TEST REPORT

Application No.:	SHCR2210002218AT
FCC ID:	2AFF6-X4G81EVADDL
IC:	22349-X4G81EVADDL
Applicant:	Adam Hall GmbH
Address of Applicant:	Adam-Hall-Str. 1, 61267 Neu-Anspach, Germany
Manufacturer:	Adam Hall GmbH
Address of Manufacturer:	Adam-Hall-Str. 1, 61267 Neu-Anspach, Germany
Factory:	Speaker Electronic(Jiashan) Co.,Ltd
Address of Factory:	No. 8 Development Zone Road, Huimin Sub-district, Jiashan County, Zhejiang, 314112, P.R. China
Equipment Under Test (EUT):	
EUT Name:	Active PA Box
Model No.:	DAVE 18 G4X
Trade Mark:	LD Systems
Standard(s) :	47 CFR Part 15, Subpart C 15.247 RSS-247 Issue 2, February 2017 RSS-Gen Issue 5 April 2018 Amendment 2
Date of Receipt:	2022-10-18
Date of Test:	2022-11-17 to 2023-02-03
Date of Issue:	2023-02-07
Test Result:	**Pass***

* In the configuration tested, the EUT complied with the standards specified above.

Parlam Zhan

Parlam Zhan
Laboratory Manager

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Revision Record			
Version	**Description**	**Date**	**Remark**
00	Original	2023-02-07	/

Authorized for issue by:				
		Wade Zhang		
		Wade Zhang/Project Engineer		
		Parlam Zhan		
		Parlam Zhan/Reviewer		

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2 Test Summary

Radio Spectrum Technical Requirement				
Item	**FCC Requirement**	**IC Requirement**	**Method**	**Result**
Antenna Requirement	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	RSS-Gen Clause 6.8	N/A	Customer Declaration
Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence	47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)	RSS-247 Section 5.1(a)	N/A	Pass

N/A: Not applicable

Radio Spectrum Matter Part				
Item	**FCC Requirement**	**IC Requirement**	**Method**	**Result**
Conducted Emissions at AC Power Line (150kHz-30MHz)	47 CFR Part 15, Subpart C 15.207	RSS-Gen Section 8.8	ANSI C63.10 (2013) Section 6.2	Pass
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247(b)(1)	RSS-247 Section 5.4(b)	ANSI C63.10 (2013) Section 7.8.5	Pass
20dB Bandwidth	47 CFR Part 15, Subpart C 15.247(a)(1)	RSS-247 Section 5.1(a)	ANSI C63.10 (2013) Section 7.8.7	Pass
Carrier Frequencies Separation	47 CFR Part 15, Subpart C 15.247a(1)	RSS-247 Section 5.1(b)	ANSI C63.10 (2013) Section 7.8.2	Pass
Hopping Channel Number	47 CFR Part 15, Subpart C 15.247a(1)(iii)	RSS-247 Section 5.1(d)	ANSI C63.10 (2013) Section 7.8.3	Pass
Dwell Time	47 CFR Part 15, Subpart C 15.247a(1)(iii)	RSS-247 Section 5.1(d)	ANSI C63.10 (2013) Section 7.8.4	Pass
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247(d)	RSS-247 Section 5.5	ANSI C63.10 (2013) Section 7.8.6	Pass
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247(d)	RSS-247 Section 5.5	ANSI C63.10 (2013) Section 7.8.8	Pass
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.205 & 15.209	RSS-247 Section 3.3 & RSS-Gen Section 8.9	ANSI C63.10 (2013) Section 6.10.5	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.205 & 15.209	RSS-247 Section 3.3 & RSS-Gen Section 8.9	ANSI C63.10 (2013) Section 6.4,6.5,6.6	Pass
99% Bandwidth	-	RSS-Gen Section 6.7	ANSI C63.10 Section 6.9.3	Pass

