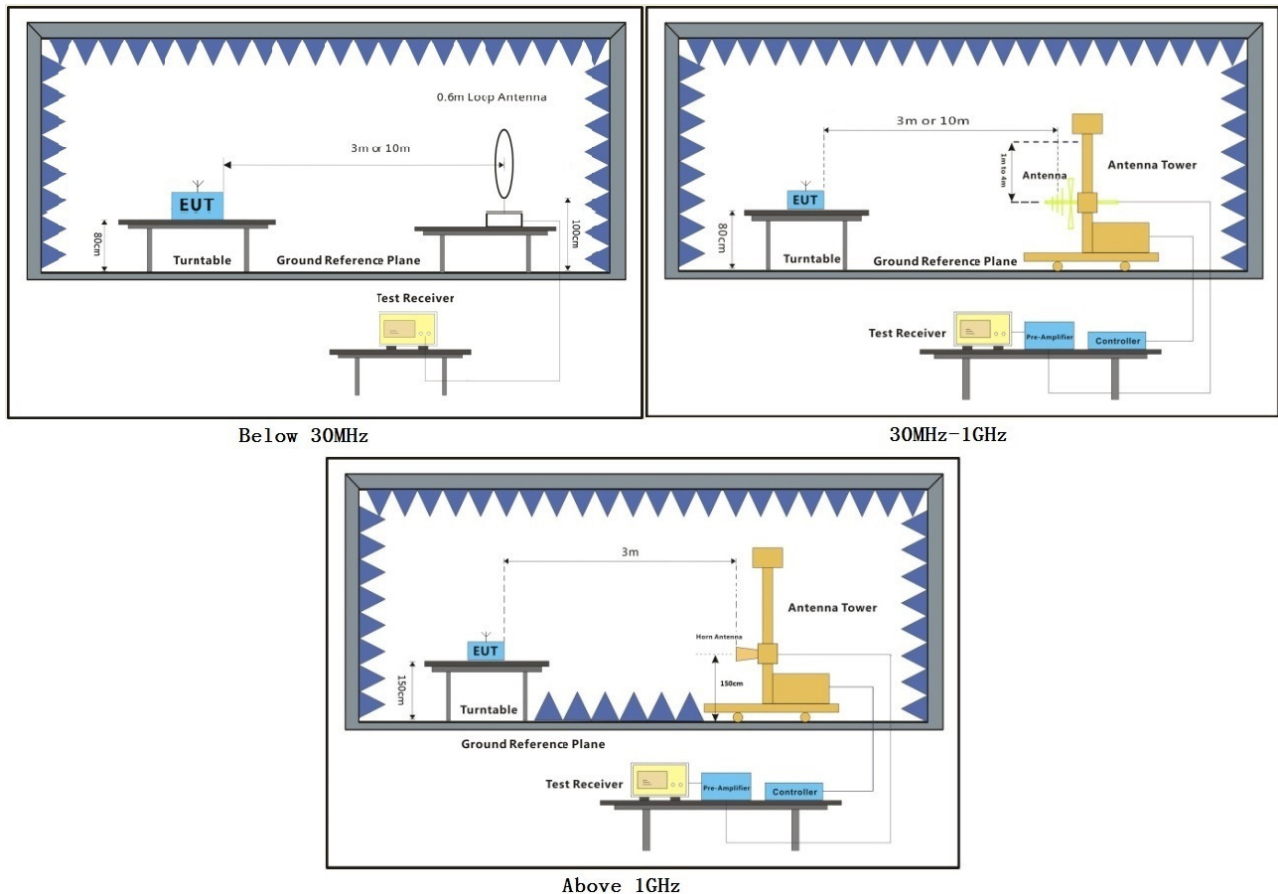
Temperature: 22 °C Humidity: 54 % RH Atmospheric Pressure: 1005 mbar

Pretest these modes to find the worst case: c:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.(Battery supply)

f:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

The worst case for final test: f:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. (Adapter supply)

7.10.2 Test Setup Diagram





7.10.3 Measurement Procedure and 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.

Remark:

- 1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) 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
- 3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 4) 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. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.



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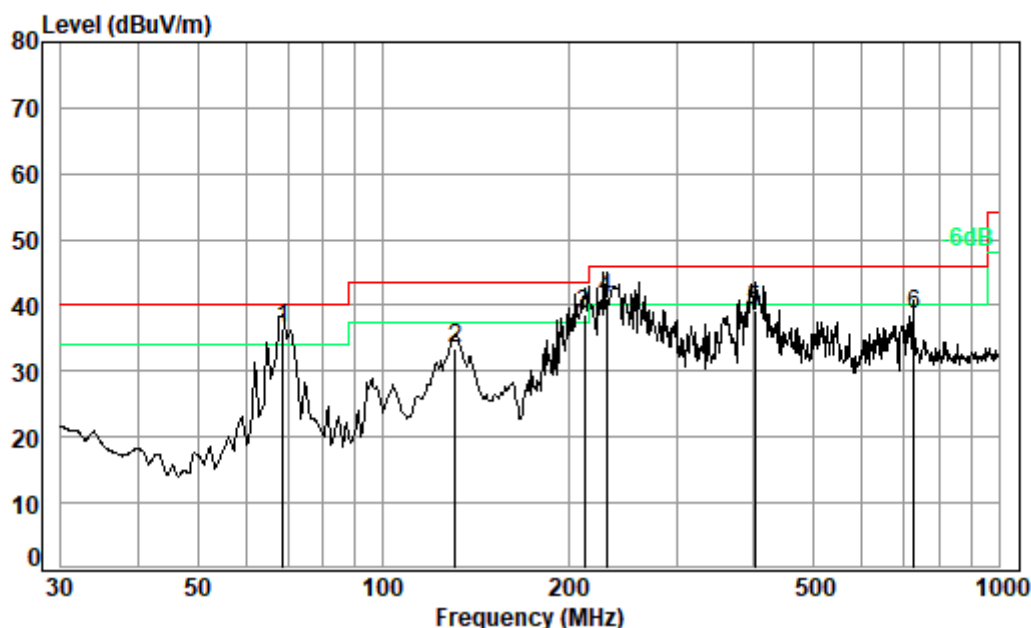
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30MHz~1GHz

QP value:

Mode: f; Polarization: Horizontal;



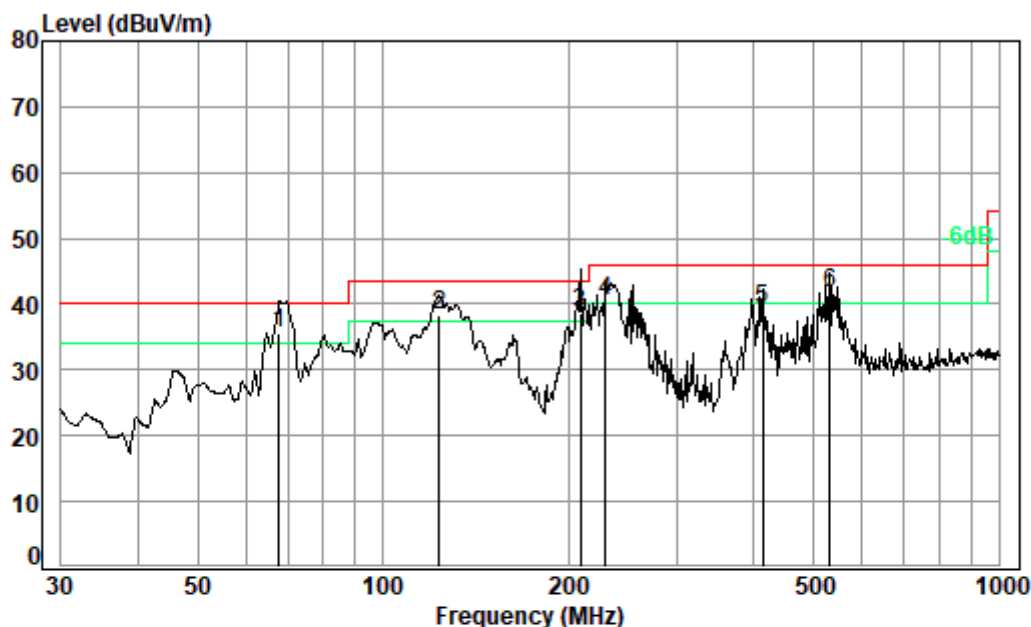
Condition: 3m HORIZONTAL

Job No. : 16369CR

Test mode: f

		Cable	Ant	Preamp	Read		Limit	Over
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	pp	68.87	0.80	12.84	27.67	50.57	36.54	40.00
2		130.84	1.28	13.44	27.46	46.28	33.54	43.50
3		212.27	1.47	16.94	27.13	47.24	38.52	43.50
4		230.91	1.58	18.09	27.07	48.39	40.99	46.00
5		401.84	2.21	22.45	27.43	42.12	39.35	46.00
6		726.81	2.99	28.07	27.87	35.50	38.69	46.00

Mode :f; Polarization: Vertical



Condition: 3m Vertical

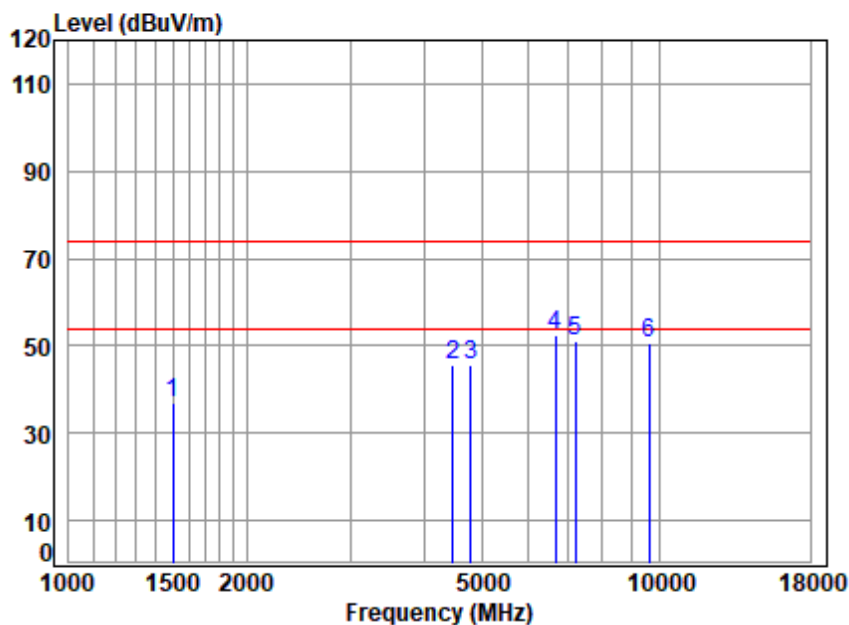
Job No. : 16369CR

Test mode: f

	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	67.91	0.80	12.88	27.67	49.55	35.56	40.00	-4.44
2	123.27	1.26	13.20	27.50	51.35	38.31	43.50	-5.19
3 qp	209.31	1.46	16.83	27.14	47.56	38.71	43.50	-4.79
4	230.10	1.57	18.03	27.07	47.84	40.37	46.00	-5.63
5	413.27	2.26	22.72	27.48	41.86	39.36	46.00	-6.64
6 pp	531.96	2.63	25.28	27.95	41.80	41.76	46.00	-4.24

Above 1GHz

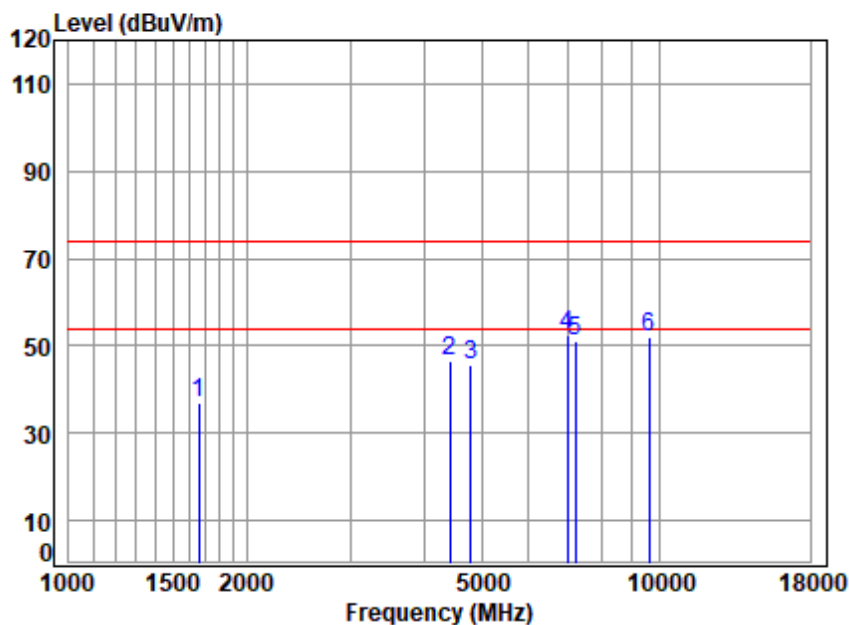
Mode:f; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low



Site : chamber
Condition: 3m HORIZONTAL
Job No : 16369CR\16370CR
Mode : 2402 TX RSE
Note : BT

	Freq	Cable Loss	Ant Factor	Preamplifier Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1503.119	5.48	25.81	40.71	46.19	36.77	74.00	-37.23	peak
2	4469.214	7.53	33.60	43.27	47.89	45.75	74.00	-28.25	peak
3	4804.000	7.89	34.16	43.61	47.22	45.66	74.00	-28.34	peak
4	6659.763	11.08	35.56	42.28	47.93	52.29	74.00	-21.71	peak
5	7206.000	10.08	36.42	41.86	46.39	51.03	74.00	-22.97	peak
6	9608.000	10.75	37.52	38.43	40.66	50.50	74.00	-23.50	peak

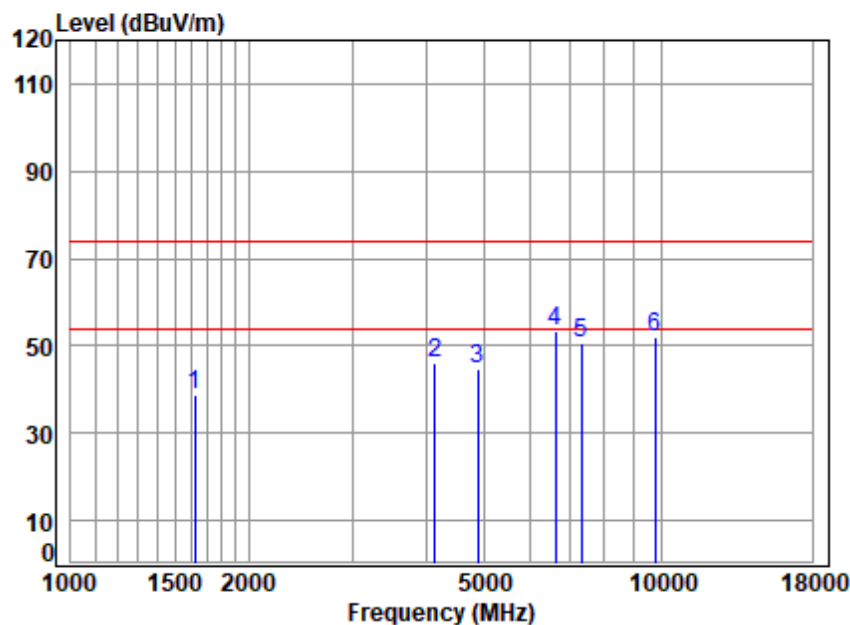
Mode:f; Polarization:Vertical; Modulation:GFSK; ; Channel:Low



Site : chamber
Condition: 3m VERTICAL
Job No : 16369CR\16370CR
Mode : 2402 TX RSE
Note : BT

	Freq	Cable Loss	Ant Factor	Preamplifier Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1663.137	5.27	26.52	40.81	46.09	37.07	74.00	-36.93	peak
2	4417.841	7.47	33.60	43.22	48.63	46.48	74.00	-27.52	peak
3	4804.000	7.89	34.16	43.61	47.06	45.50	74.00	-28.50	peak
4	6995.172	10.14	36.49	42.01	47.75	52.37	74.00	-21.63	peak
5	7206.000	10.08	36.42	41.86	46.62	51.26	74.00	-22.74	peak
6	9608.000	10.75	37.52	38.43	42.03	51.87	74.00	-22.13	peak

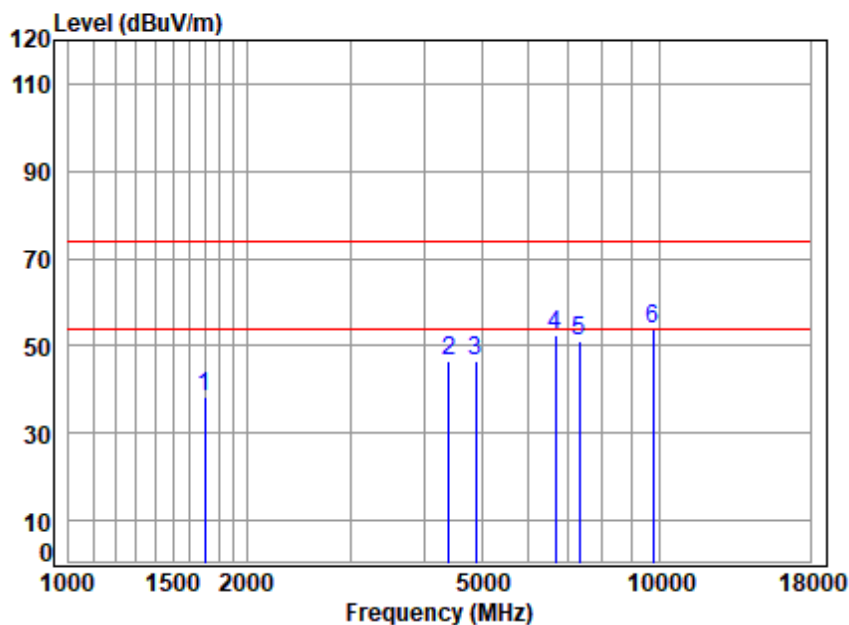
Mode:f; Polarization:Horizontal; Modulation:GFSK; ; Channel:middle



Site : chamber
Condition: 3m HORIZONTAL
Job No : 16369CR\16370CR
Mode : 2441 TX RSE
Note : BT

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1625.121	5.32	26.36	40.79	47.99	38.88	74.00	-35.12	peak
2	4133.699	7.14	33.60	42.91	48.09	45.92	74.00	-28.08	peak
3	4882.000	7.97	34.30	43.69	46.02	44.60	74.00	-29.40	peak
4	6621.375	11.19	35.45	42.31	48.96	53.29	74.00	-20.71	peak
5	7323.000	10.05	36.37	41.77	45.81	50.46	74.00	-23.54	peak
6	9764.000	10.82	37.55	38.17	42.00	52.20	74.00	-21.80	peak

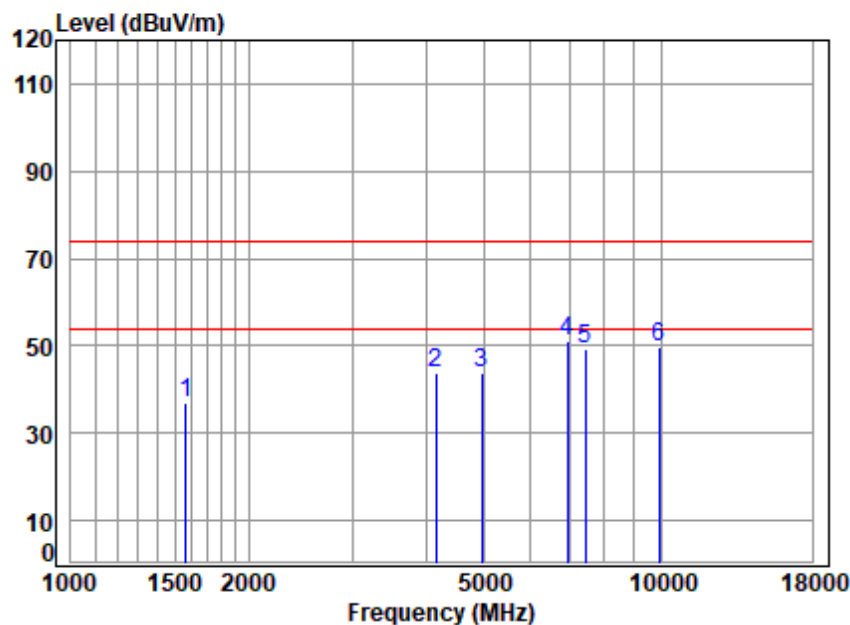
Mode:f; Polarization:Vertical; Modulation:GFSK; ; Channel:middle



Site : chamber
Condition: 3m VERTICAL
Job No : 16369CR\16370CR
Mode : 2441 TX RSE
Note : BT

	Freq	Cable Loss	Ant Factor	Preamplifier Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1702.042	5.23	26.68	40.83	47.29	38.37	74.00	-35.63	peak
2	4405.090	7.46	33.60	43.20	48.84	46.70	74.00	-27.30	peak
3	4882.000	7.97	34.30	43.69	47.81	46.39	74.00	-27.61	peak
4	6679.040	11.02	35.61	42.26	48.20	52.57	74.00	-21.43	peak
5	7323.000	10.05	36.37	41.77	46.59	51.24	74.00	-22.76	peak
6	9764.000	10.82	37.55	38.17	43.51	53.71	74.00	-20.29	peak

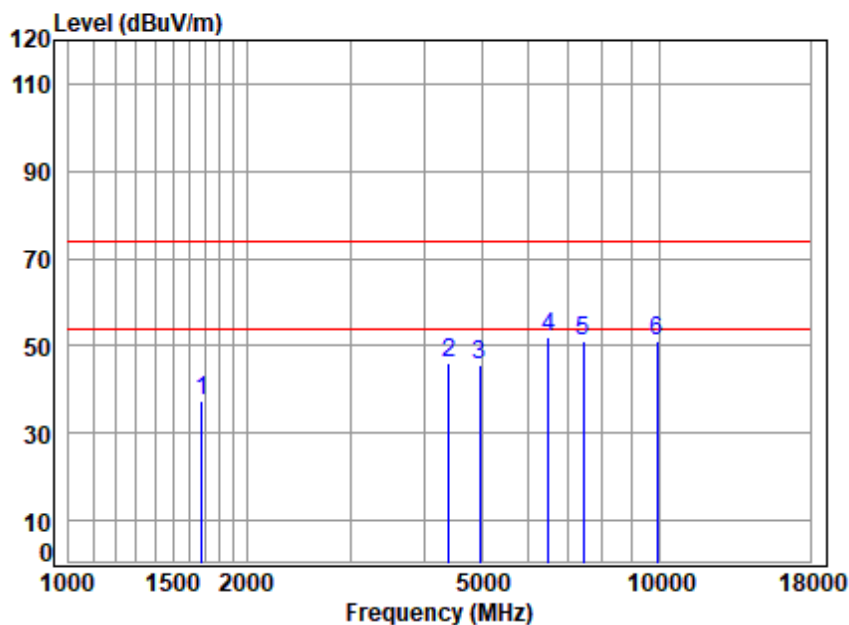
Mode:f; Polarization:Horizontal; Modulation:GFSK; ; Channel:High



Site : chamber
Condition: 3m HORIZONTAL
Job No : 16369CR\16370CR
Mode : 2480 TX RSE
Note : 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	1569.721	5.39	26.12	40.75	46.20	36.96	74.00	-37.04	peak
2	4157.664	7.17	33.60	42.93	46.09	43.93	74.00	-30.07	peak
3	4960.000	8.05	34.43	43.76	45.12	43.84	74.00	-30.16	peak
4	6934.778	10.31	36.32	42.06	46.49	51.06	74.00	-22.94	peak
5	7440.000	10.02	36.32	41.69	44.53	49.18	74.00	-24.82	peak
6	9920.000	10.90	37.58	37.93	39.04	49.59	74.00	-24.41	peak

Mode:f; Polarization:Vertical; Modulation:GFSK; ; Channel:High



Site : chamber
Condition: 3m VERTICAL
Job No : 16369CR\16370CR
Mode : 2480 TX RSE
Note : BT

	Freq	Cable Loss	Ant Factor	Preamplifier Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1677.621	5.25	26.58	40.82	46.19	37.20	74.00	-36.80	peak
2	4405.090	7.46	33.60	43.20	48.15	46.01	74.00	-27.99	peak
3	4960.000	8.05	34.43	43.76	46.96	45.68	74.00	-28.32	peak
4	6488.754	11.52	35.09	42.41	47.61	51.81	74.00	-22.19	peak
5	7440.000	10.02	36.32	41.69	46.53	51.18	74.00	-22.82	peak
6	9920.000	10.90	37.58	37.93	40.57	51.12	74.00	-22.88	peak



8 Photographs

8.1 Test Setup

Please refer to setup photos.