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4 General Information

4.1 Details of E.U.T.

Power supply:	AC 100-240V 50/60Hz
Test Voltage:	AC120V 60Hz
Operation Frequency:	2402MHz to 2480MHz
Modulation Type:	GFSK, pi/4DQPSK, 8DPSK
Number of Channels:	79
Channel Spacing:	1MHz
Spectrum Spread Technology:	Frequency Hopping Spread Spectrum(FHSS)
Antenna Type:	SMD Antenna
Antenna Gain:	3.3 dBi (Provided by manufacturer)
S/N:	B8301365
Firmware Version:	FCC_V2.24_20200921

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Laptop	LENOVO	L460	-
SecureCRT	VanDyke	V 6.2.0	-
Serial port adapter plate	-	Test Plate 3	-

4.3 Power level setting using in test:

Channel	Power setting		
	DH5	2DH5	3DH5
Low	2	2	2
Middle	2	2	2
High	2	2	2

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4.4 Measurement Uncertainty & Decision Rule

No.	Item	Measurement Uncertainty
1	Radio Frequency	8.4×10^{-8}
2	Timeout	2s
3	Duty cycle	0.4%
4	Occupied Bandwidth	3%
5	RF conducted power	0.6dB
6	RF power density	2.9dB
7	Conducted Spurious emissions	0.75dB
8	RF Radiated power	5.2dB (Below 1GHz)
		5.9dB (Above 1GHz)
9	Radiated Spurious emission test	4.2dB (Below 30MHz)
		4.5dB (30MHz-1GHz)
		5.1dB (1GHz-6GHz)
		5.4dB (6GHz-18GHz)
10	Temperature test	1°C
11	Humidity test	3%
12	Supply voltages	1.5%
13	Time	3%

Note: The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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4.5 Test Location

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Tel: +86 21 6191 5666 Fax: +86 21 6191 5678
No tests were sub-contracted.
Note:
1. SGS is not responsible for wrong test results due to incorrect information (e.g. max. clock frequency, highest internal frequency, antenna gain, cable loss, etc) is provided by the applicant. (if applicable).
2. SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (if applicable).

4.6 Test Facility

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• FCC (Designation Number: CN1301)

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

• ISED (CAB Identifier: CN0020)

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. EMC Laboratory has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory. Company Number: 8617A

• VCCI (Member No.: 3061)

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4.7 Deviation from Standards

None

4.8 Abnormalities from Standard Conditions

None

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5 Equipment List

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RF Conducted Test					
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2022-12-20	2023-12-19
Spectrum Analyzer	Keysight	N9020B	SHEM241-1	2022-12-20	2023-12-19
Spectrum Analyzer	Agilent	N9020A	SHEM181-1	2022-08-02	2023-08-01
Signal Generator	R&S	SMR20	SHEM006-1	2022-08-02	2023-08-01
Signal Generator	Agilent	N5182A	SHEM182-1	2022-08-02	2023-08-01
Communication Tester	R&S	CMW270	SHEM183-1	2022-07-25	2023-07-24
Communication Tester	R&S	CMW500	SHEM268-1	2022-07-25	2023-07-24
Power Sensor	Keysight	U2021XA * 4	SHEM184-1	2022-08-02	2023-08-01
Splitter	Anritsu	MA1612A	SHEM185-1	/	/
Coupler	e-meca	803-S-1	SHEM186-1	/	/
High-low Temp Cabinet	Suzhou Zhihe	TL-40	SHEM087-1	2022-11-08	2024-11-07
AC Power Stabilizer	APC	KDF-31020T-V0-F0	SHEM216-1	2022-12-20	2023-12-19
DC Power Supply	MCH	MCH-303A	SHEM210-1	2022-12-20	2023-12-19
Conducted test Cable	/	RF01~RF04	/	2022-12-20	2023-12-19
Switcher	Tonscend	JS0806	SHEM184-1	2022-08-02	2023-08-01
Test software	Tonscend	JS Tonscend BT/WIFI System	Version: 2.6	/	/
Coaxial Cable	TST		SHEM263-1	2022-08-02	2023-08-01
Test software	TST	TST PASS	Version: 2.0	/	/
RF Radiated Test					
EMI test Receiver	R&S	ESU40	SHEM051-1	2022-12-20	2023-12-19
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2022-12-20	2023-12-19
Communication Tester	R&S	CMW500	SHEM268-1	2022-07-25	2023-07-24
Loop Antenna (9kHz-30MHz)	Schwarzbeck	FMZB1519	SHEM135-1	2022-12-20	2023-12-19
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM048-1	2021-09-11	2023-09-10
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM202-1	2021-05-07	2023-05-06
Horn Antenna (1-18GHz)	Schwarzbeck	HF906	SHEM009-1	2022/8/11	2024-08-10
Horn Antenna (1-18GHz)	Schwarzbeck	BBHA9120D	SHEM050-1	2021-09-18	2023-09-17
Horn Antenna (14-40GHz)	Schwarzbeck	BBHA 9170	SHEM049-1	2021-09-18	2023-09-17
Pre-Amplifier	HP	8447D	SHEM236-1	2022-08-02	2023-08-01
High-amplifier (14-40GHz)	Schwarzbeck	10001	SHEM049-2	2022-12-20	2023-12-19
Band Filter	LORCH	9BRX-875/X150	SHEM156-1	/	/
Band Filter	LORCH	13BRX-1950/X500	SHEM083-2	/	/
Band Filter	LORCH	5BRX-2400/X200	SHEM155-1	/	/
Band Filter	LORCH	5BRX-5500/X1000	SHEM157-2	/	/
High pass Filter	Wainwright	WHK3.0/18G	SHEM157-1	/	/
High pass Filter	Wainwright	WHKS1700	SHEM157-3	/	/
Semi/Fully Anechoic	ST	11*6*6M	SHEM078-2	2020-05-25	2023-05-24
RE test Cable	/	RE01, RE02, RE06	/	2023-01-07	2024-01-06
Test software	ESE	E3	Version: 6.111221a	/	/