8.2 EUT Constructional Details (EUT Photos)

Please refer to external and internal photos for details.





9 Appendix

9.1 Appendix 15.247

1.20 dB Bandwidth

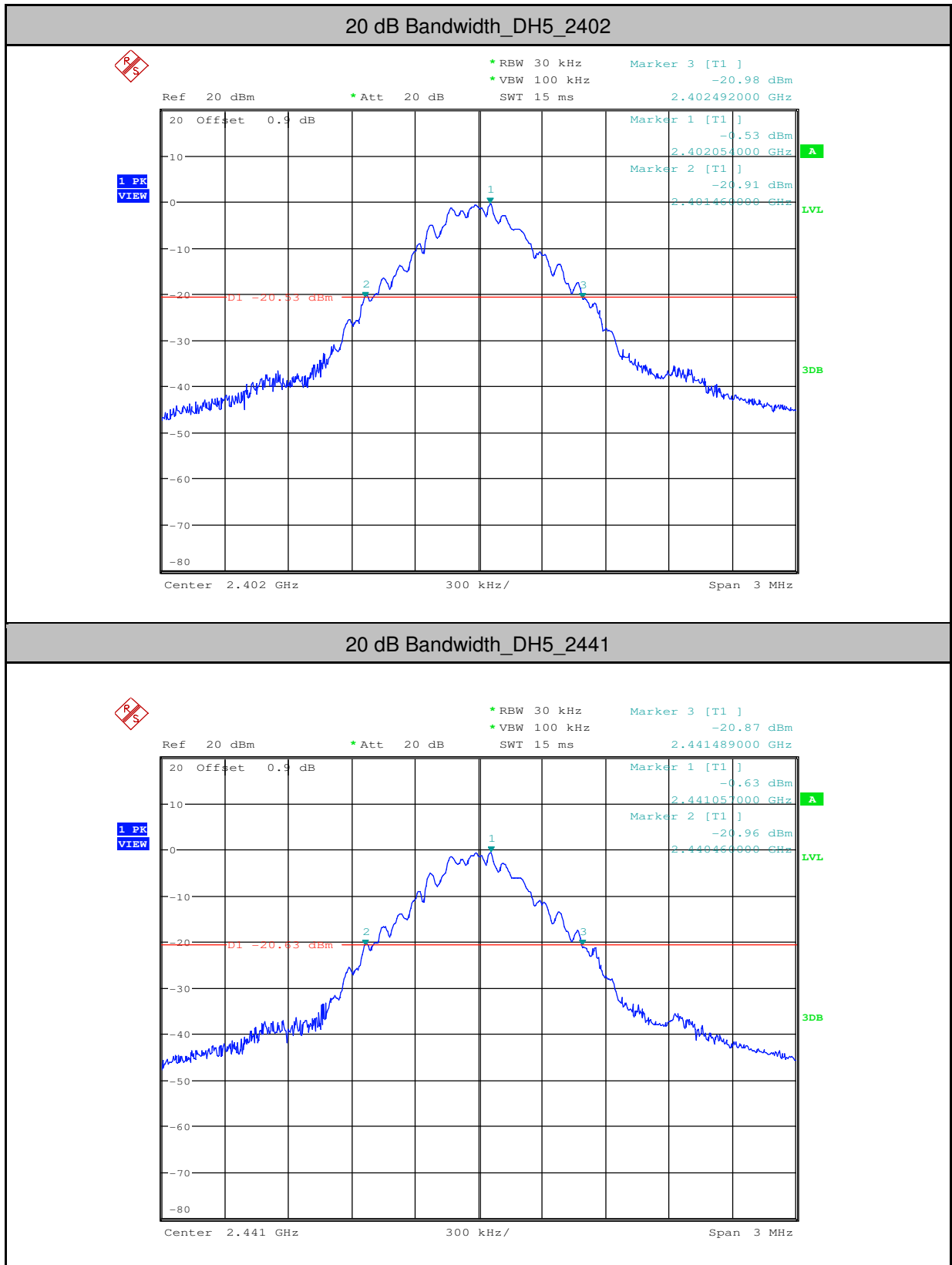
Test Mode	Test Channel	EBW[MHz]	Limit[MHz]	Verdict
DH5	2402	1.032	---	PASS
DH5	2441	1.029	---	PASS
DH5	2480	1.032	---	PASS
2DH5	2402	1.365	---	PASS
2DH5	2441	1.365	---	PASS
2DH5	2480	1.365	---	PASS
3DH5	2402	1.350	---	PASS
3DH5	2441	1.350	---	PASS
3DH5	2480	1.350	---	PASS

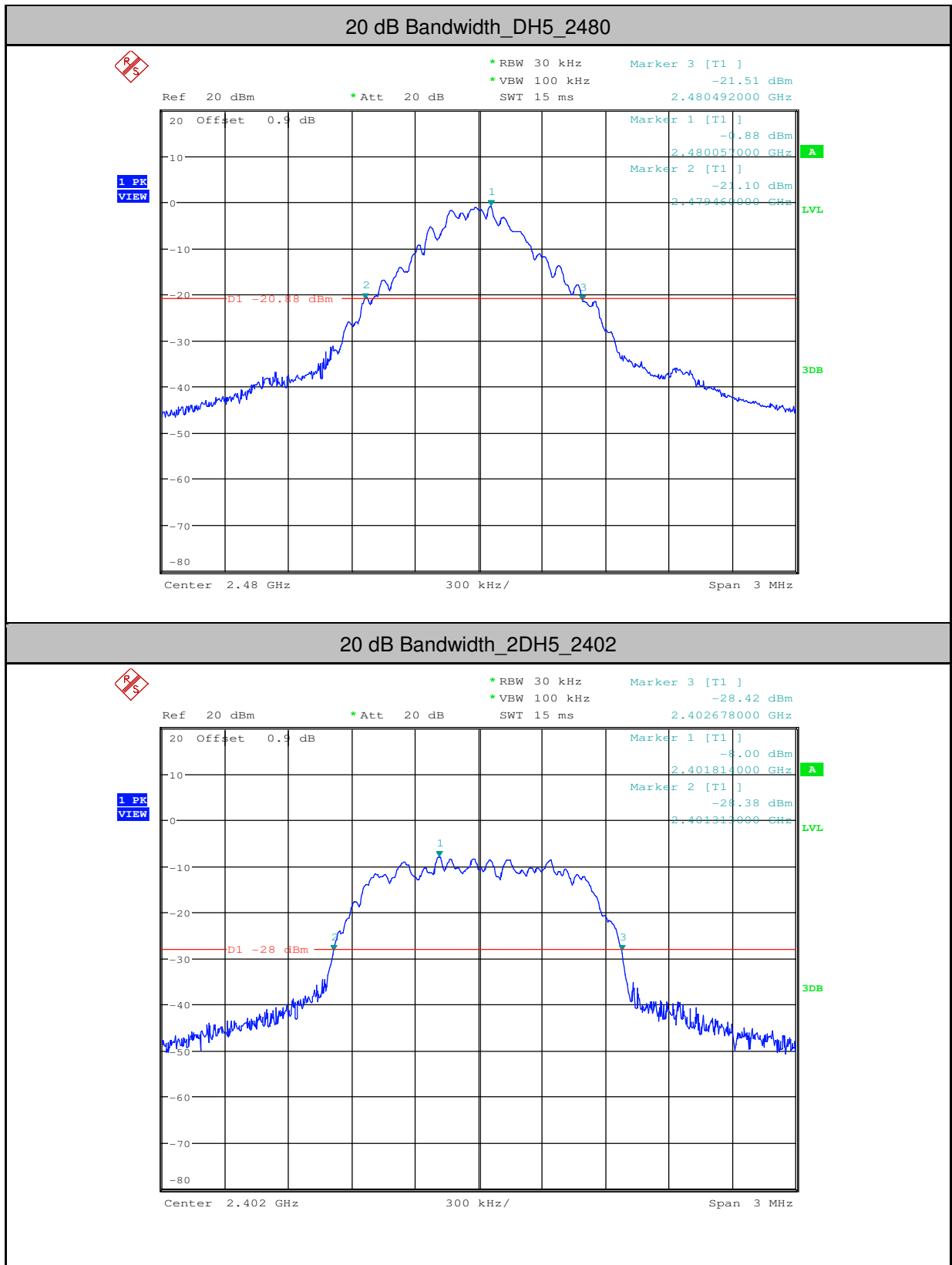


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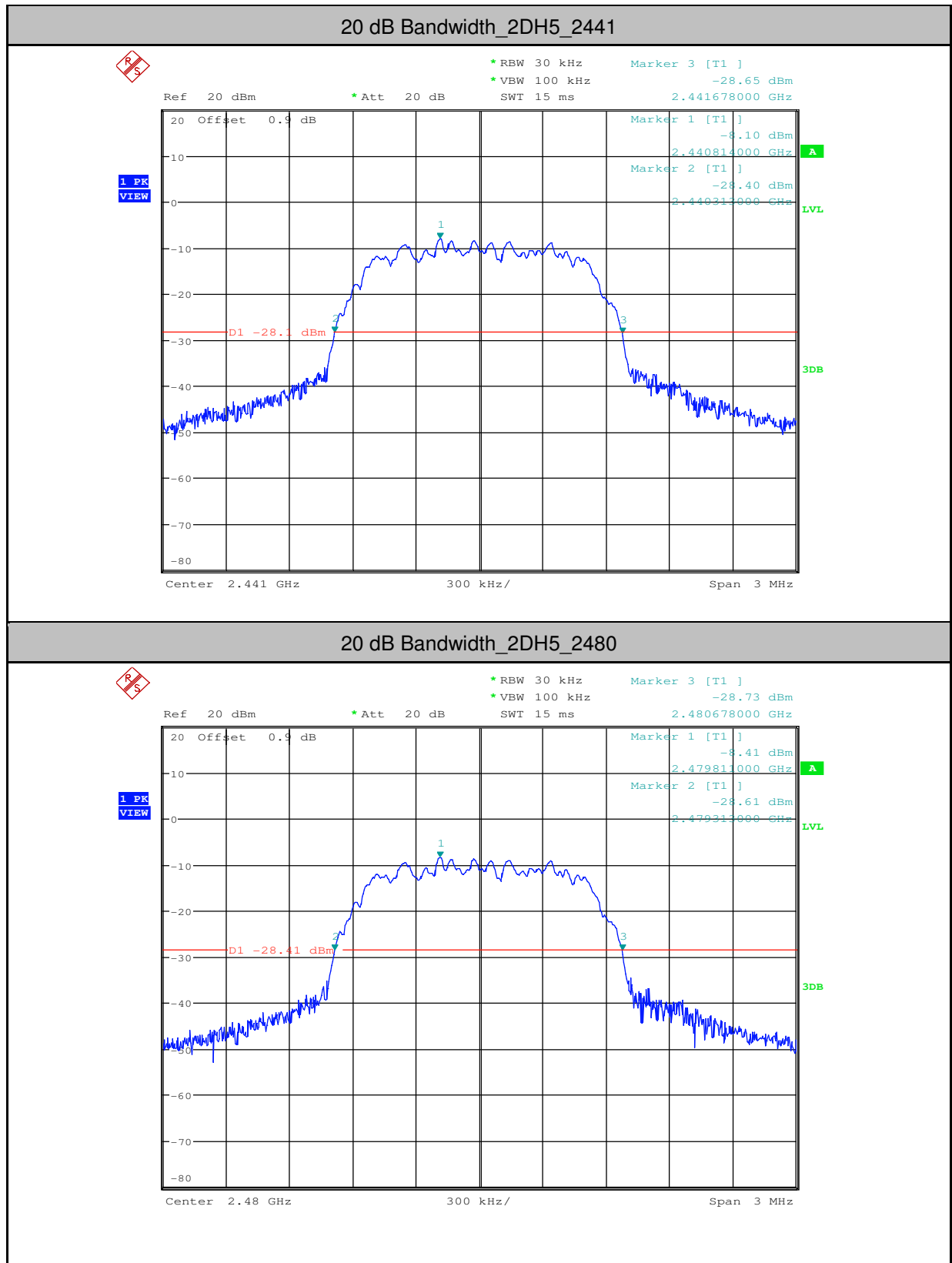


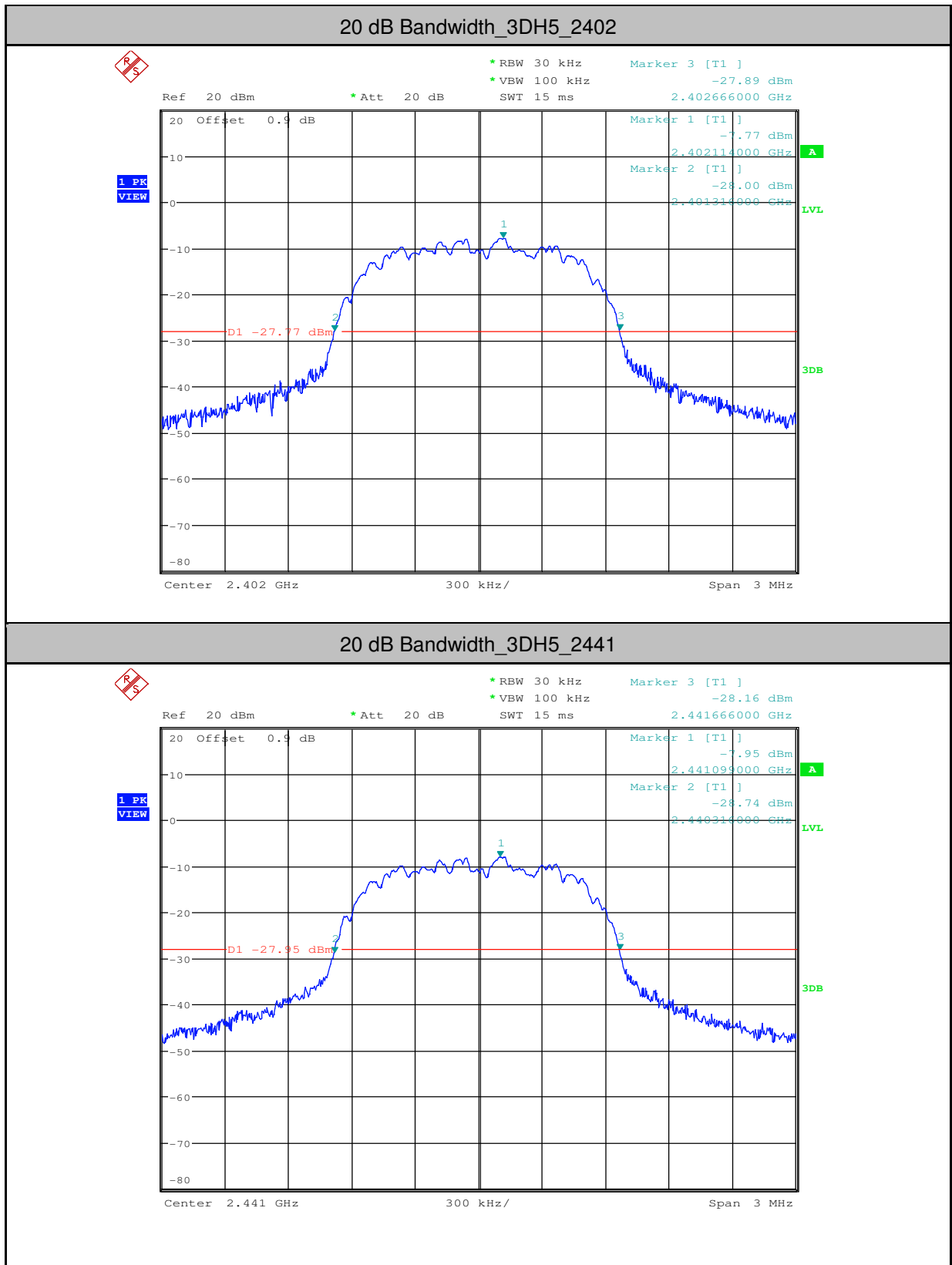


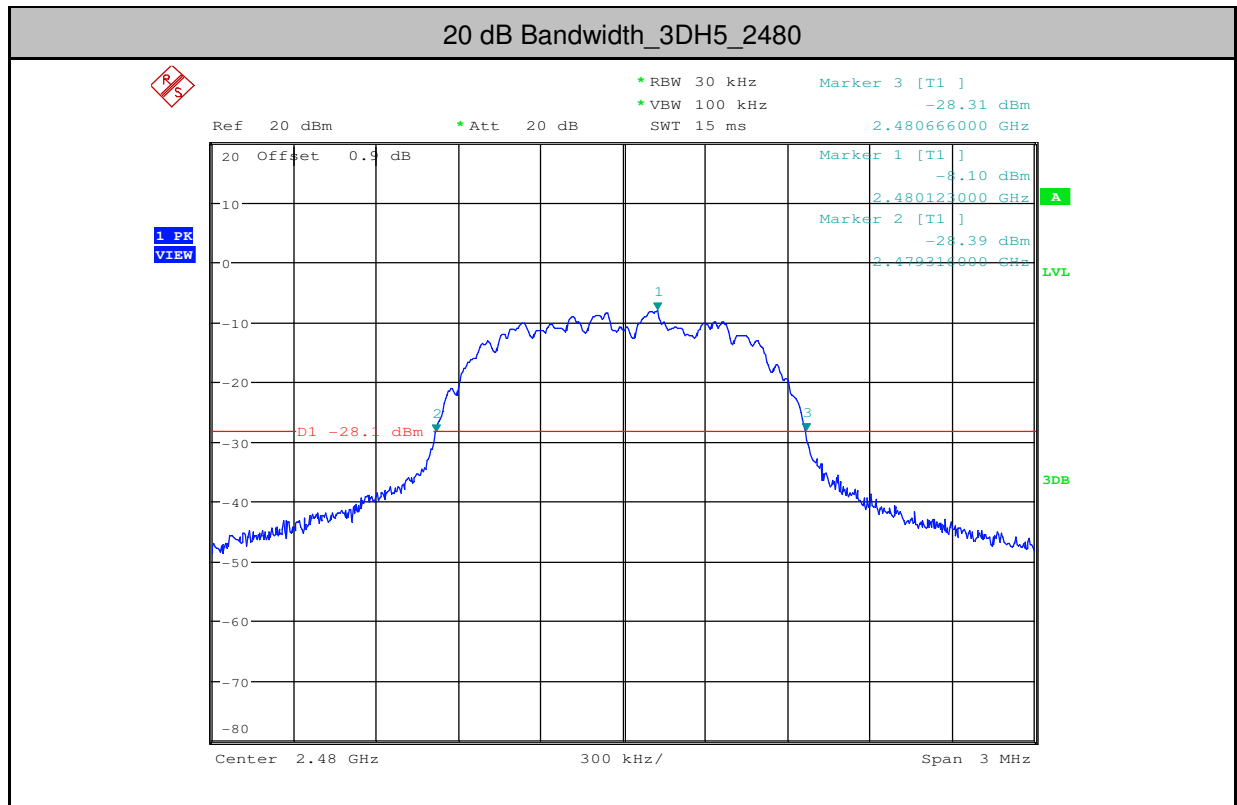
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2. Conducted Peak Output Power

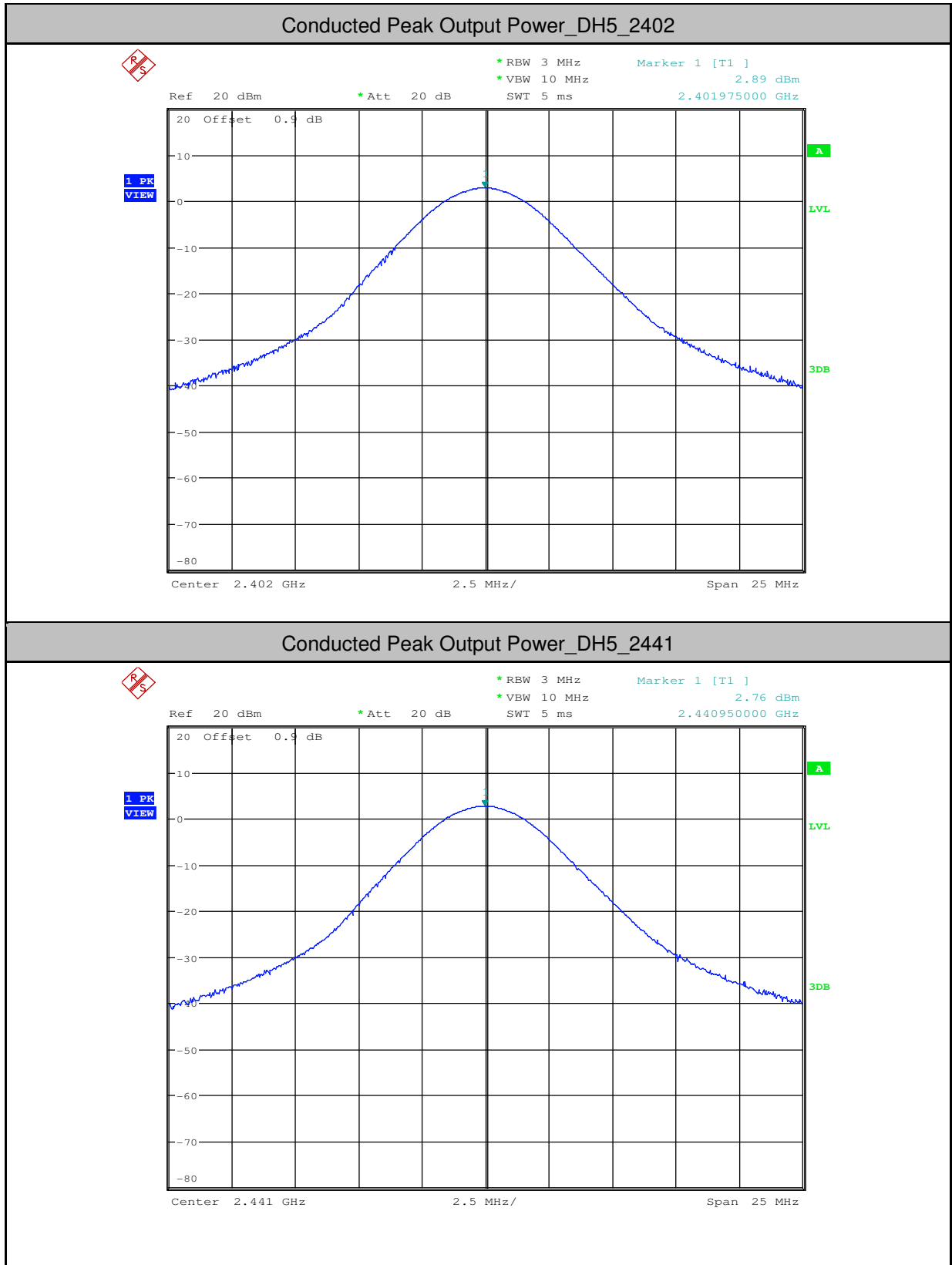
Test Mode	Test Channel	Power[dBm]	Limit[dBm]	Verdict
DH5	2402	2.89	<=20.97	PASS
DH5	2441	2.76	<=20.97	PASS
DH5	2480	2.51	<=20.97	PASS
2DH5	2402	0.68	<=20.97	PASS
2DH5	2441	0.54	<=20.97	PASS
2DH5	2480	0.27	<=20.97	PASS
3DH5	2402	1.21	<=20.97	PASS
3DH5	2441	1.08	<=20.97	PASS
3DH5	2480	0.8	<=20.97	PASS

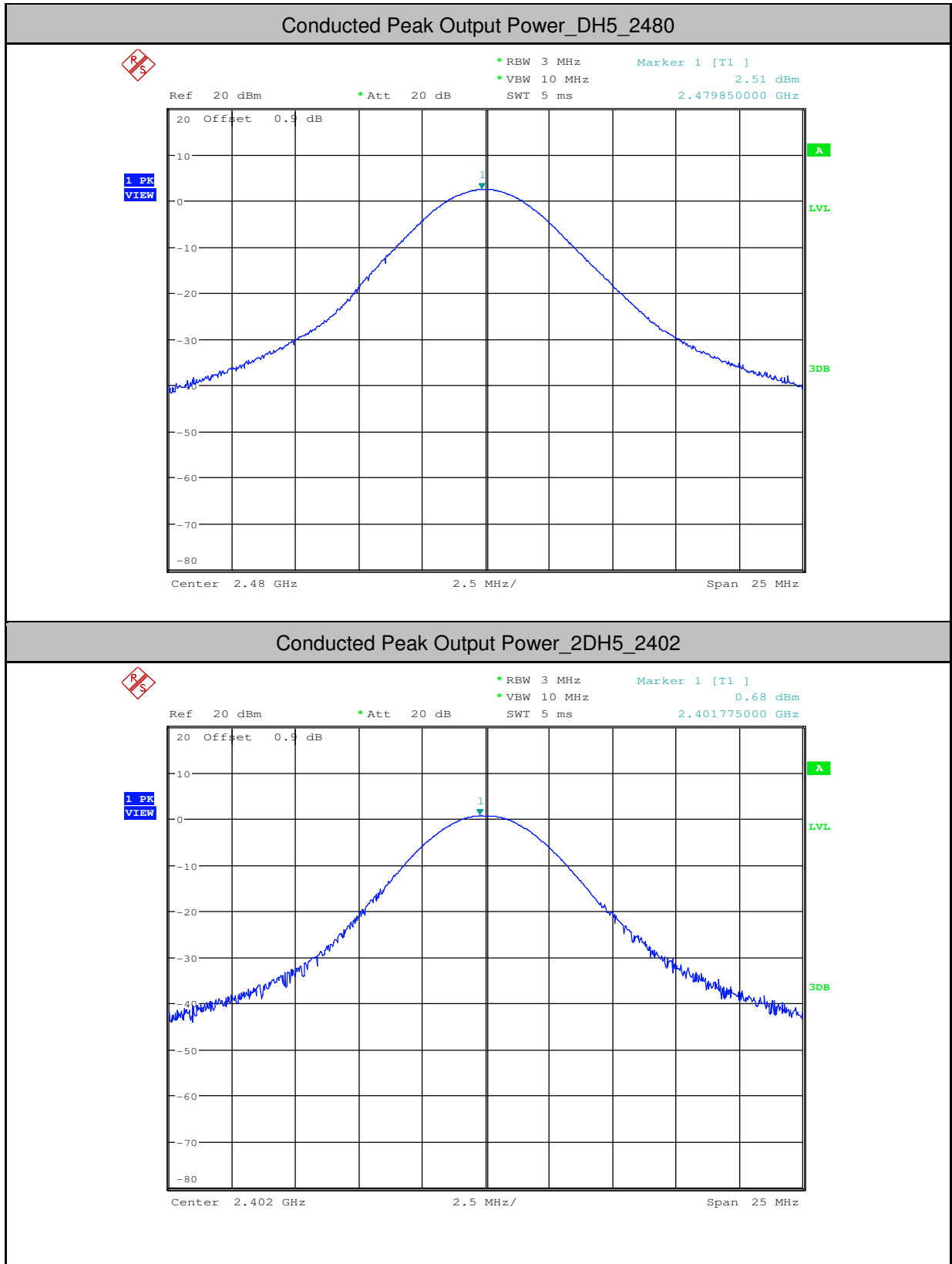


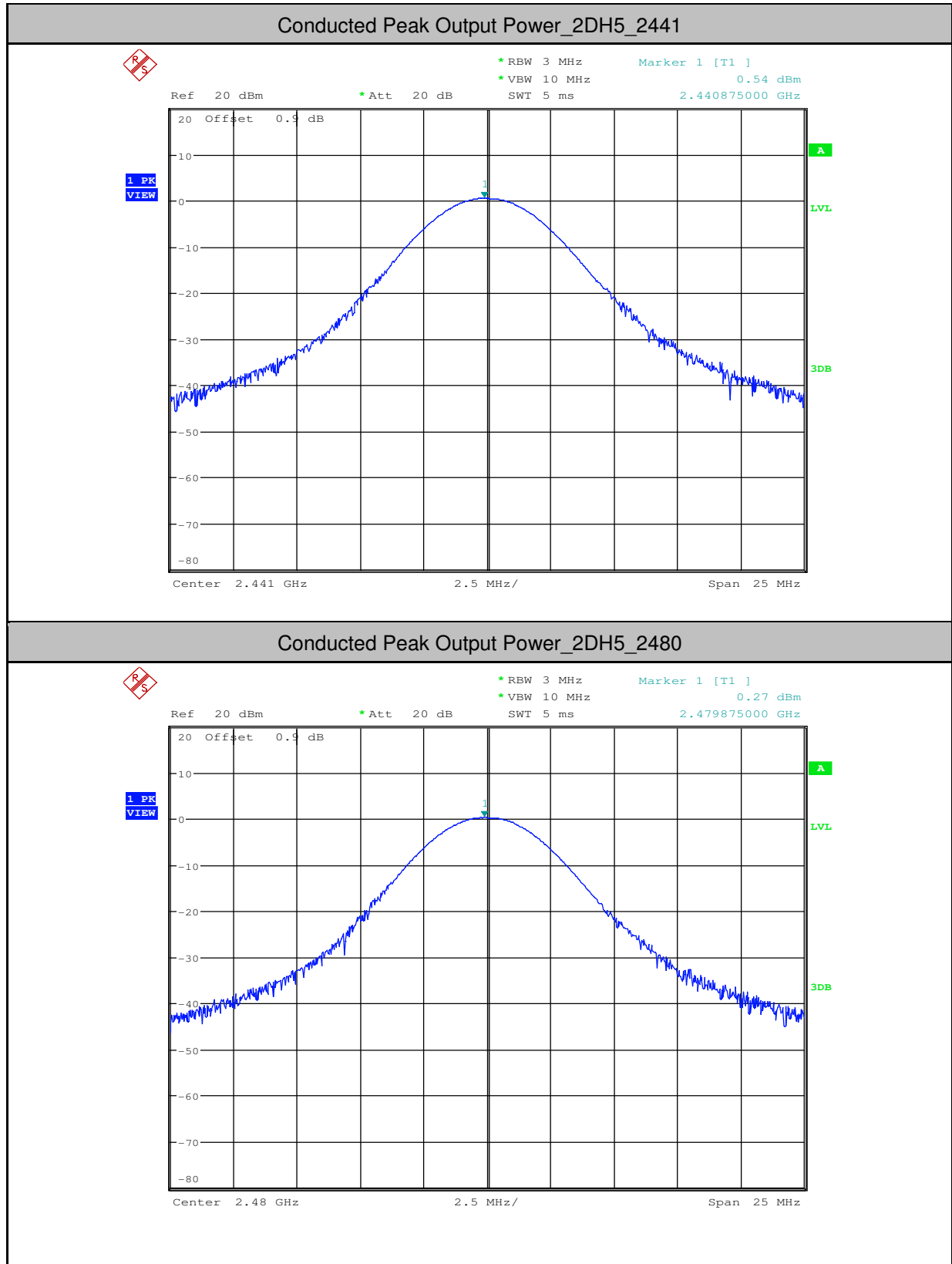
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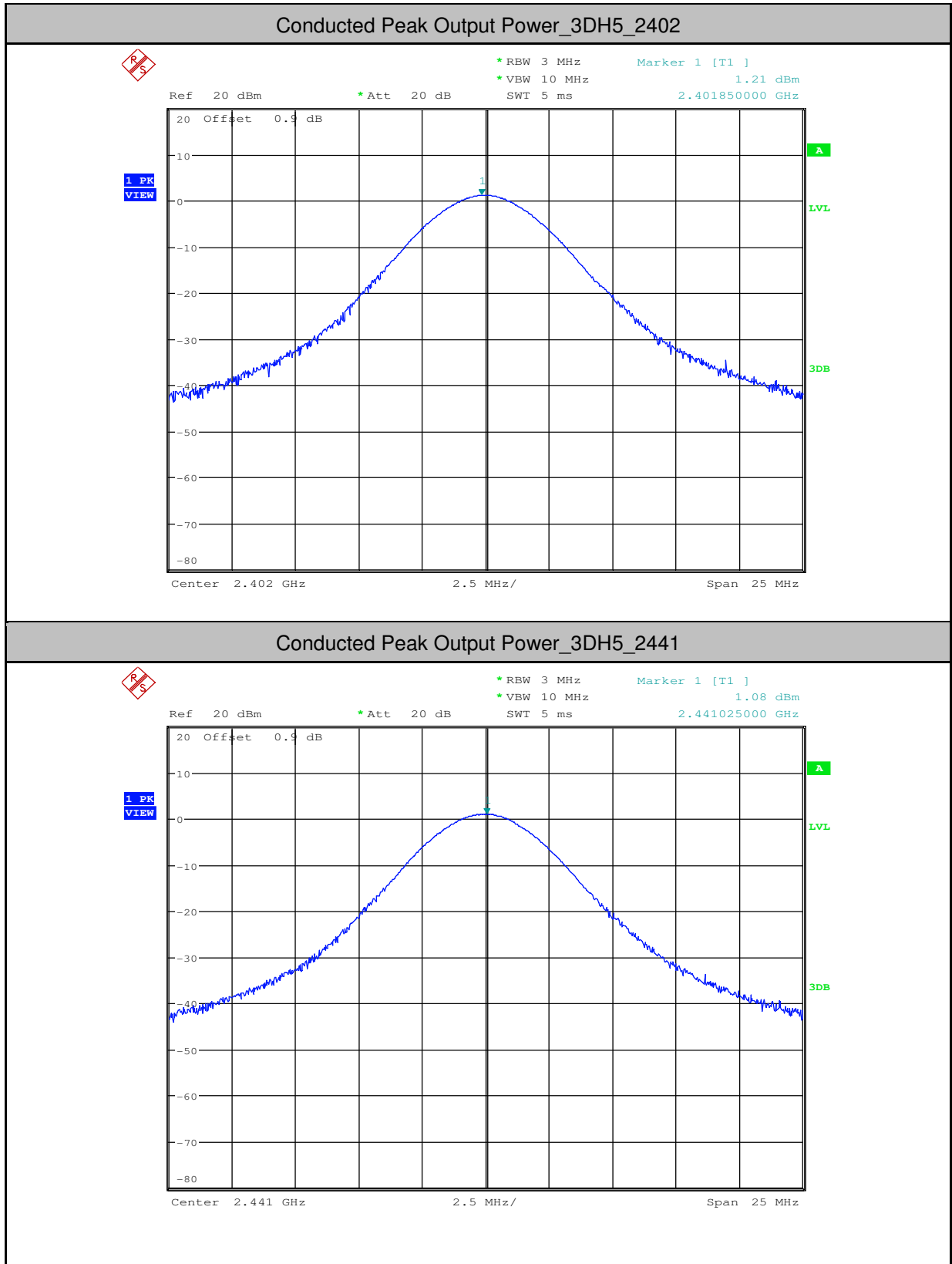
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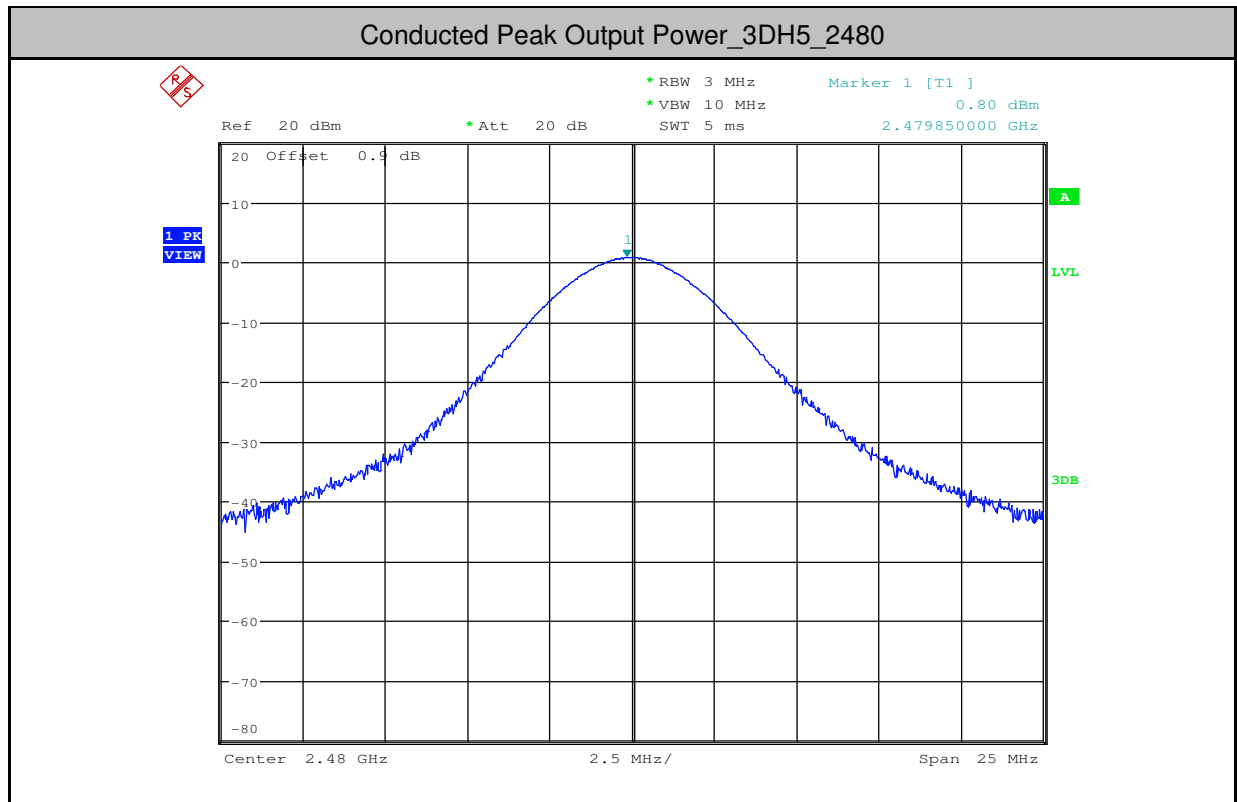
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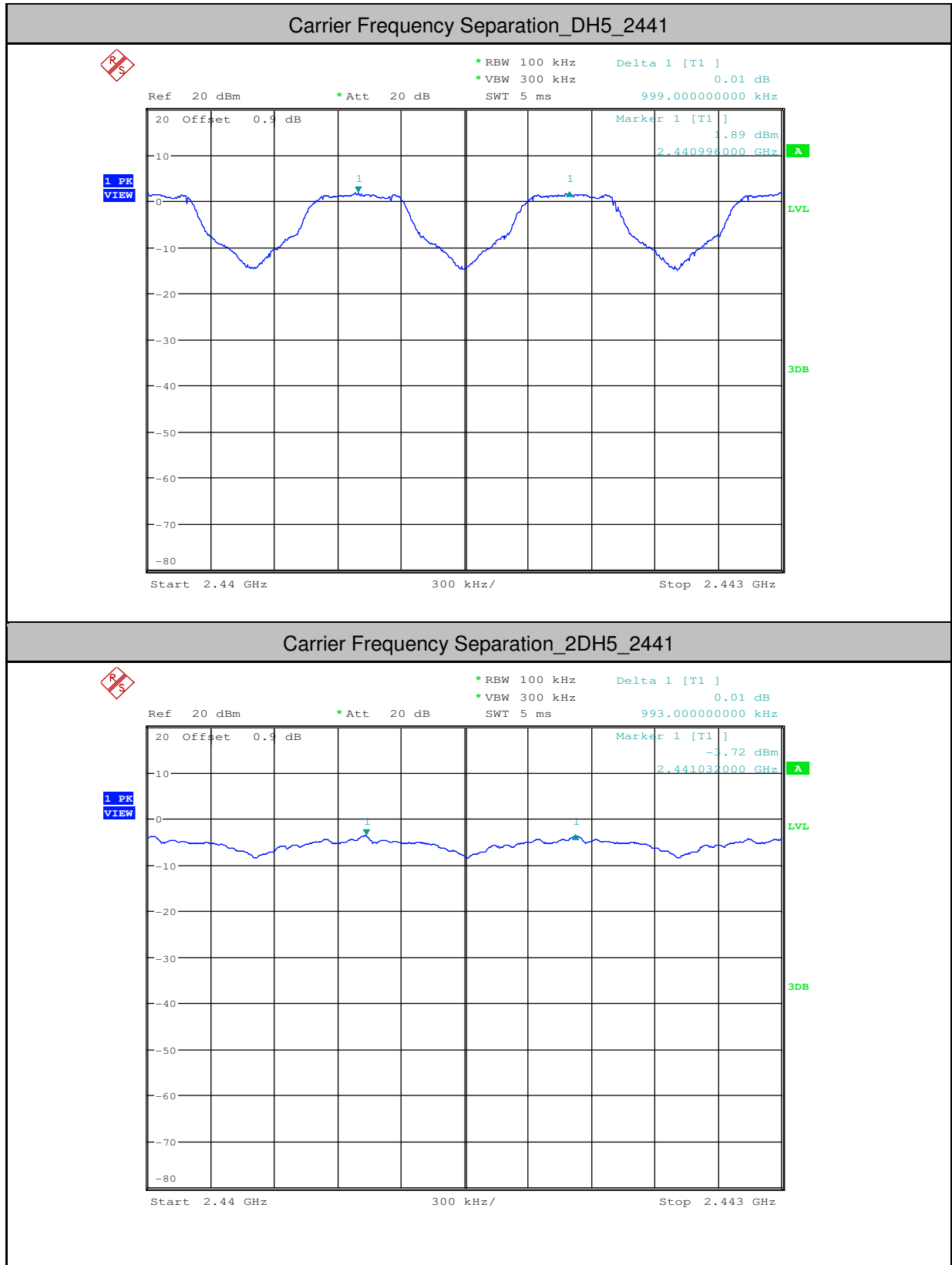






3.Carrier Frequency Separation

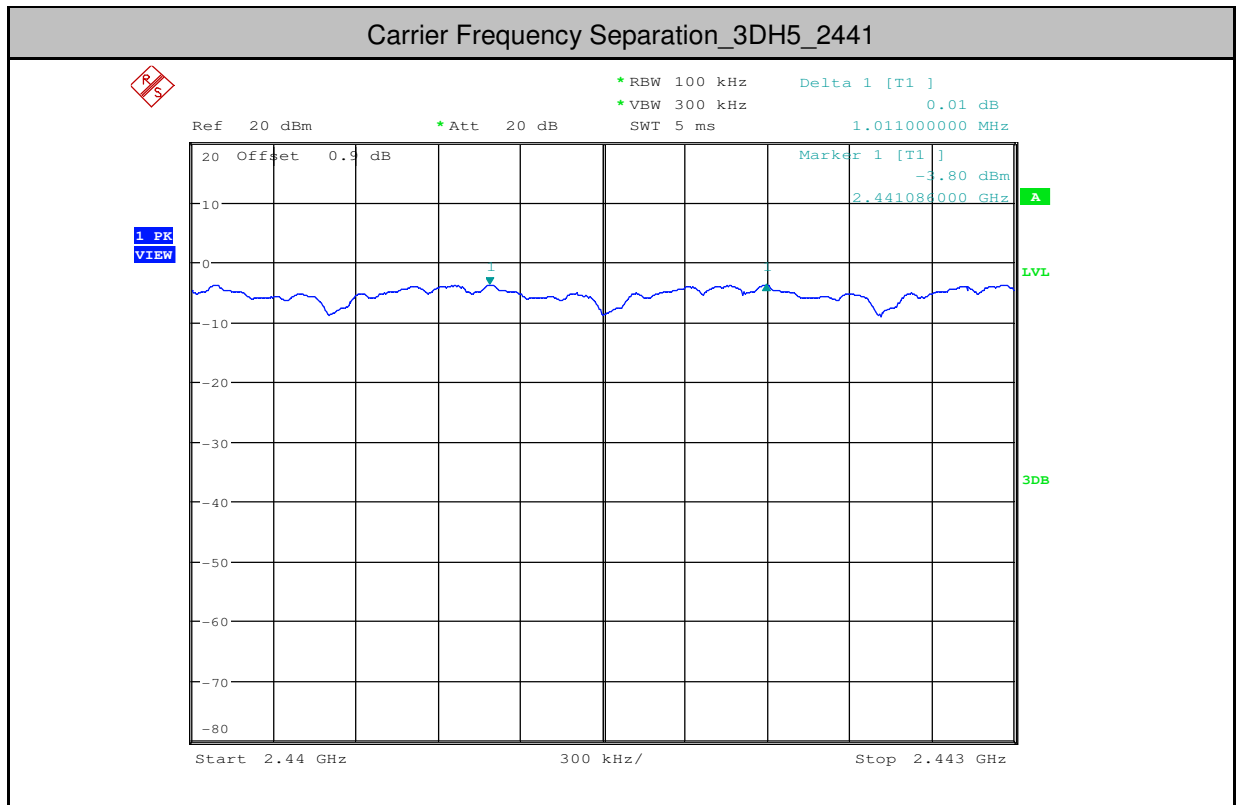
Test Mode	Test Channel	Result[MHz]	Limit[MHz]	Verdict
DH5	2441	0.999	≥ 0.69	PASS
2DH5	2441	0.993	≥ 0.91	PASS
3DH5	2441	1.011	≥ 0.90	PASS



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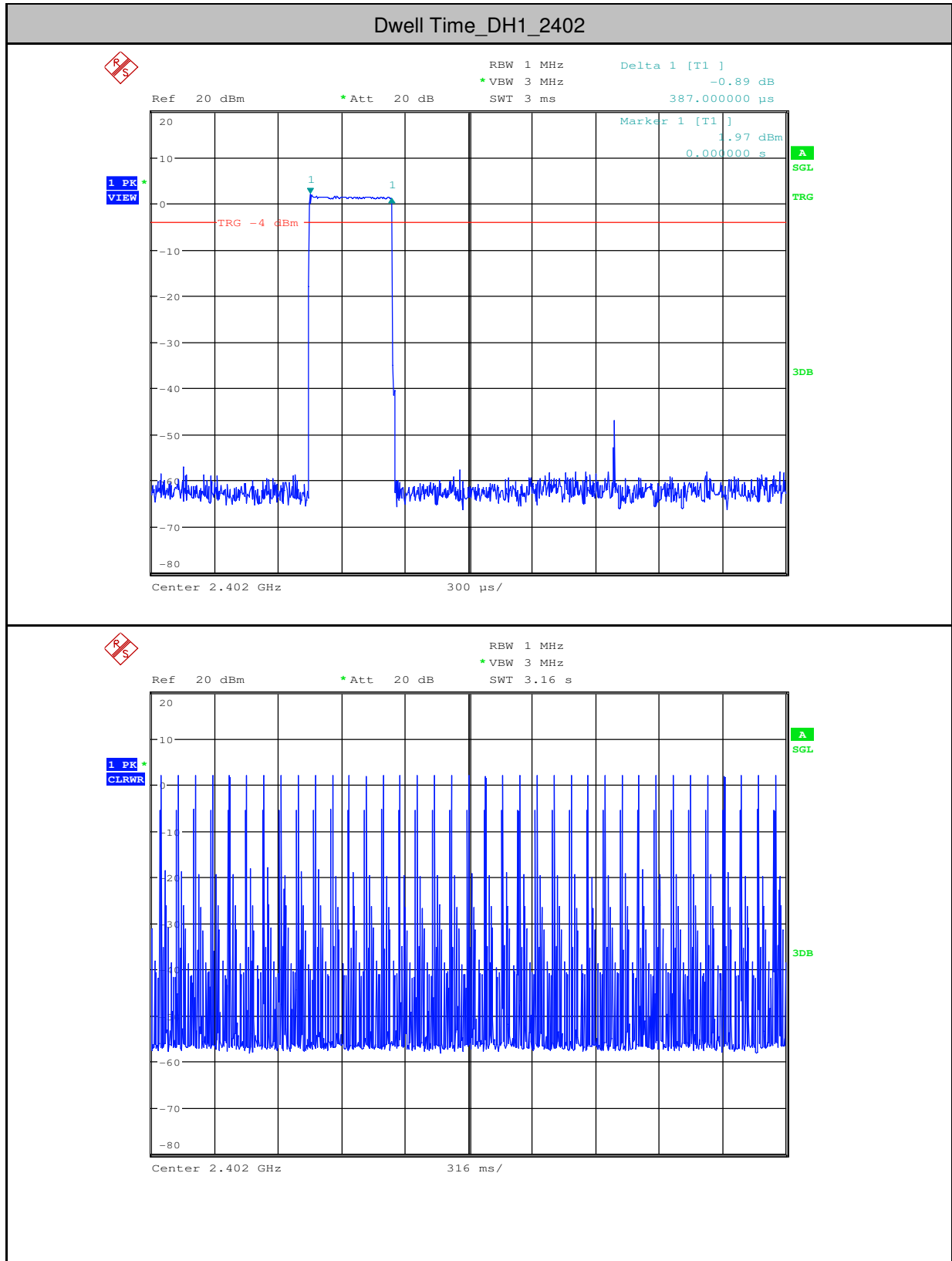
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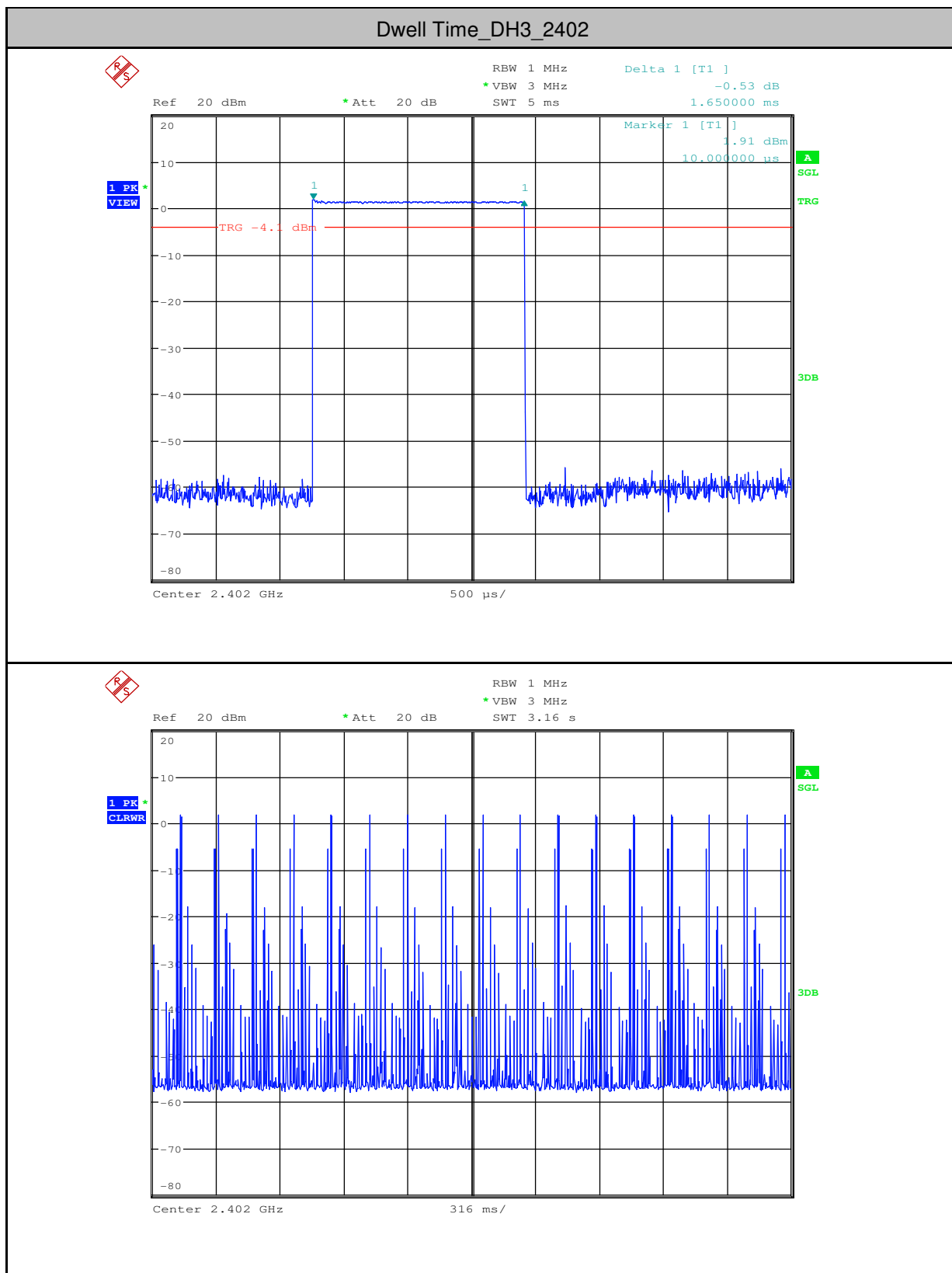


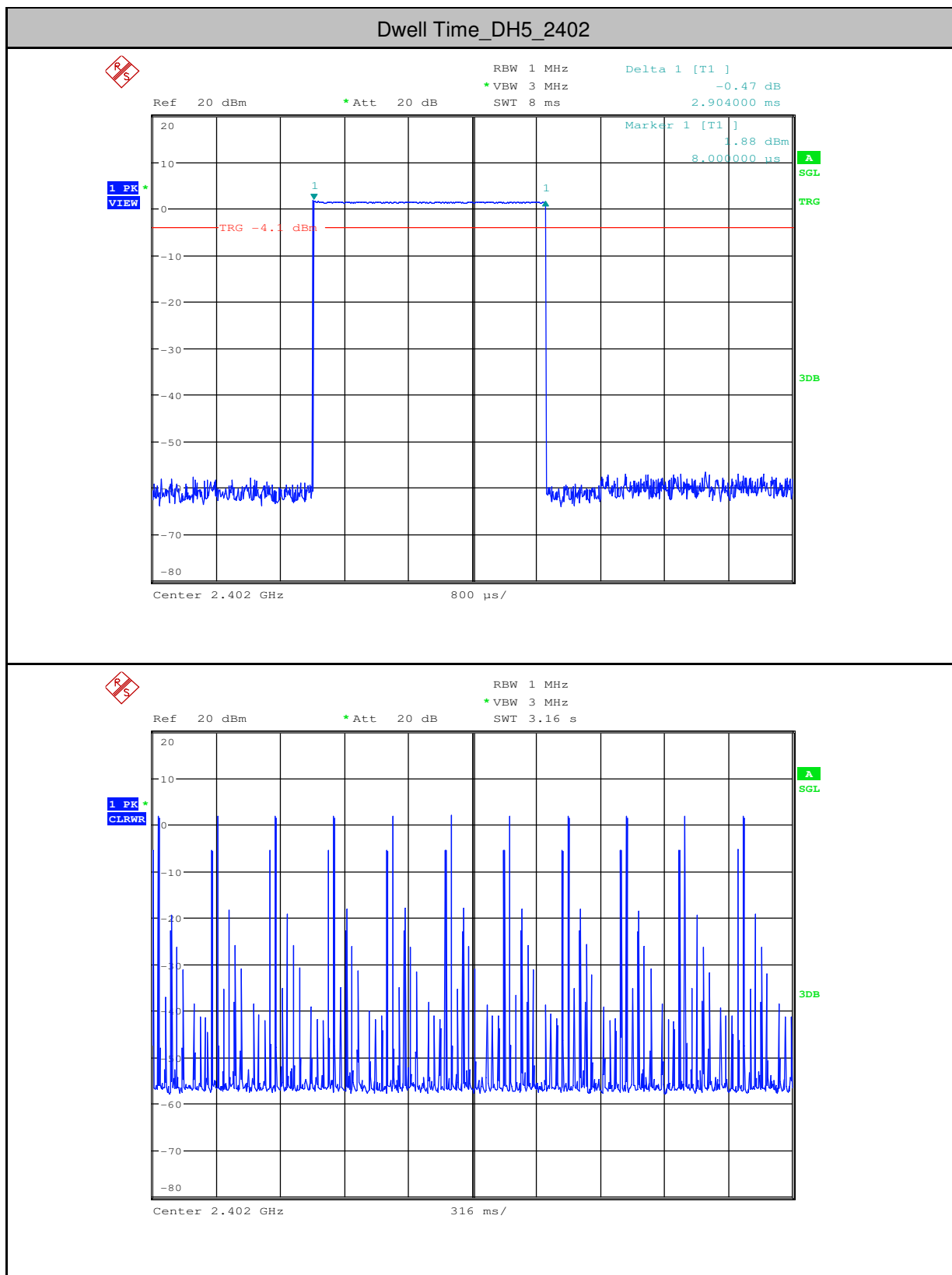
4.Dwell Time

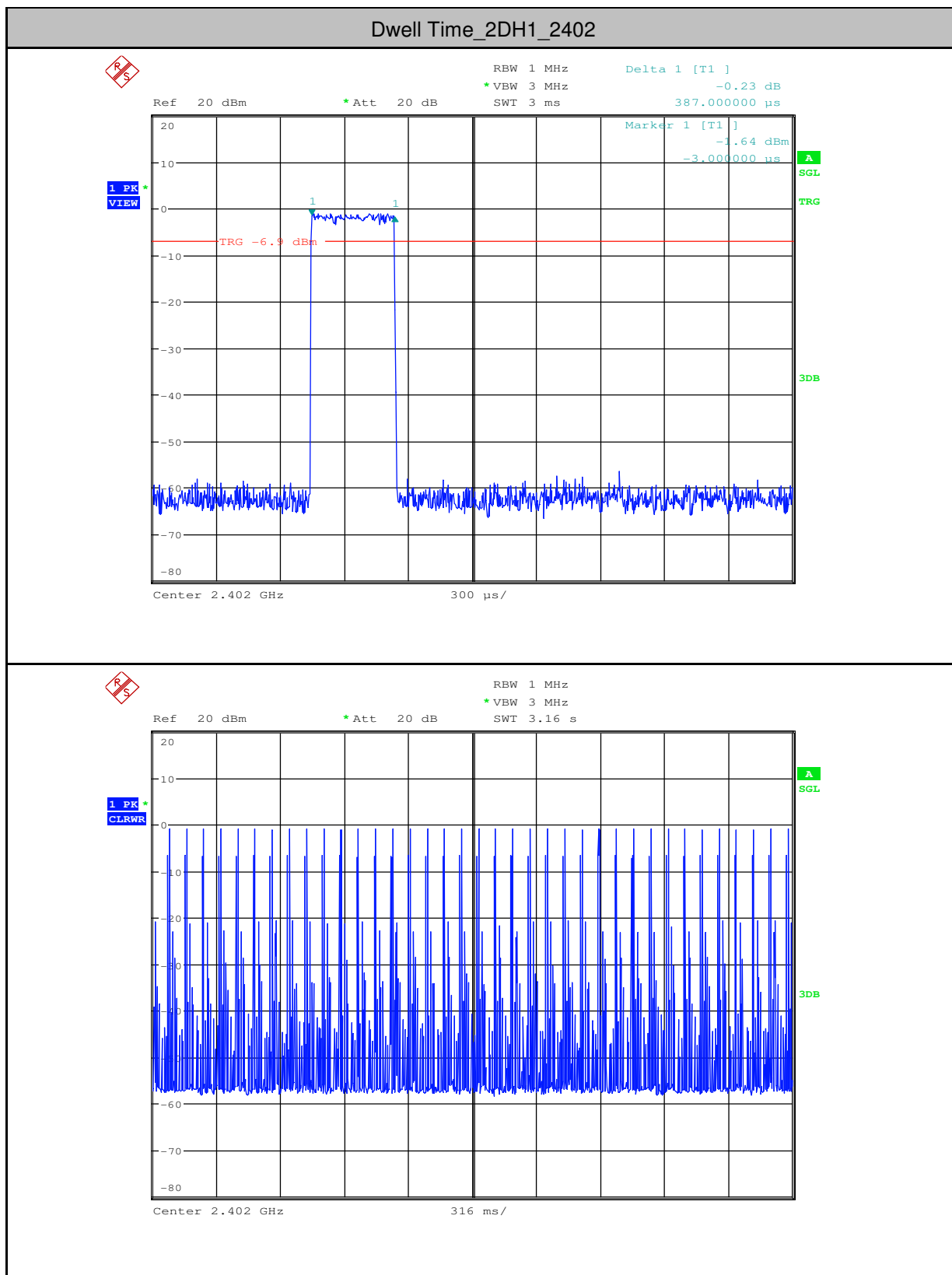
Test Mode	Test Channel	Burst Width[ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[s]	Limit[s]	Verdict
DH1	2402	0.39	370	0.144	<0.4	PASS
DH3	2402	1.65	170	0.281	<0.4	PASS
DH5	2402	2.9	110	0.319	<0.4	PASS
2DH1	2402	0.39	370	0.144	<0.4	PASS
2DH3	2402	1.65	170	0.281	<0.4	PASS
2DH5	2402	2.91	110	0.320	<0.4	PASS
3DH1	2402	0.37	380	0.141	<0.4	PASS
3DH3	2402	1.66	170	0.282	<0.4	PASS
3DH5	2402	2.92	110	0.321	<0.4	PASS

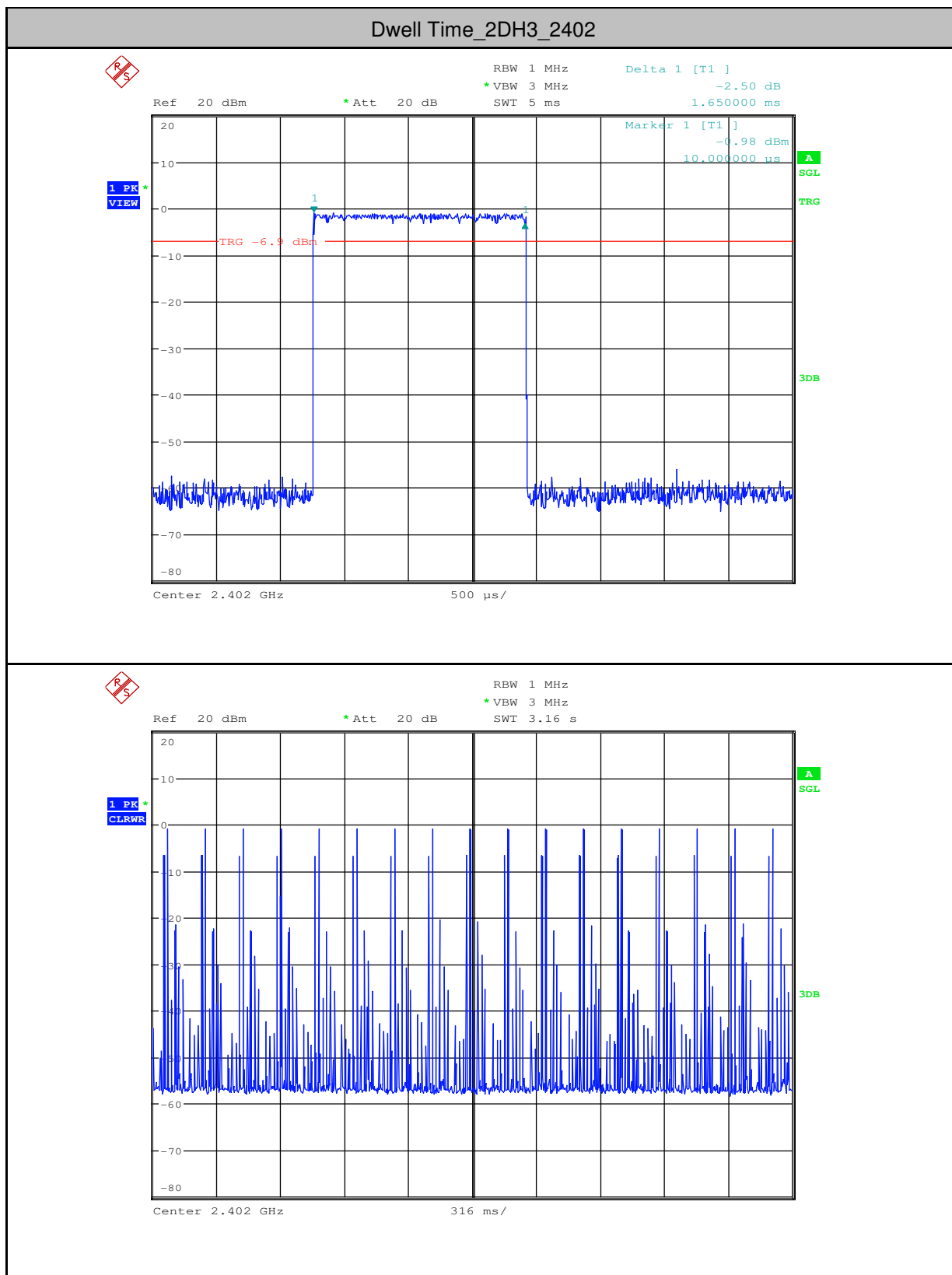


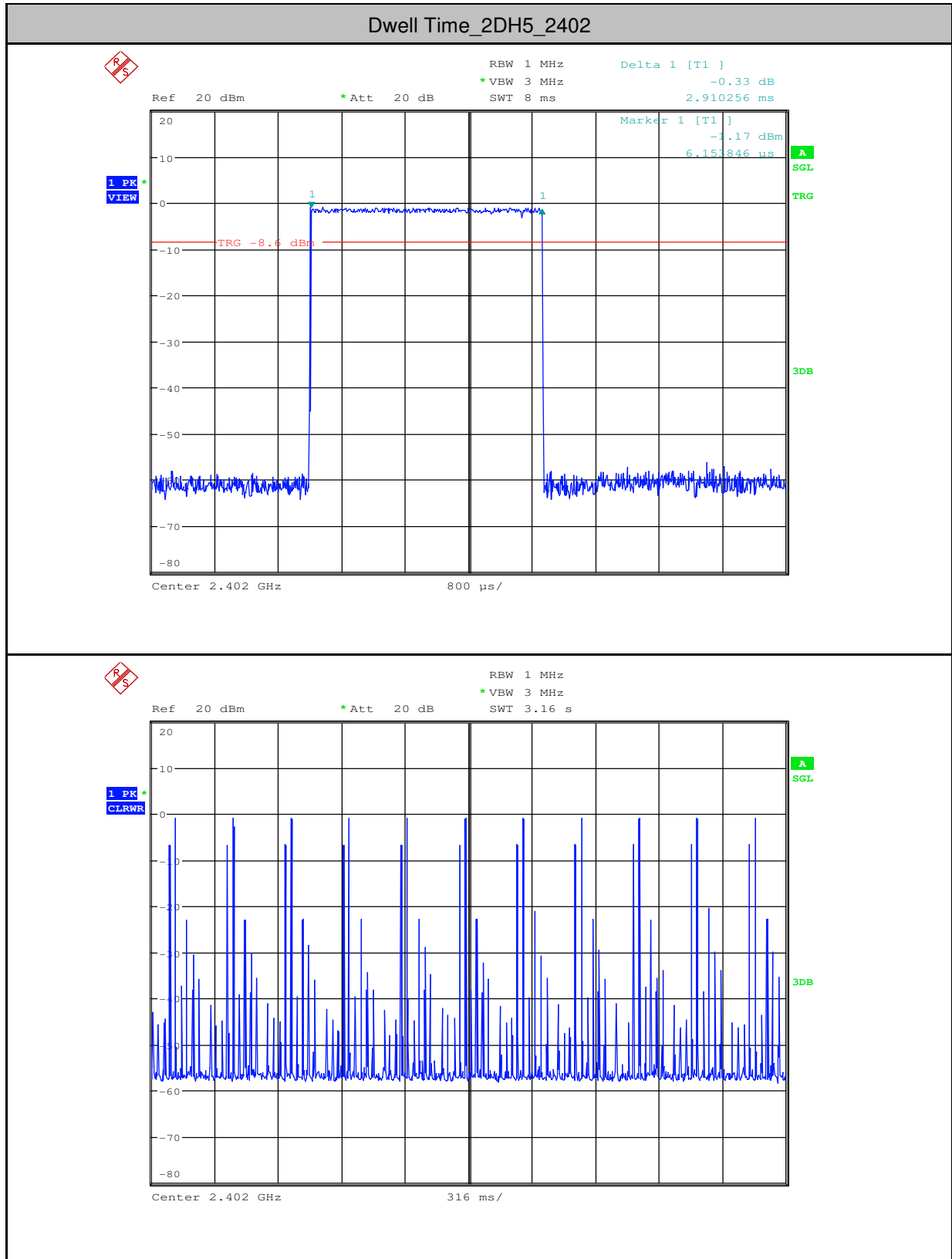


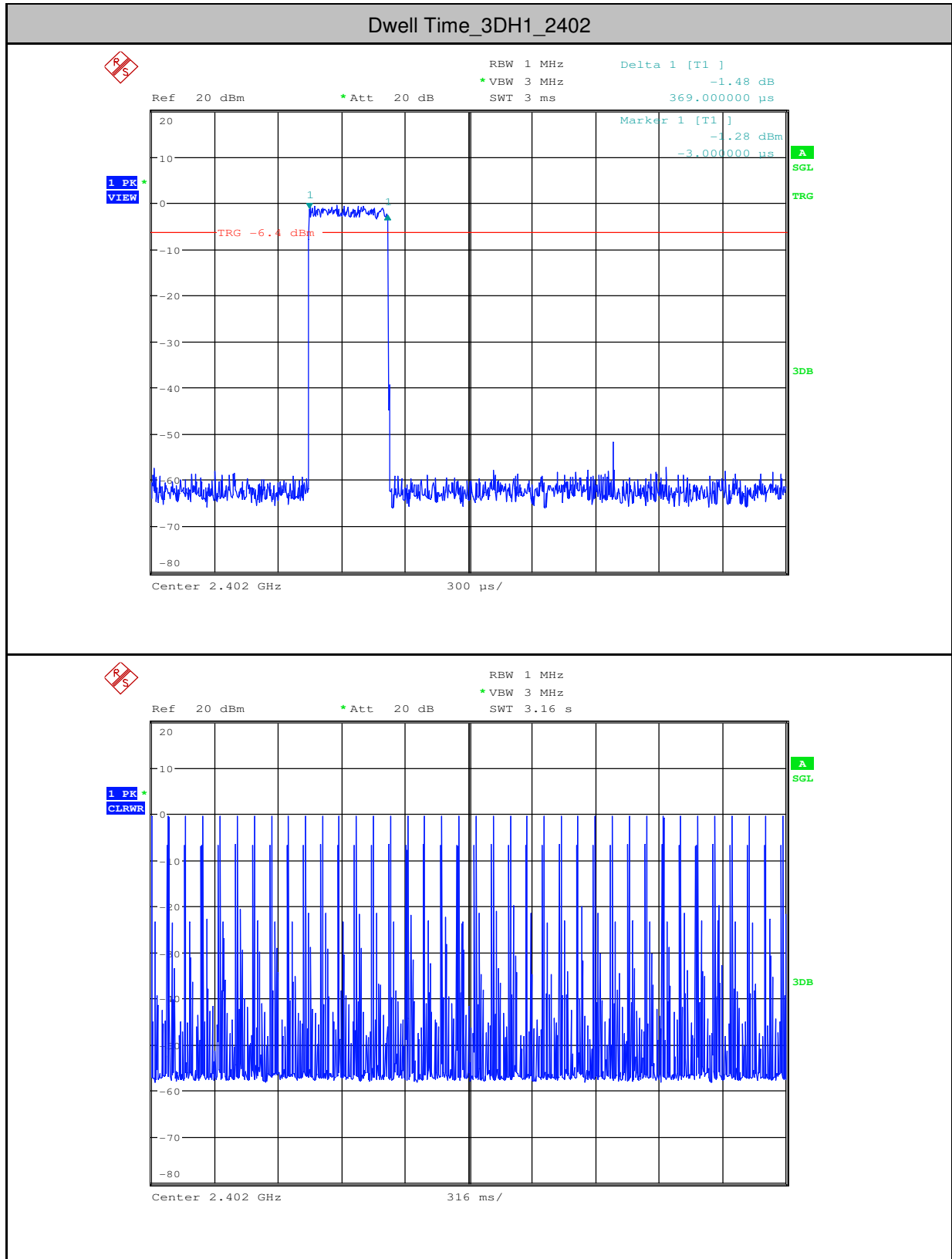


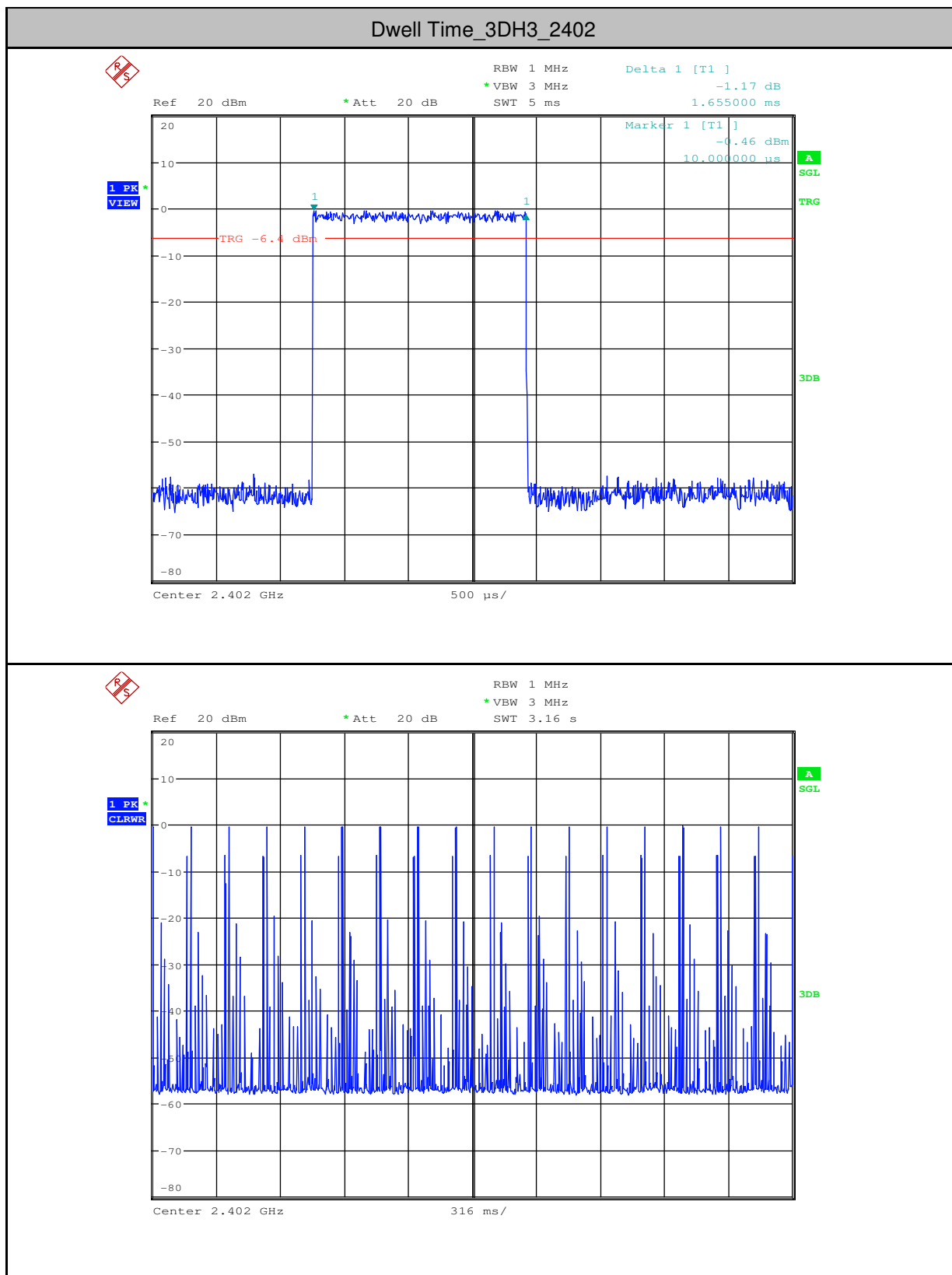


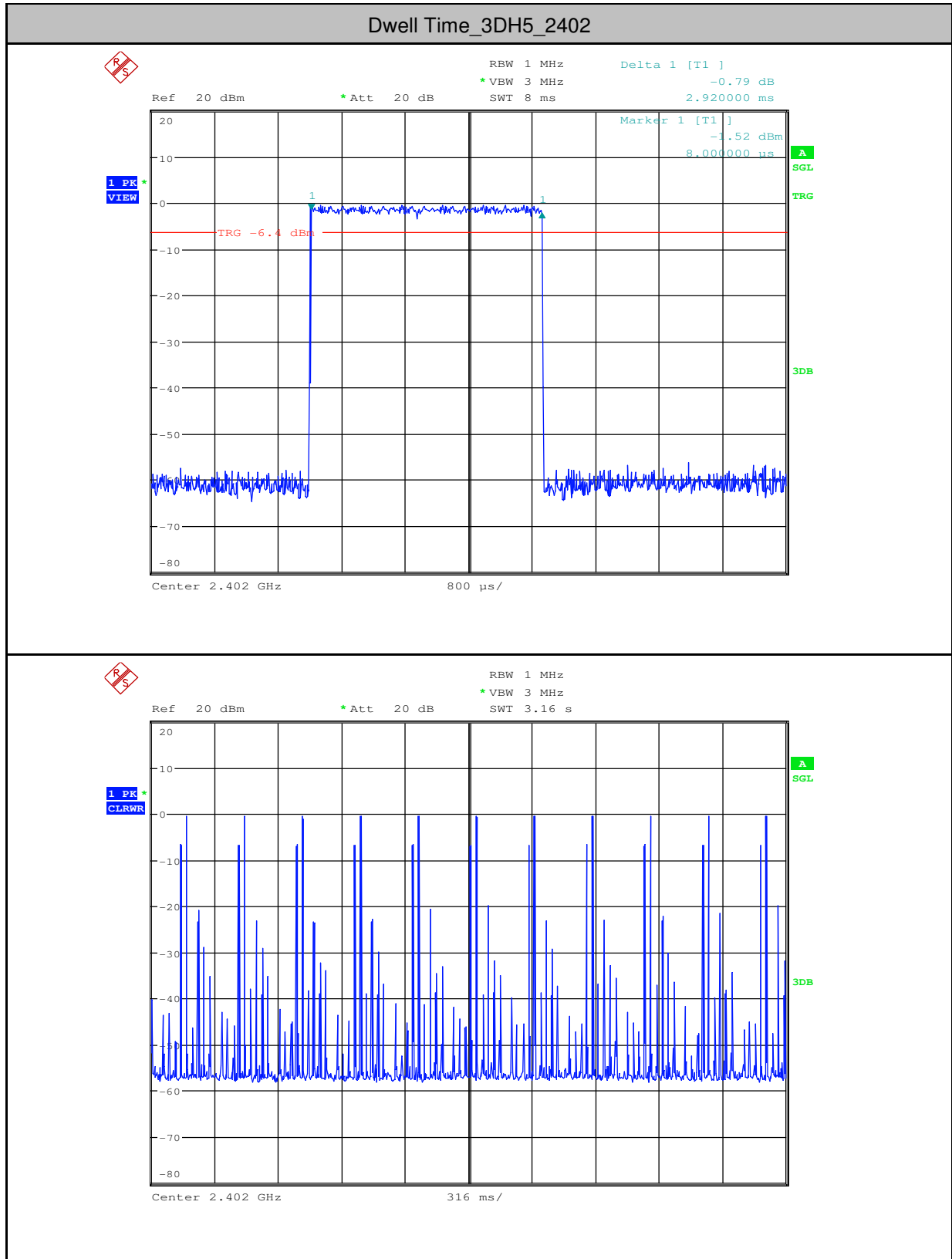












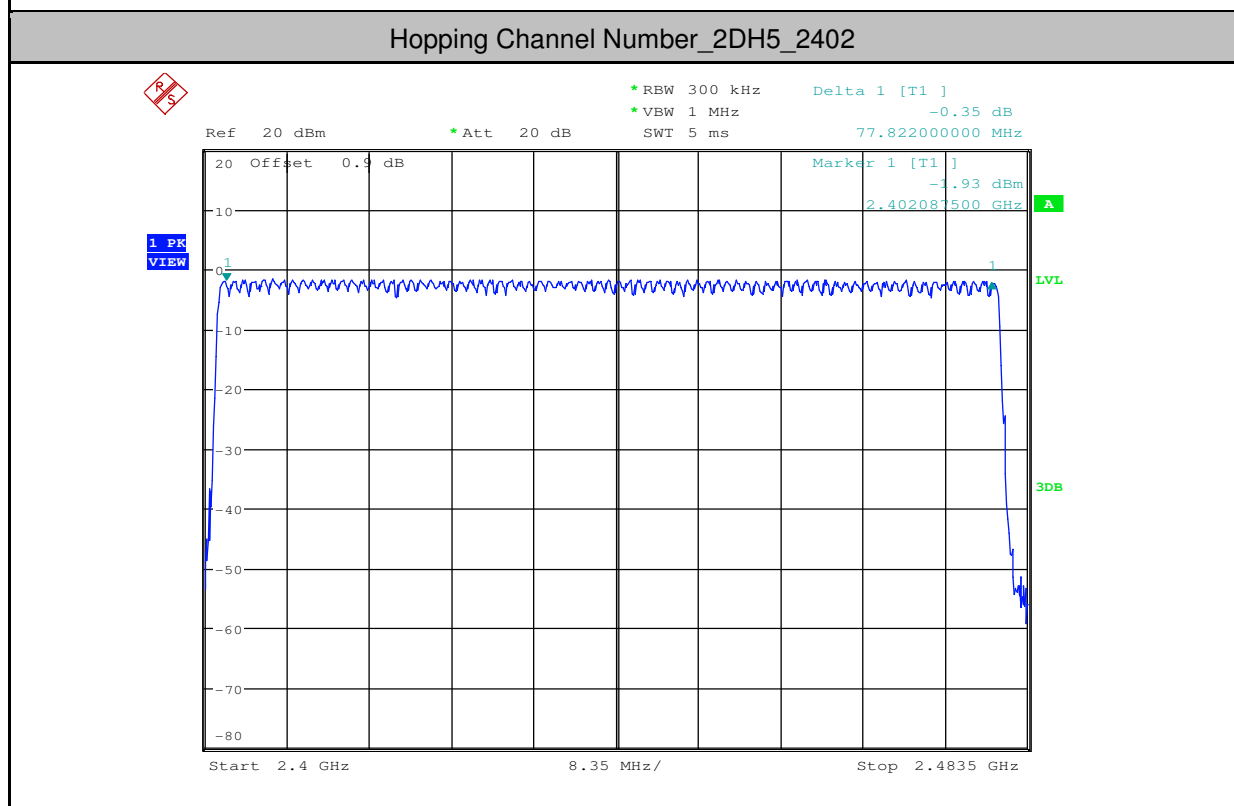
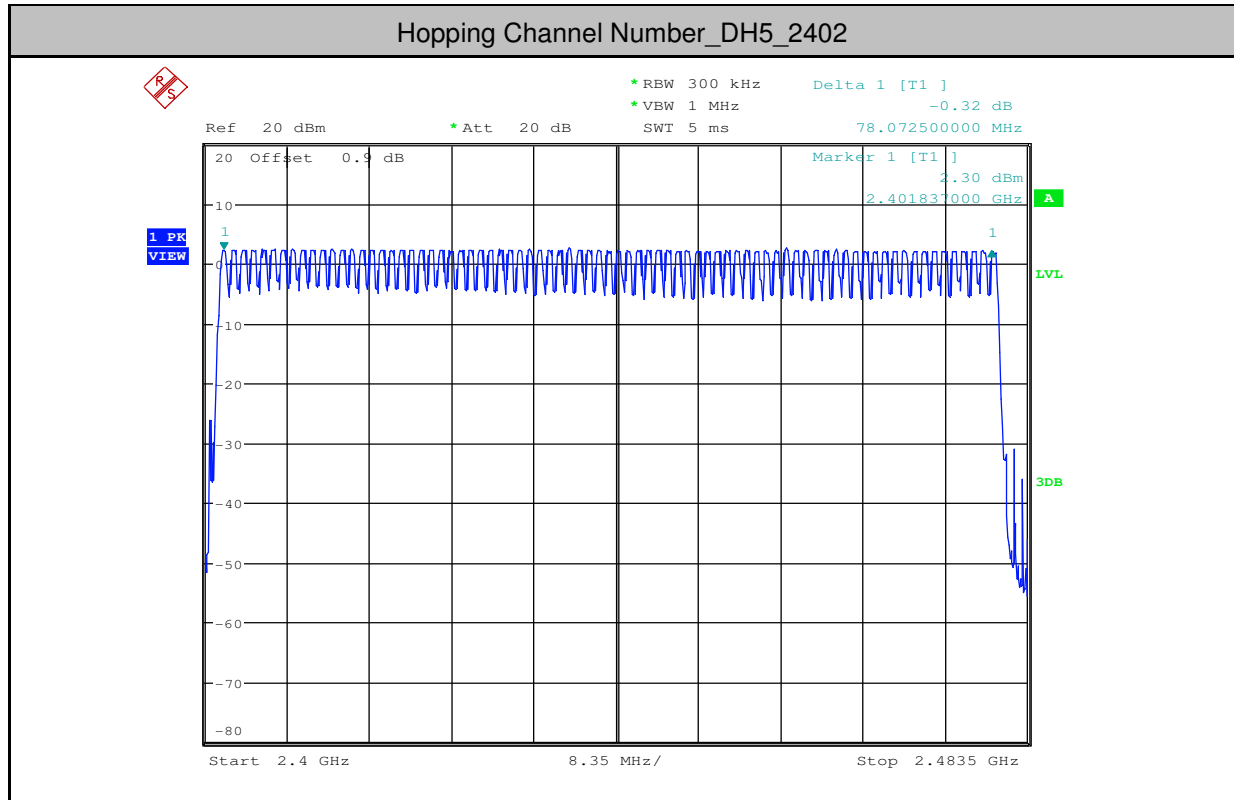


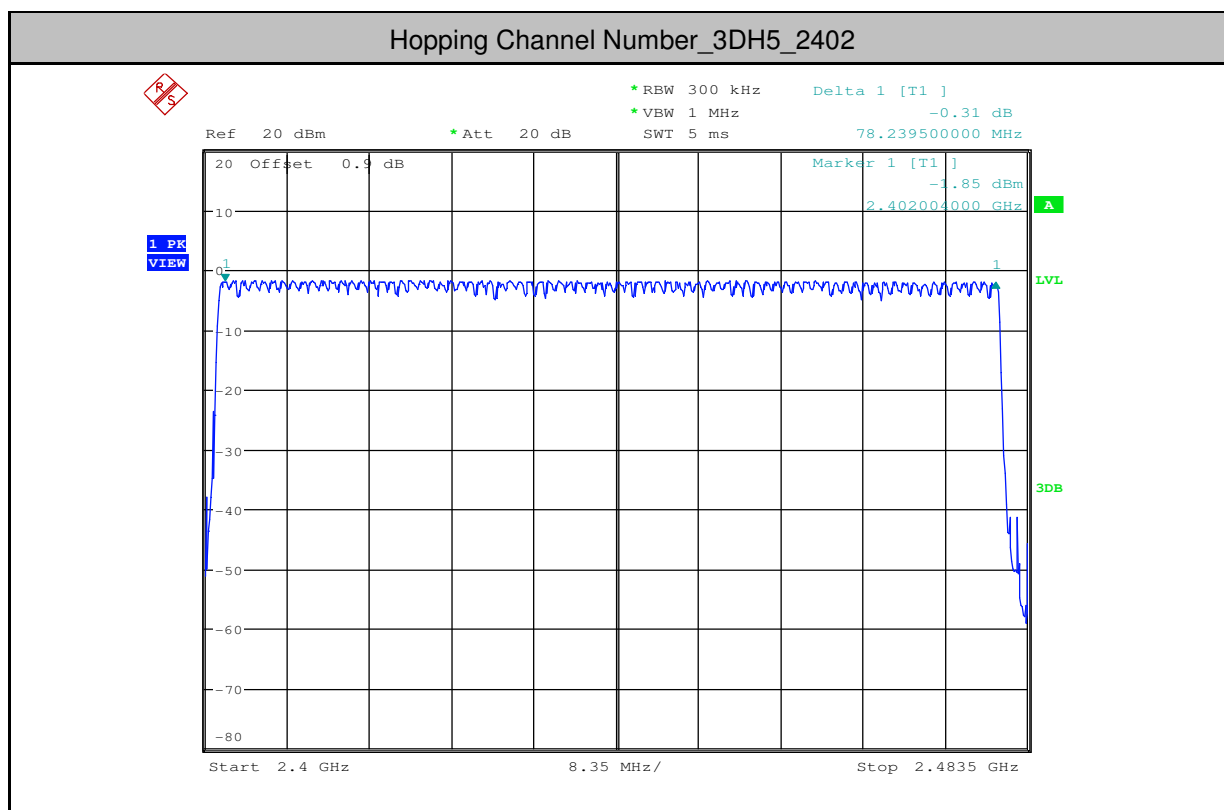
5.Hopping Channel Number

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



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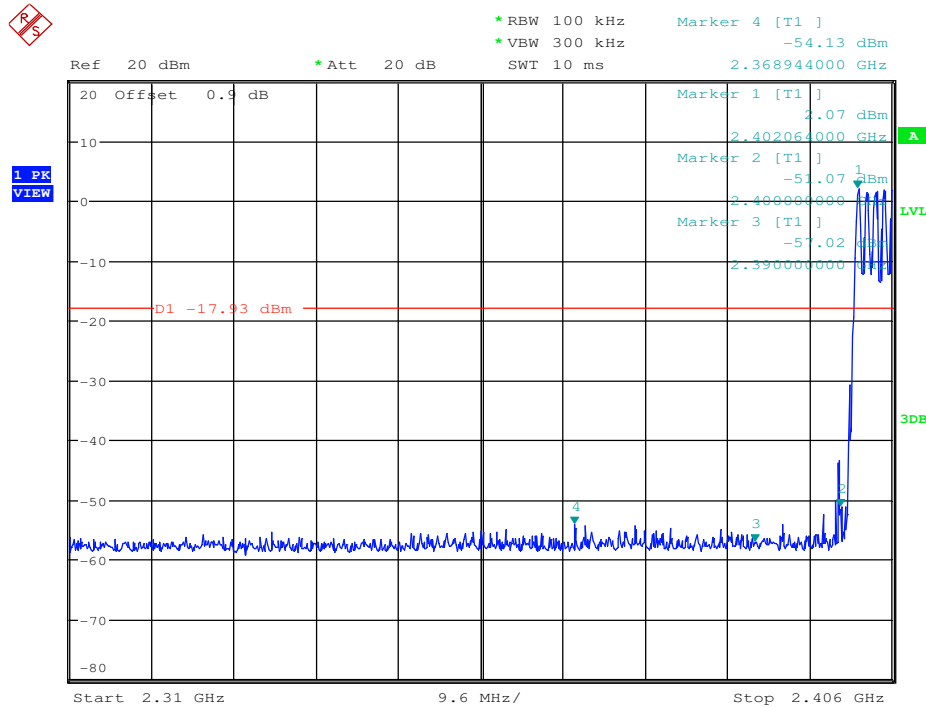




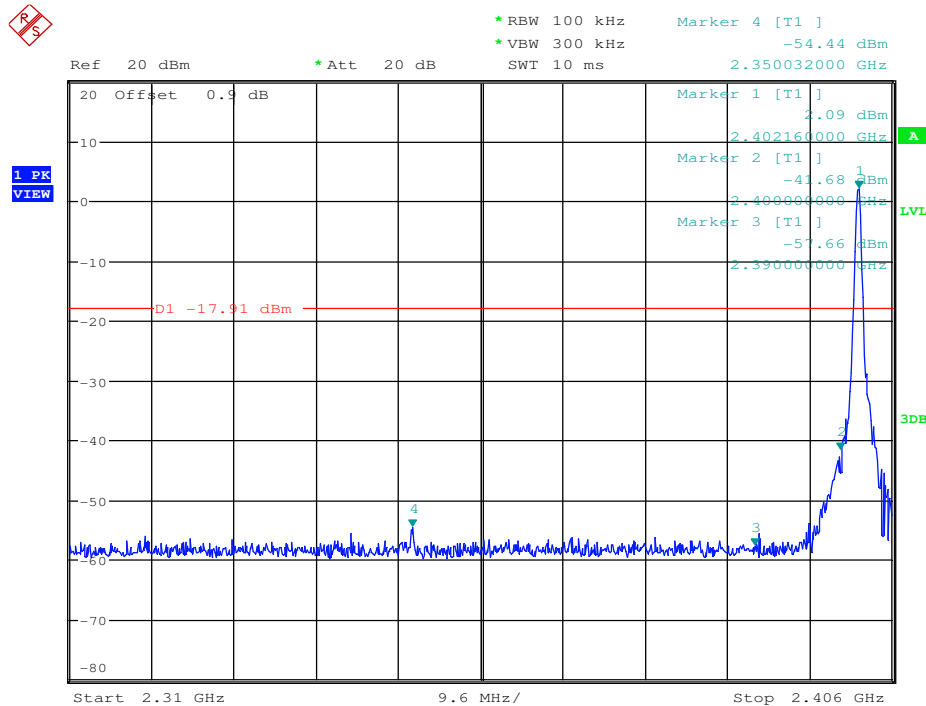
6.Band-edge for RF Conducted Emissions

Test Mode	Test Channel	Hopping	Carrier Power[dBm]	Max. Spurious Level [dBm]	Limit[dBm]	Verdict
DH5	2402	On	2.070	-54.126	<-17.93	PASS
DH5	2402	Off	2.090	-54.441	<-17.91	PASS
DH5	2480	On	1.670	-54.539	<-18.33	PASS
DH5	2480	Off	1.670	-48.115	<-18.33	PASS
2DH5	2402	On	-4.120	-55.659	<-24.12	PASS
2DH5	2402	Off	-3.590	-55.648	<-23.59	PASS
2DH5	2480	On	-4.110	-54.687	<-24.11	PASS
2DH5	2480	Off	-3.970	-50.759	<-23.97	PASS
3DH5	2402	On	-3.680	-55.330	<-23.68	PASS
3DH5	2402	Off	-3.520	-55.287	<-23.52	PASS
3DH5	2480	On	-4.210	-53.511	<-24.21	PASS
3DH5	2480	Off	-4.050	-50.289	<-24.05	PASS

Band-edge for RF Conducted Emissions_DH5_2402_Hopping On



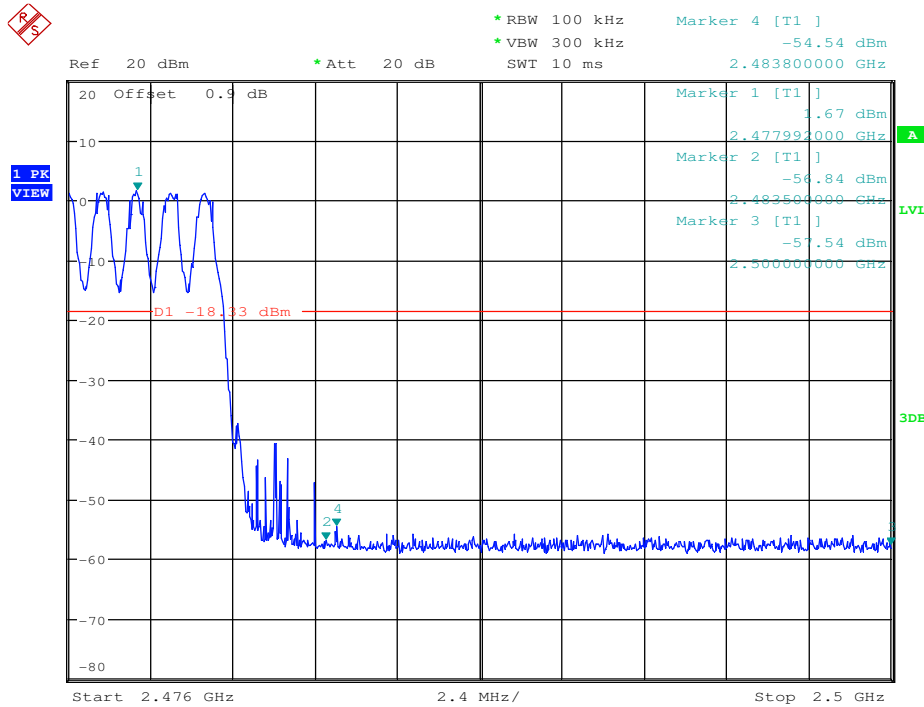
Band-edge for RF Conducted Emissions_DH5_2402_Hopping Off



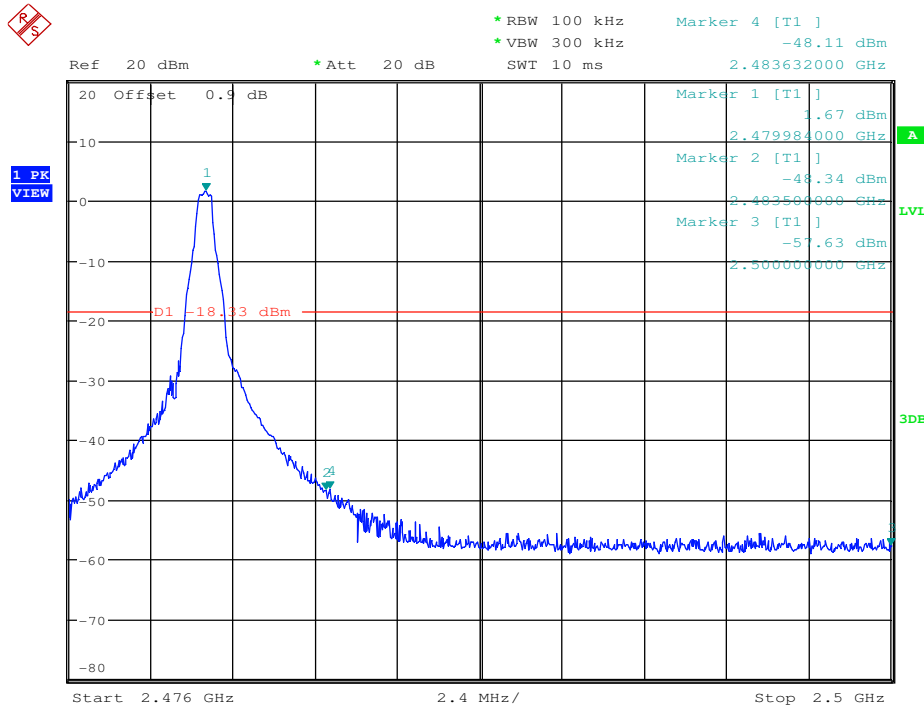
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Band-edge for RF Conducted Emissions_DH5_2480_Hopping On



Band-edge for RF Conducted Emissions_DH5_2480_Hopping Off

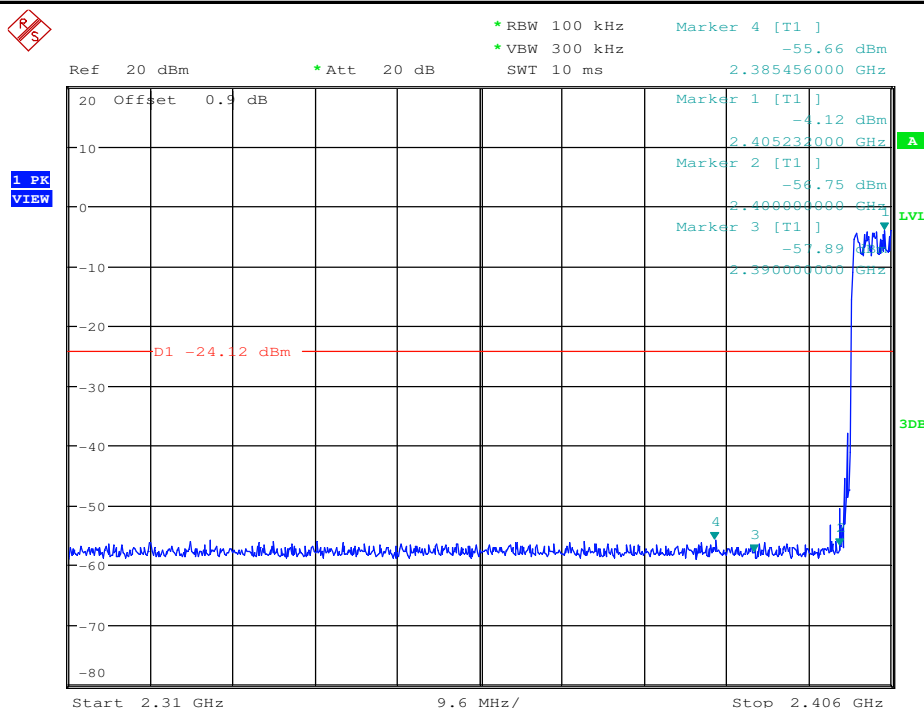


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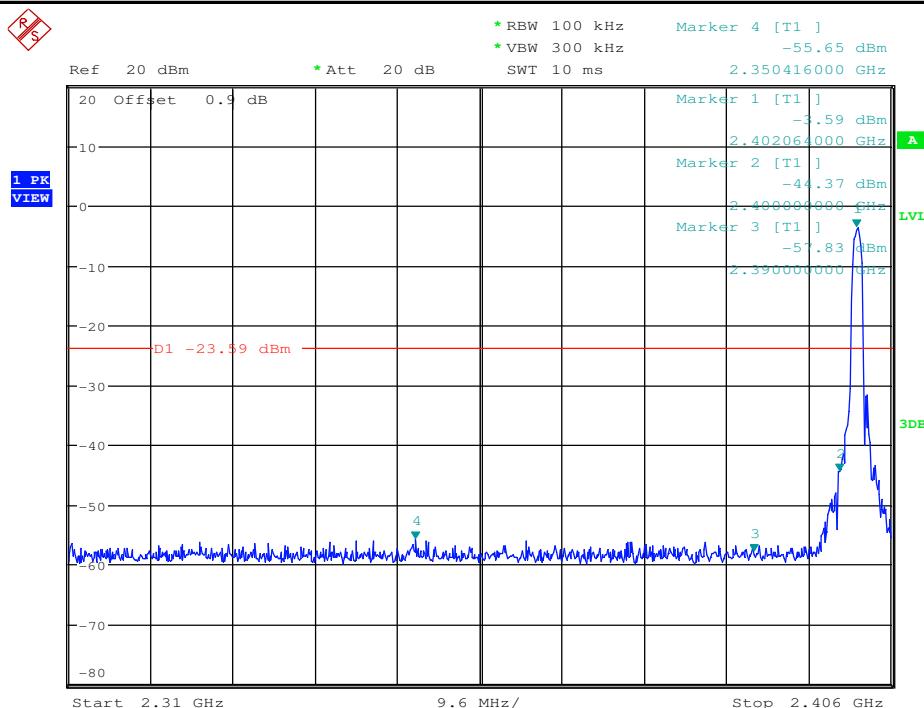
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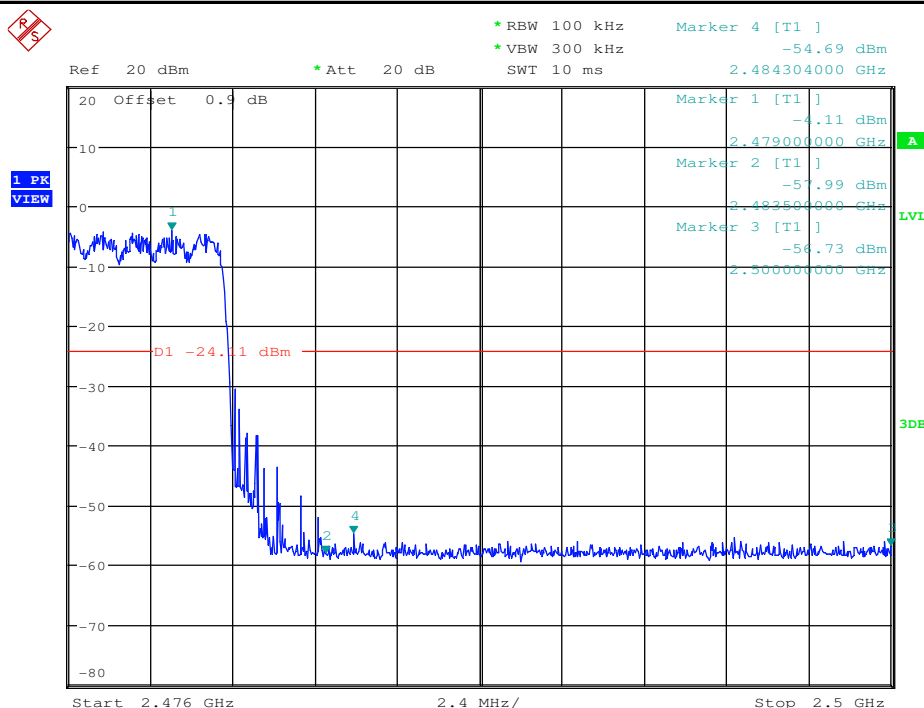
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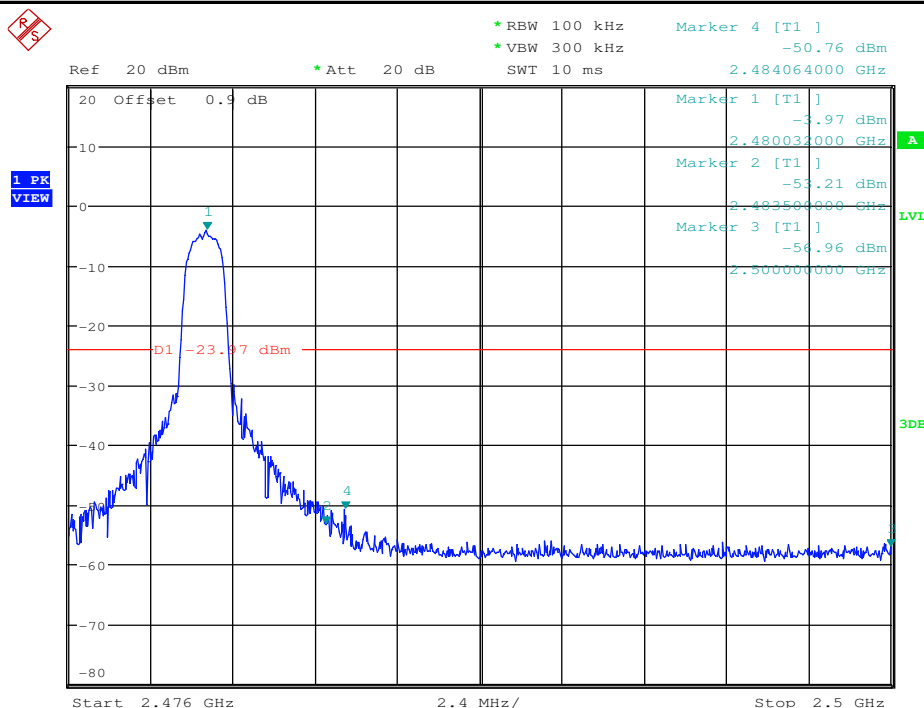
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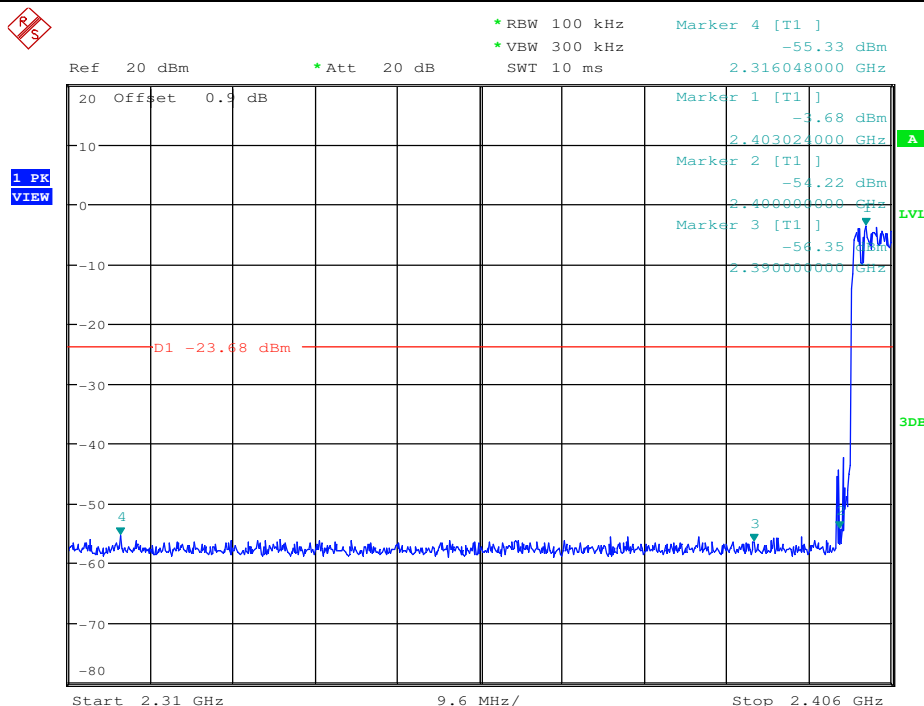
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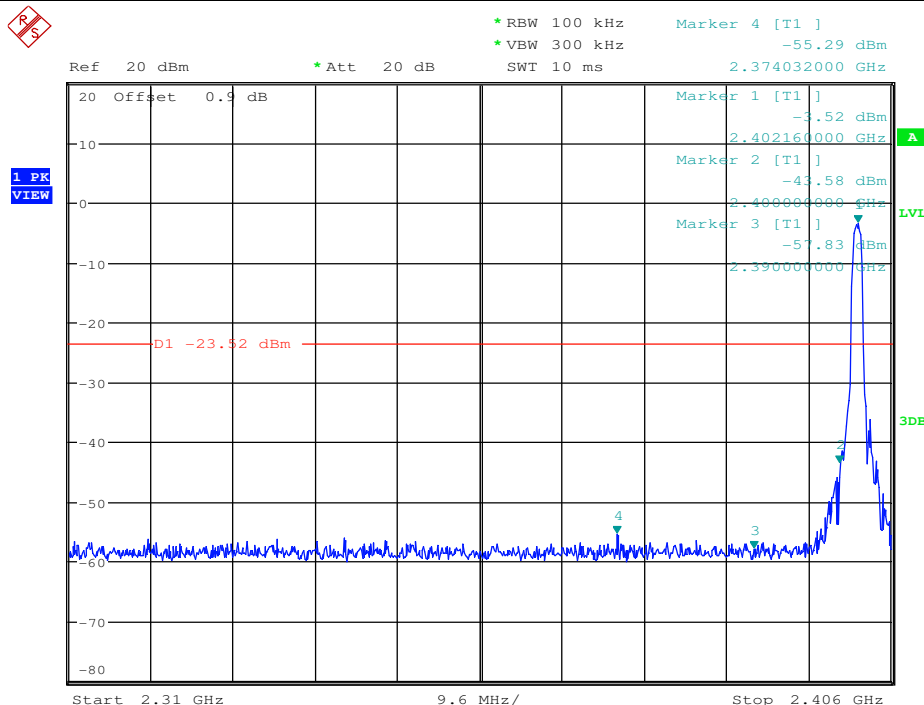
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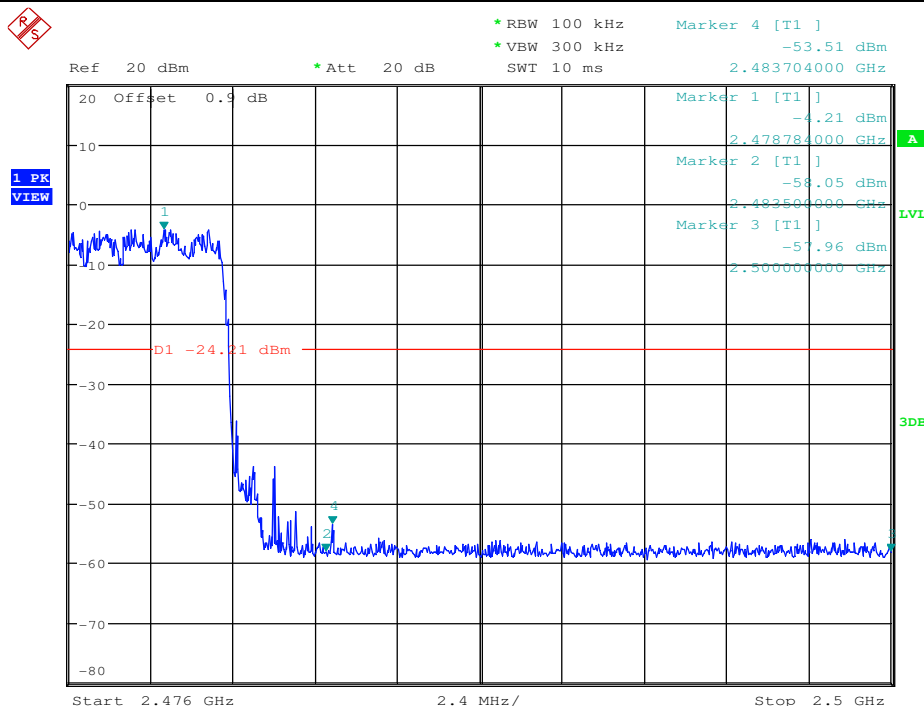
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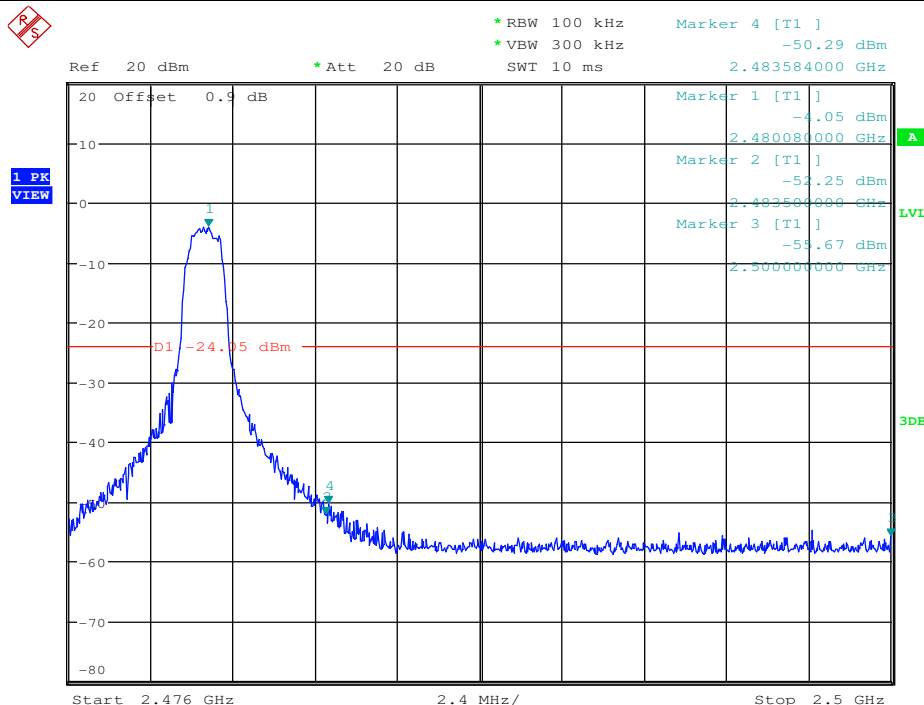
Band-edge for RF Conducted Emissions_3DH5_2402_Hopping Off



Band-edge for RF Conducted Emissions_3DH5_2480_Hopping On



Band-edge for RF Conducted Emissions_3DH5_2480_Hopping Off



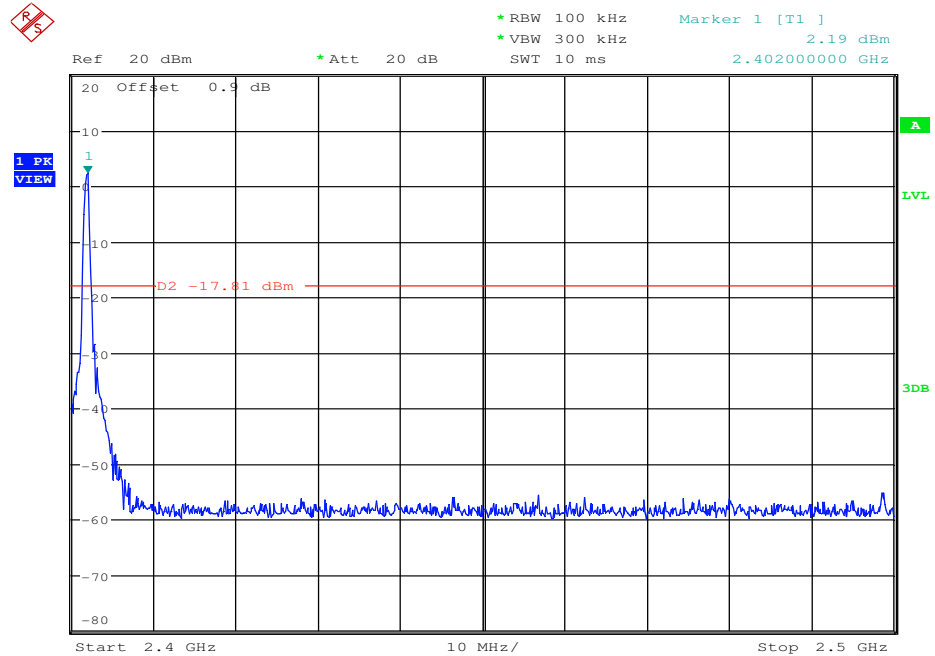
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7.RF Conducted Spurious Emissions

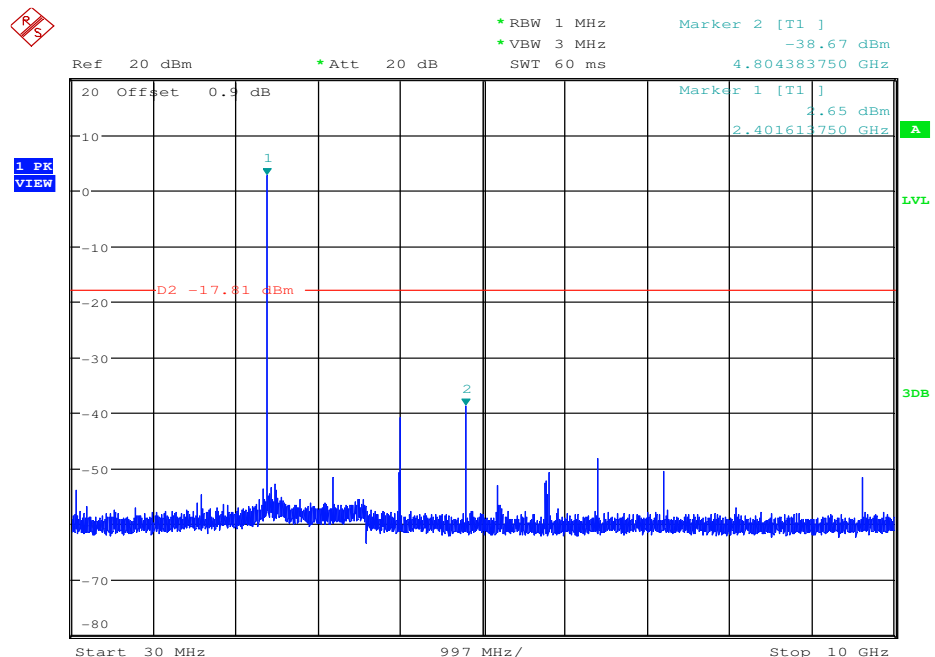
Test Mode	Test Channel	StartFre [MHz]	StopFre [MHz]	RBW [kHz]	VBW [kHz]	Pref[dBm]	Max. Level [dBm]	Limit [dBm]	Verdict
DH5	2402	30	10000	1000	3000	2.19	-38.670	<-17.81	PASS
DH5	2402	10000	25000	1000	3000	2.19	-55.020	<-17.81	PASS
DH5	2441	30	10000	1000	3000	2.14	-37.730	<-17.86	PASS
DH5	2441	10000	25000	1000	3000	2.14	-54.950	<-17.86	PASS
DH5	2480	30	10000	1000	3000	1.88	-37.240	<-18.12	PASS
DH5	2480	10000	25000	1000	3000	1.88	-54.790	<-18.12	PASS
2DH5	2402	30	10000	1000	3000	-3.57	-41.770	<-23.57	PASS
2DH5	2402	10000	25000	1000	3000	-3.57	-54.950	<-23.57	PASS
2DH5	2441	30	10000	1000	3000	-3.53	-41.150	<-23.53	PASS
2DH5	2441	10000	25000	1000	3000	-3.53	-53.830	<-23.53	PASS
2DH5	2480	30	10000	1000	3000	-4.04	-40.760	<-24.04	PASS
2DH5	2480	10000	25000	1000	3000	-4.04	-55.100	<-24.04	PASS
3DH5	2402	30	10000	1000	3000	-3.59	-41.070	<-23.59	PASS
3DH5	2402	10000	25000	1000	3000	-3.59	-54.540	<-23.59	PASS
3DH5	2441	30	10000	1000	3000	-3.74	-41.460	<-23.74	PASS
3DH5	2441	10000	25000	1000	3000	-3.74	-54.800	<-23.74	PASS
3DH5	2480	30	10000	1000	3000	-3.97	-40.400	<-23.97	PASS
3DH5	2480	10000	25000	1000	3000	-3.97	-55.040	<-23.97	PASS

RF Conducted Spurious Emissions_DH5_2402

Pref



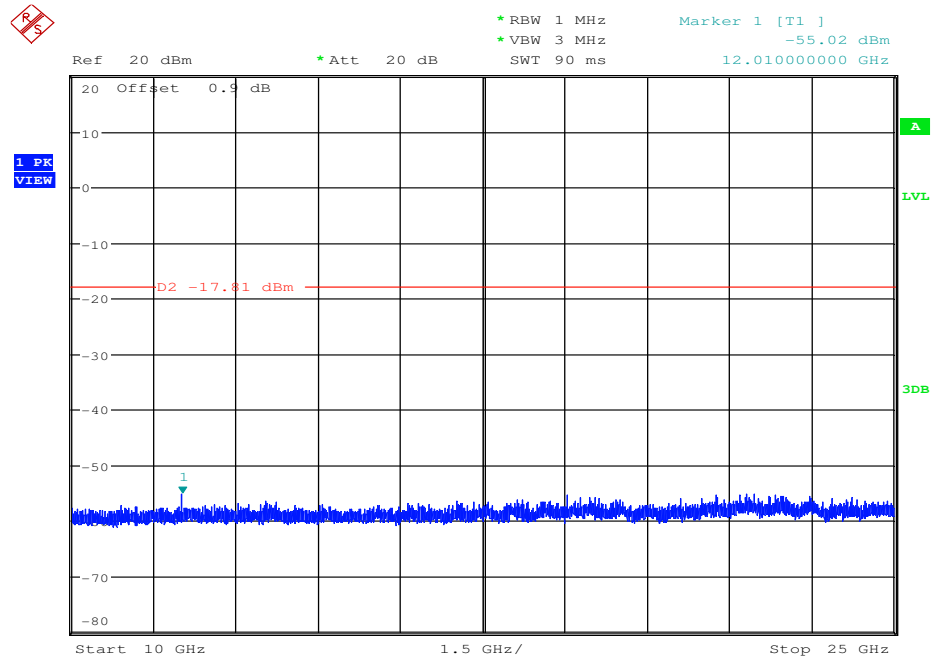
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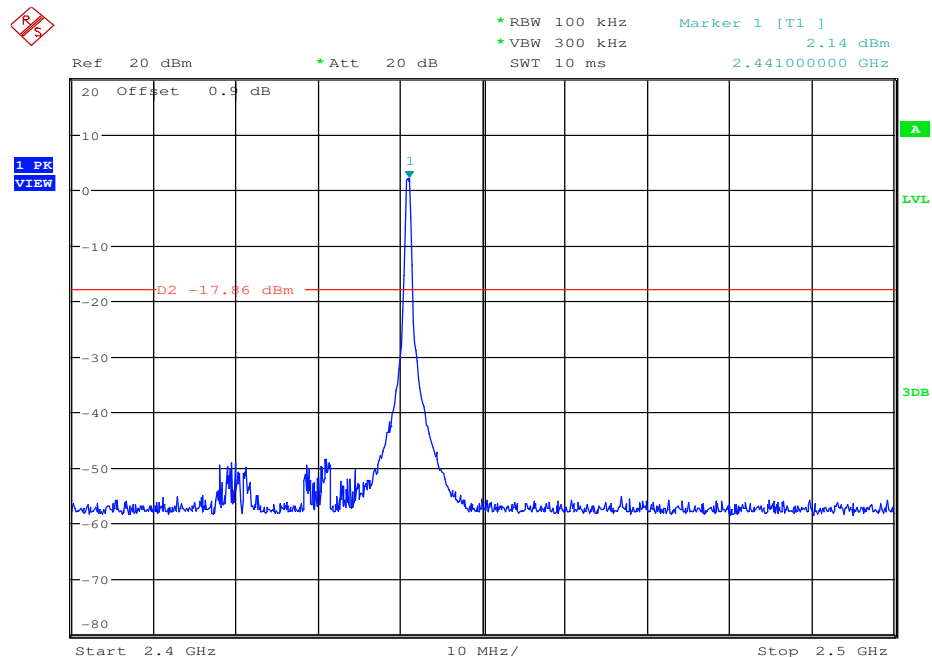
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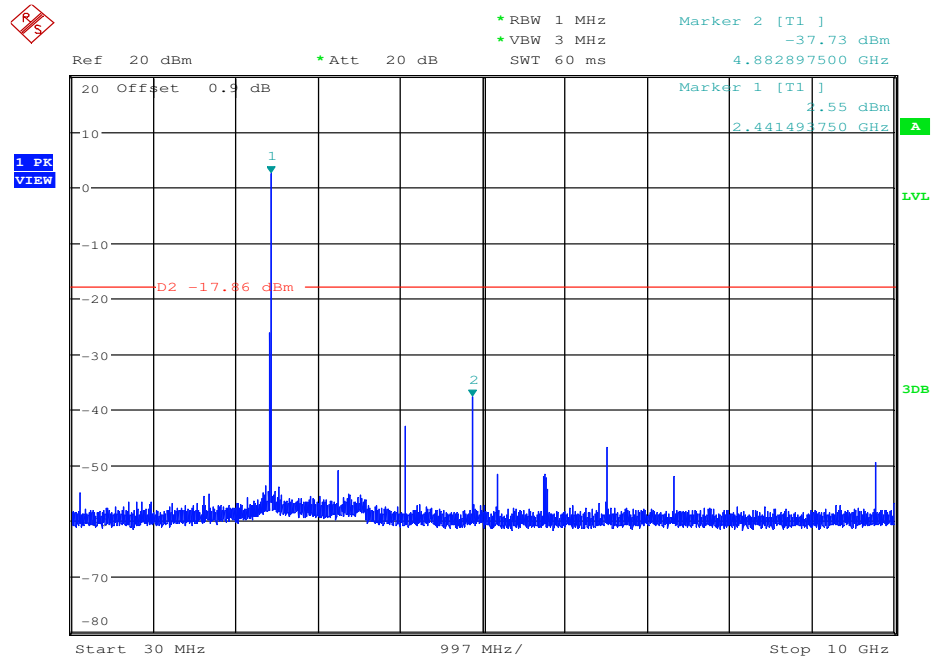
RF Conducted Spurious Emissions_DH5_2441

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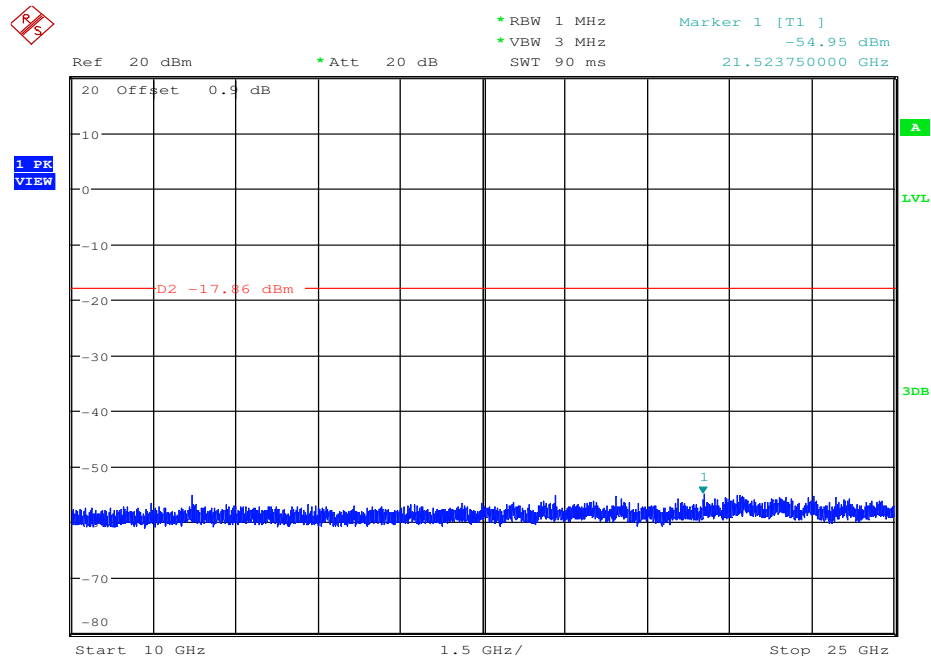


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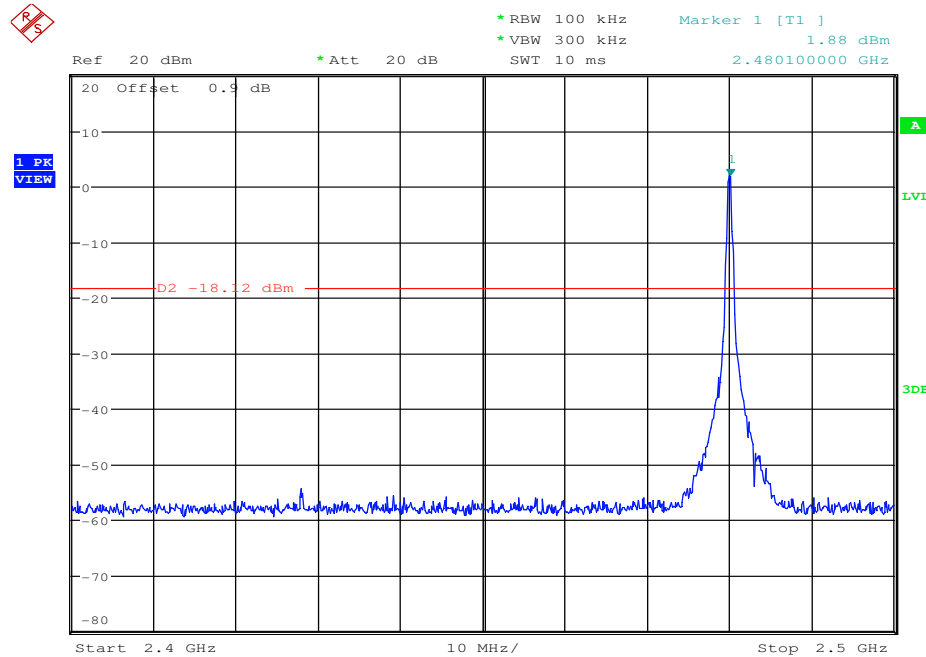


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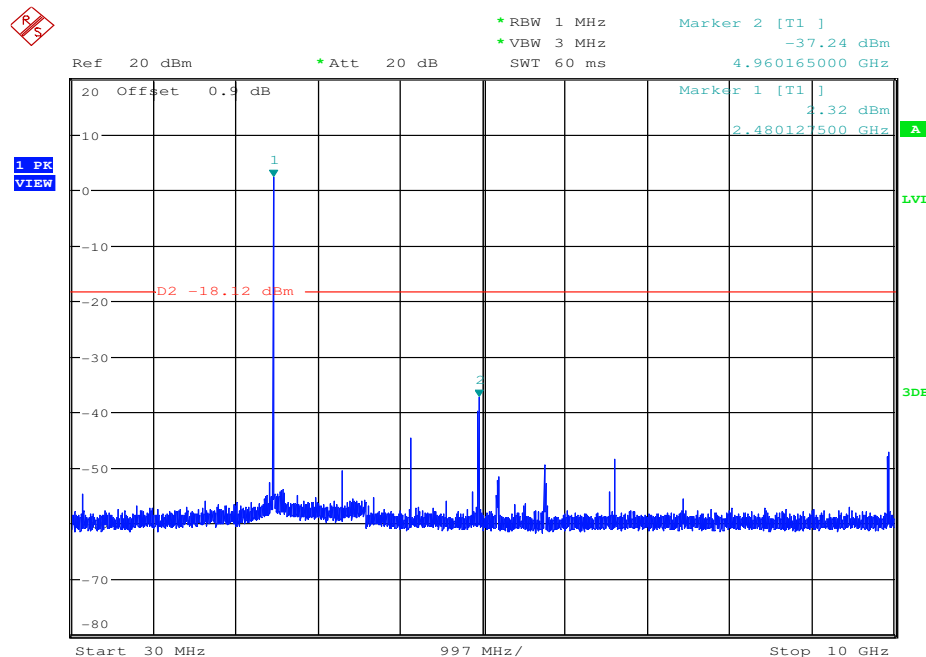


RF Conducted Spurious Emissions_DH5_2480

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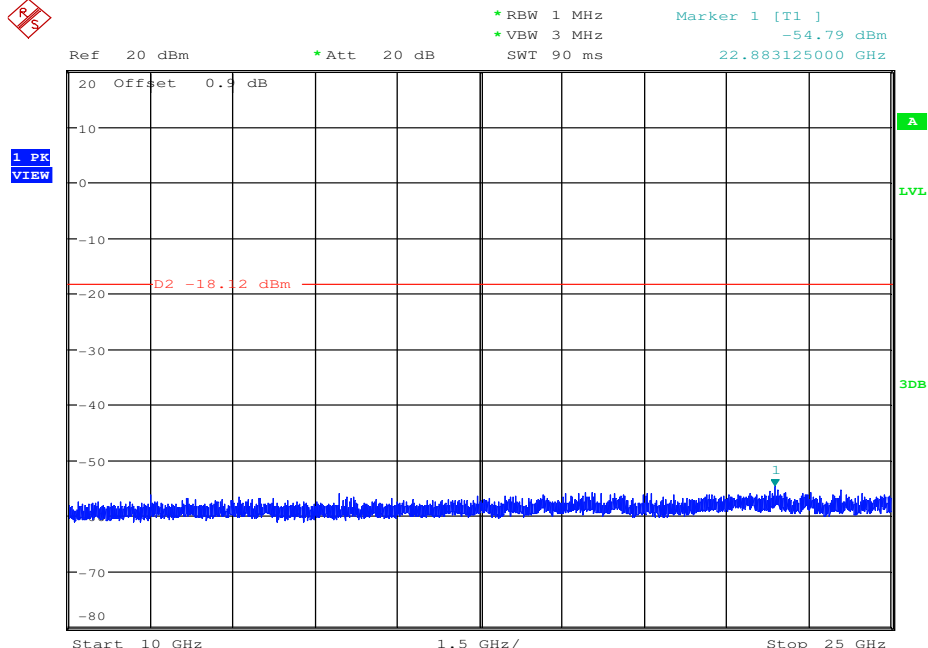
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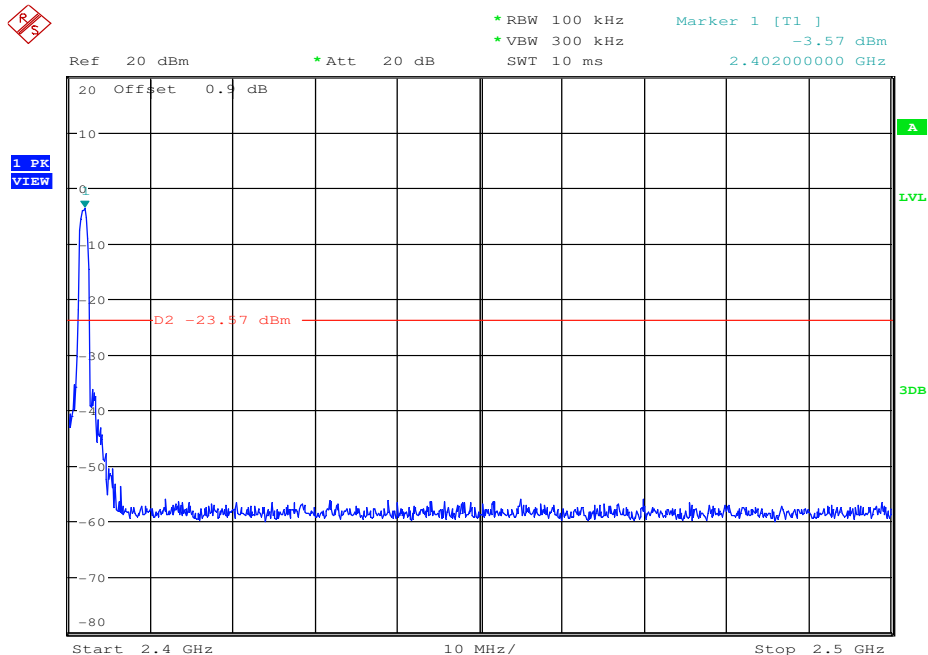
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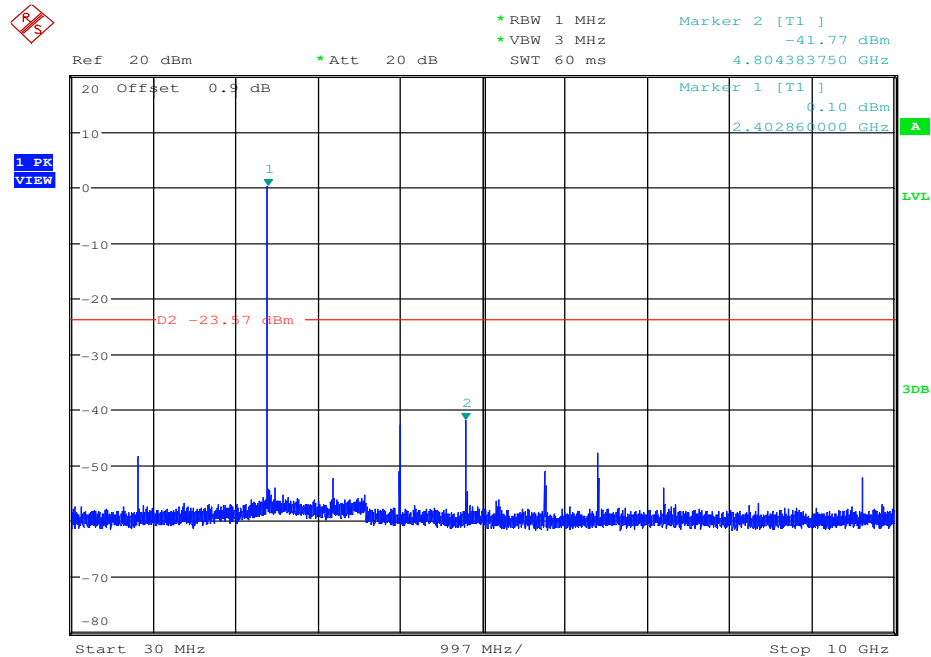
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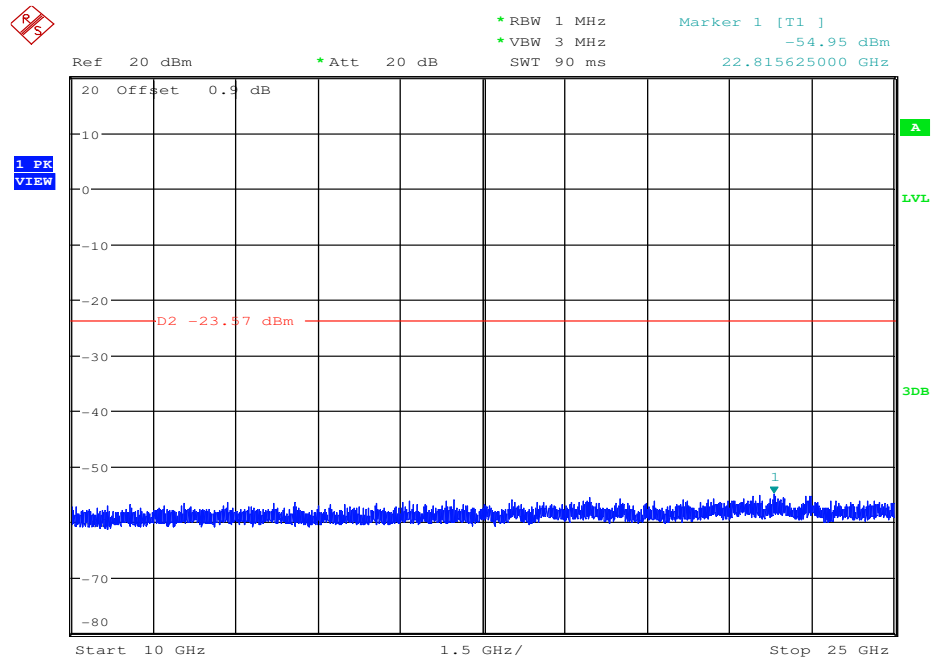
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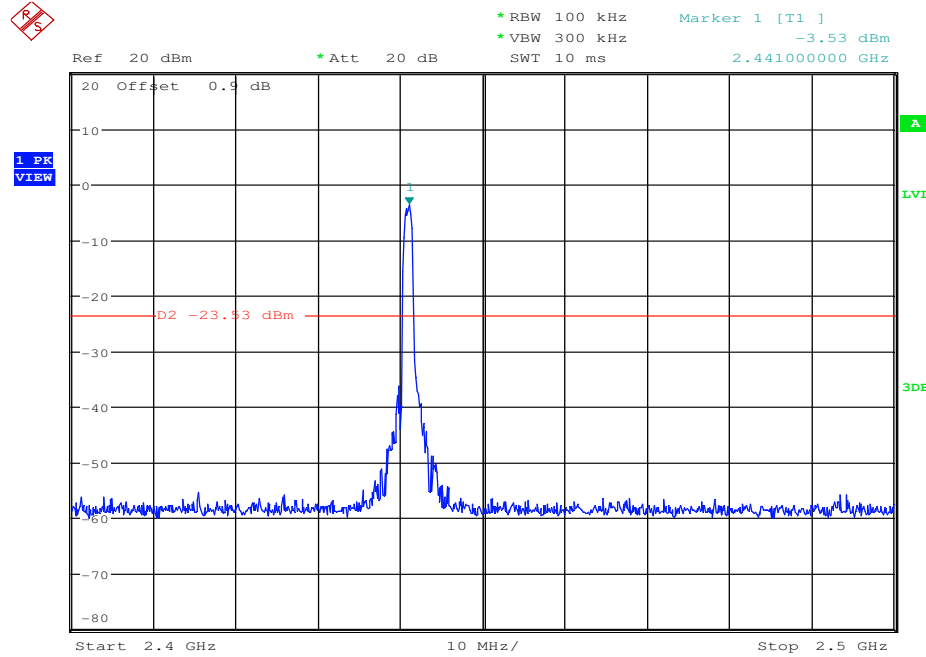


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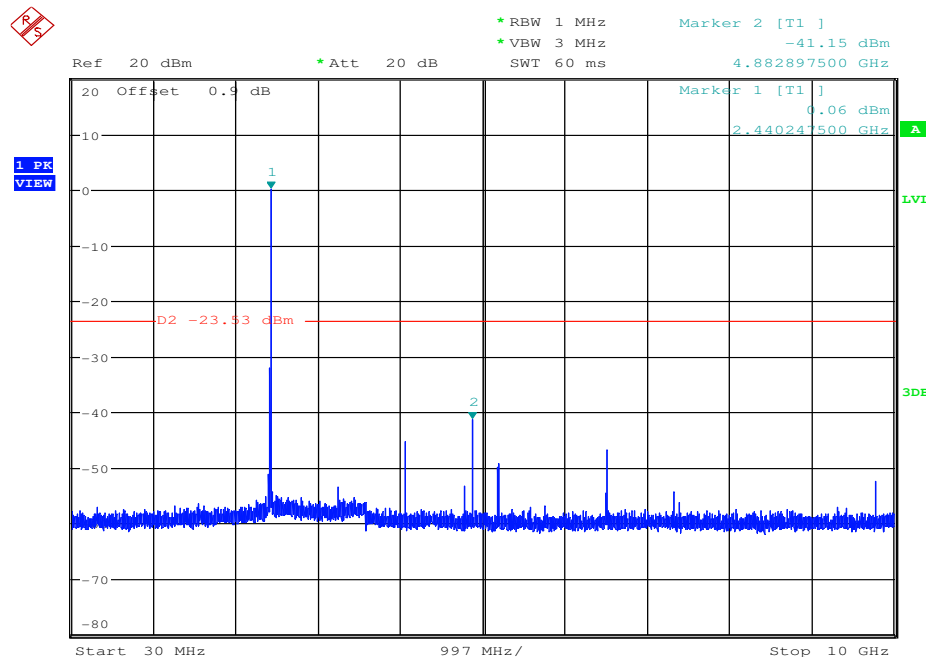


RF Conducted Spurious Emissions_2DH5_2441

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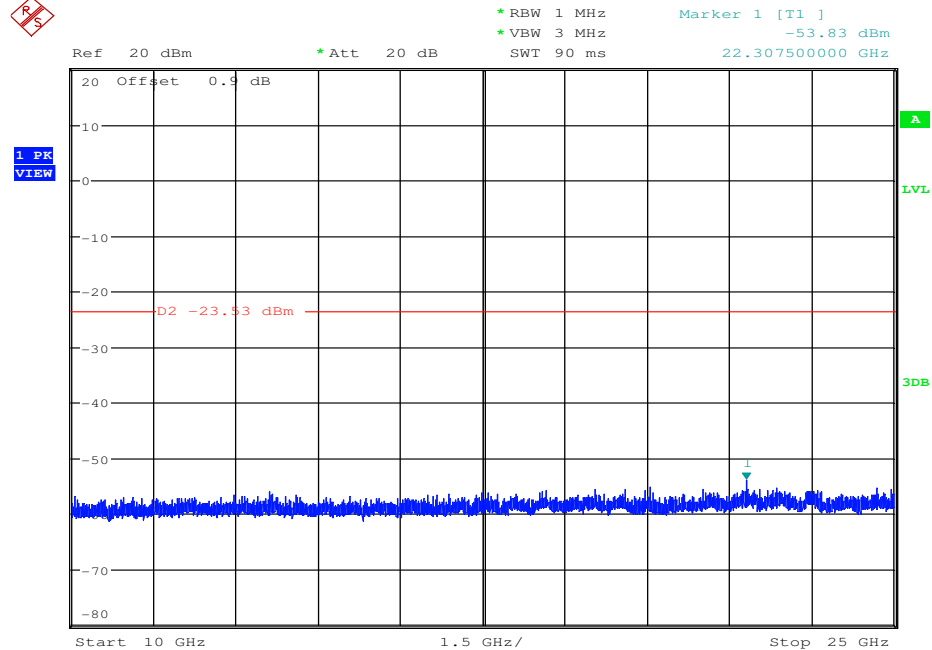
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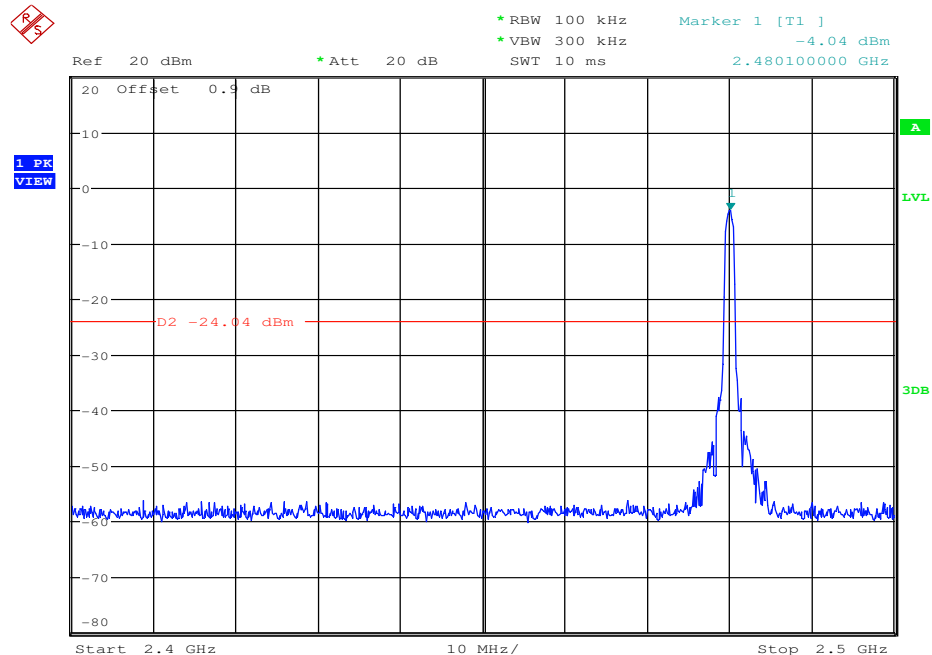
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RF Conducted Spurious Emissions_2DH5_2480

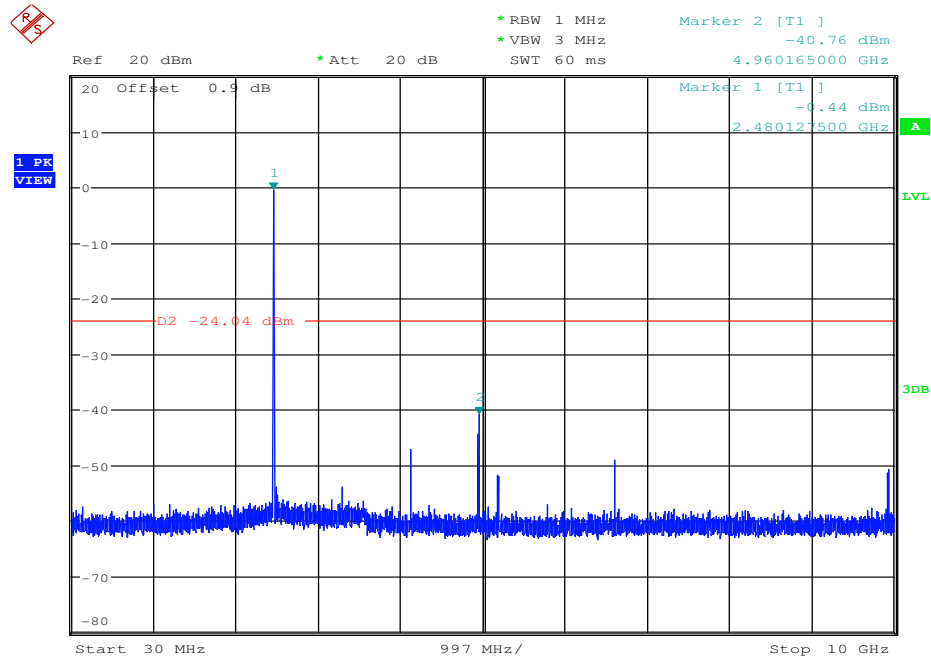
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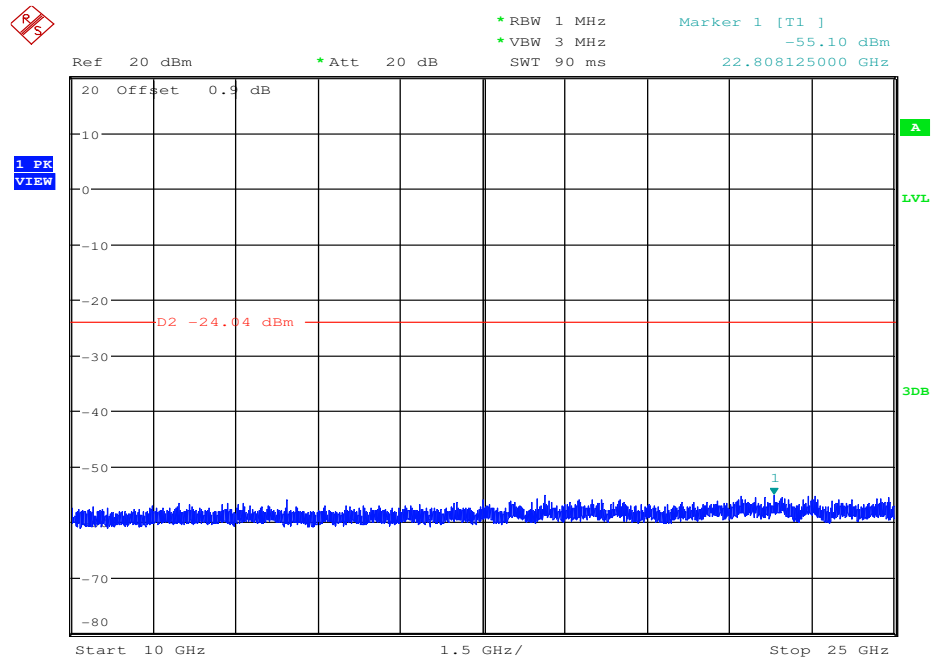
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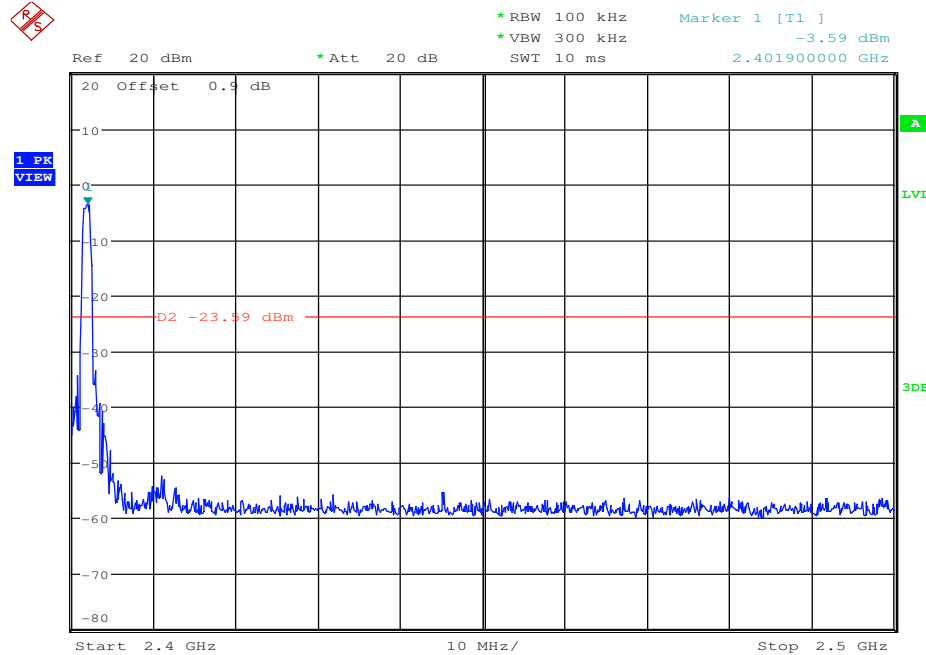


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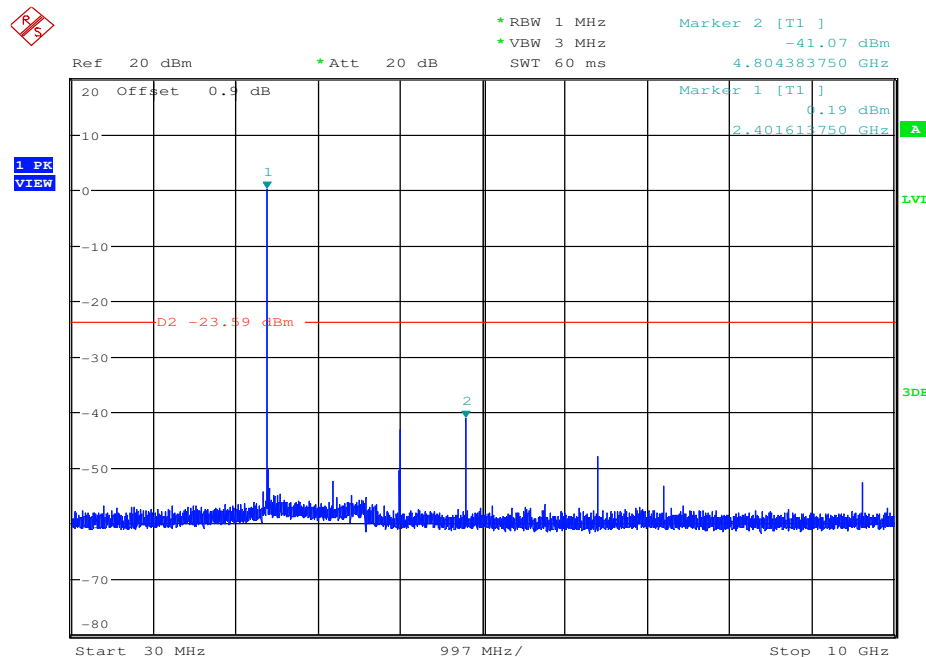


RF Conducted Spurious Emissions_3DH5_2402

Pref



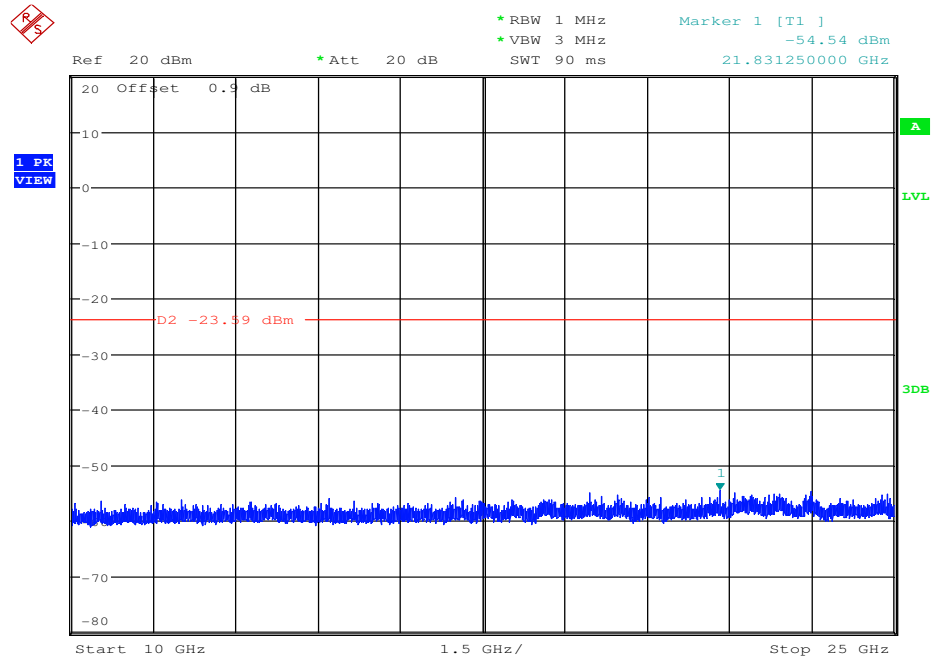
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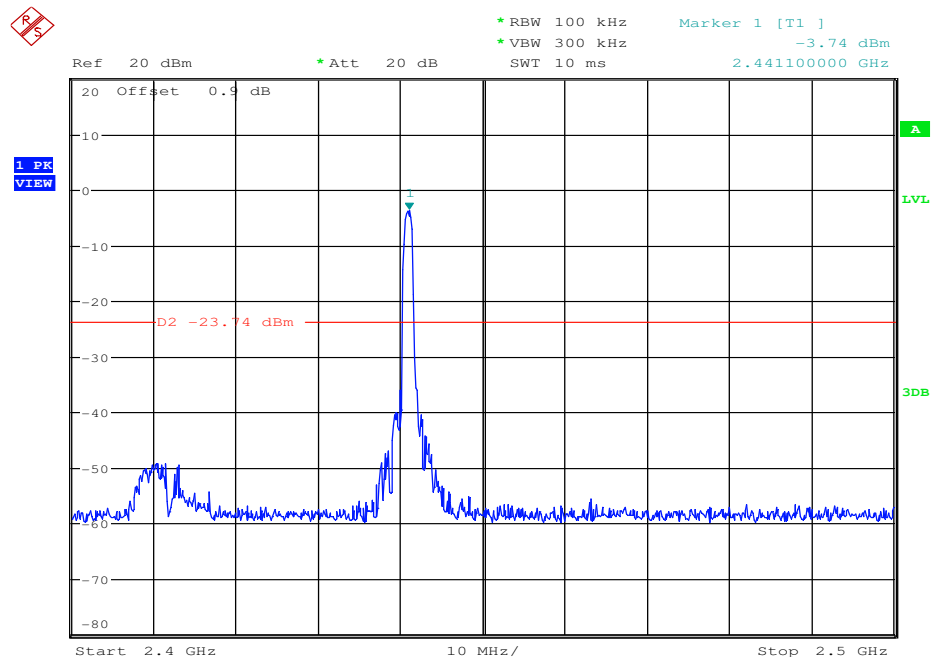
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RF Conducted Spurious Emissions_3DH5_2441

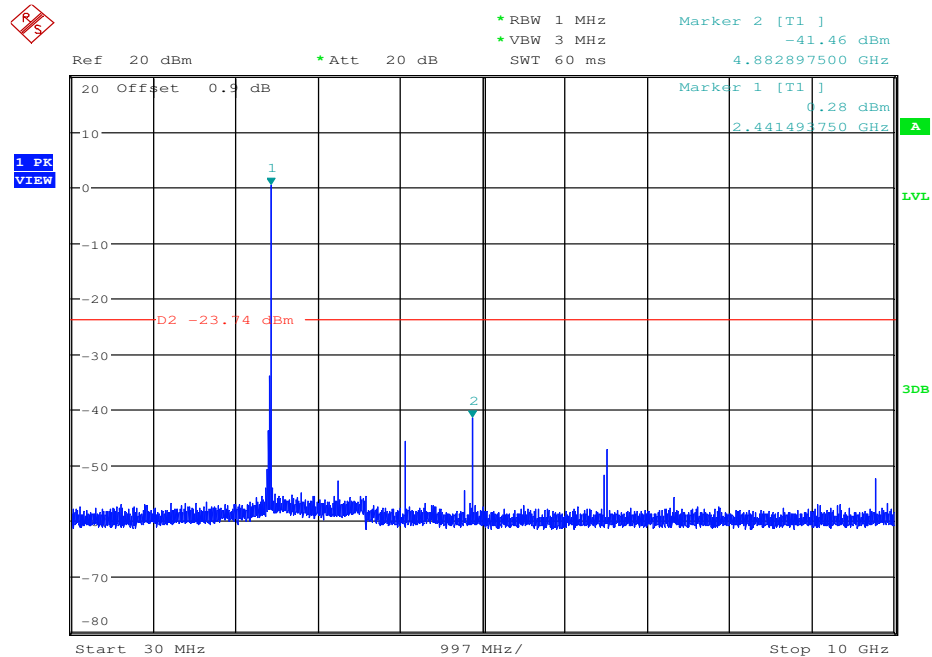
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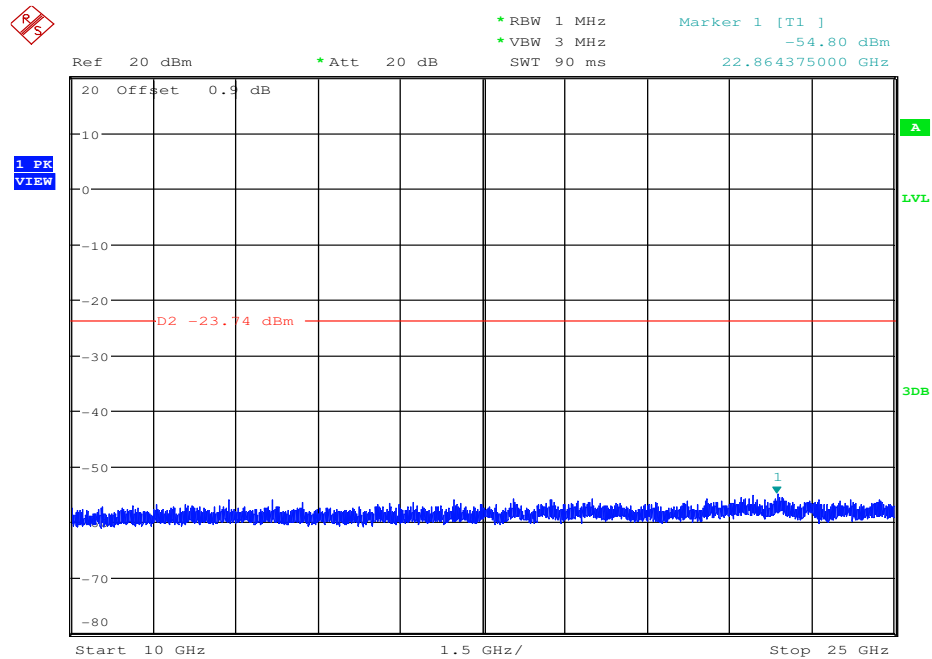
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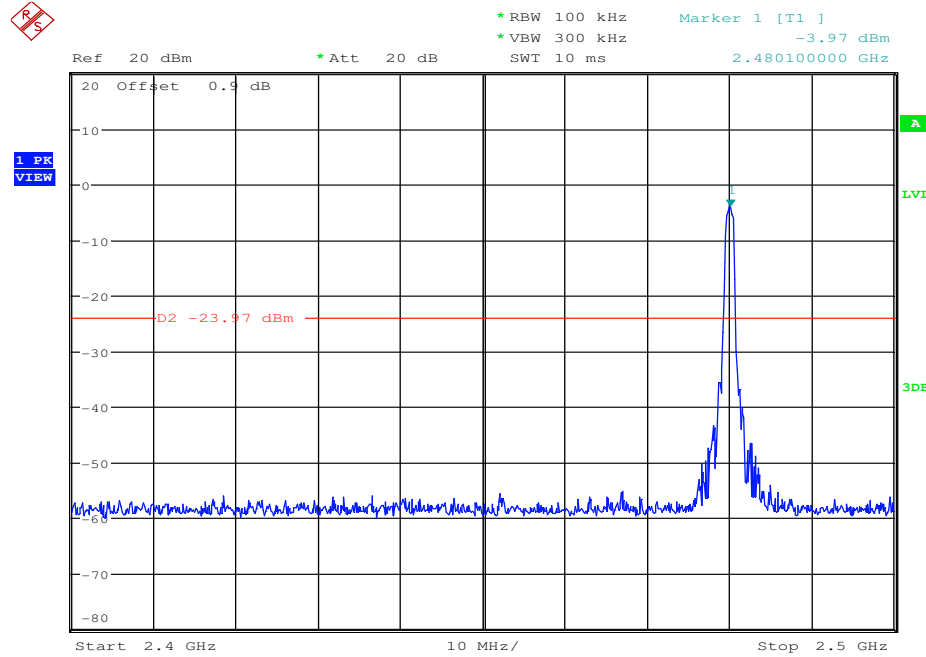


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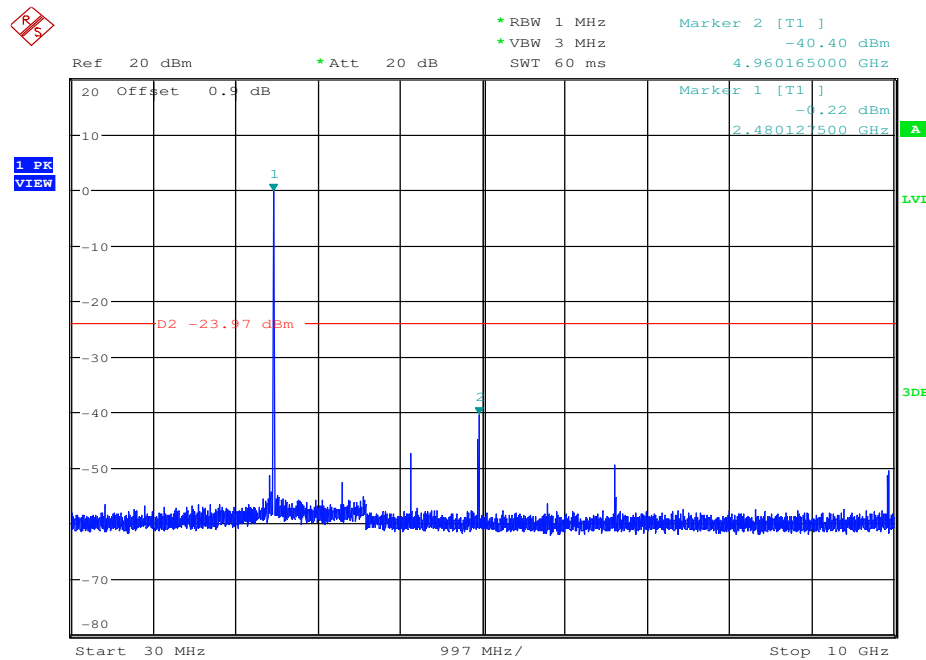


RF Conducted Spurious Emissions_3DH5_2480

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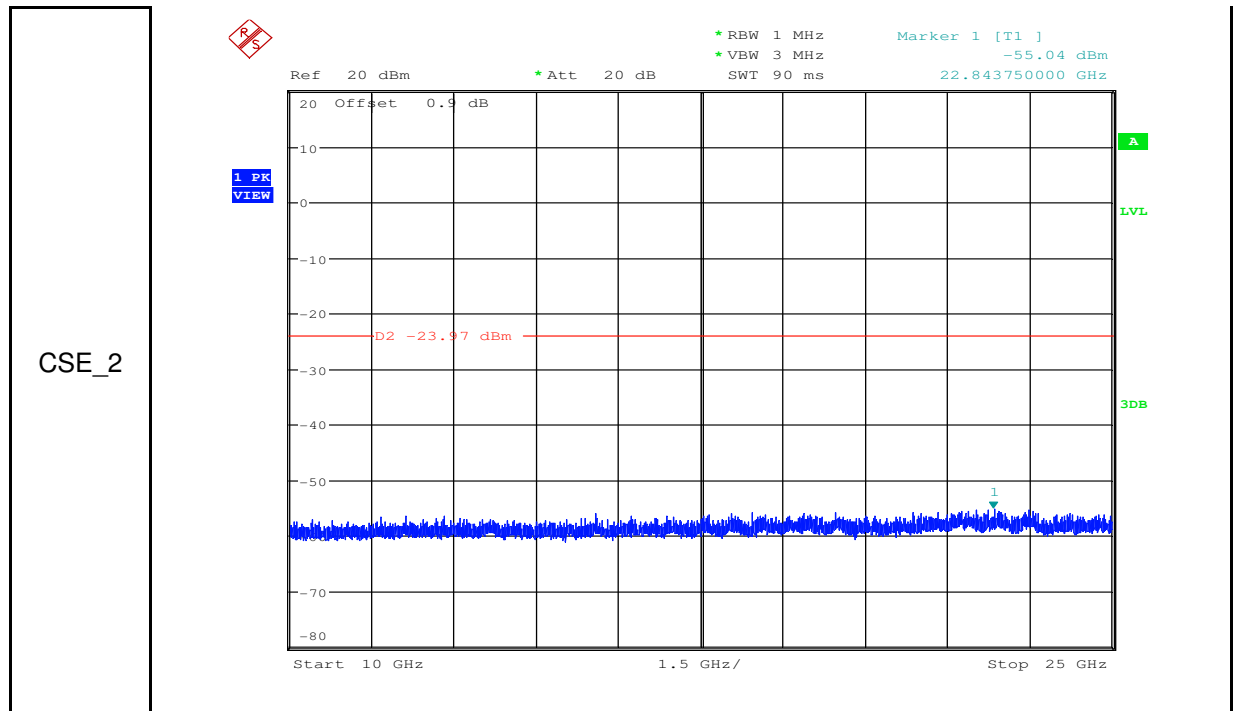


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- End of the Report -