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Conducted Emissions at AC Mains Power Port (150kHz-30MHz)					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
EMI test receiver	Rohde & Schwarz	ESR7	SHEM162-1	2022/12/20	2023/12/19
Line impedance stabilization network	SCHWARZBECK	NSLK8127	SHEM061-1	2022/12/20	2023/12/19
Line impedance stabilization network	EMCO	3816_2	SHEM019-1	2022/12/20	2023/12/19
Pulse limiter	Rohde & Schwarz	ESH3-Z2	SHEM029-1	2022/12/20	2023/12/19
Shielding Room	ZHONGYU	8*4*3M	SHEM079-2	2020/12/20	2023/12/19
CE test Cable	/	/	SHEM172-1	2022/12/20	2023/12/19
Test Software	ESE	e3	Version: 6.111221a	N/A	N/A

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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 SMD Antenna and no consideration of replacement. The best case gain of the antenna is 3.3dBi.

Antenna location: Refer to internal photo.

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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: 29 -1 = 511 bits

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

Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:

Each frequency used equally on the average by each transmitter.

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

Compliance for section 15.247(g):

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

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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.

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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.		
Detector: Peak for pre-scan (9kHz resolution bandwidth) 0.15M to 30MHz		

7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

7.1.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

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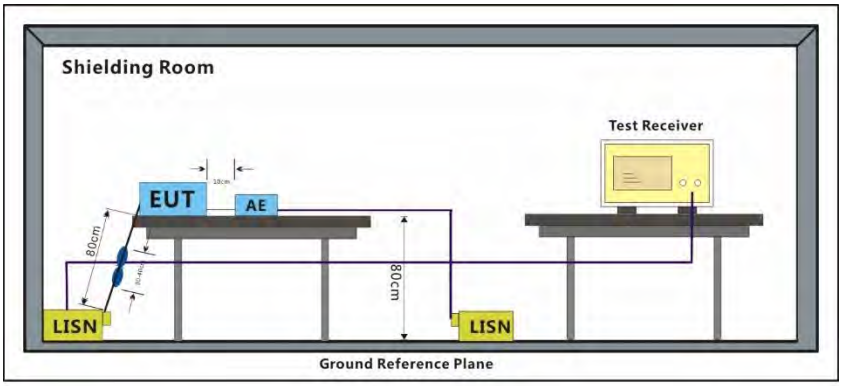
7.1.3 Test Setup Diagram



7.1.4 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/50μH + 5ohm 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: Level=Read Level+ Cable Loss+ LISN Factor

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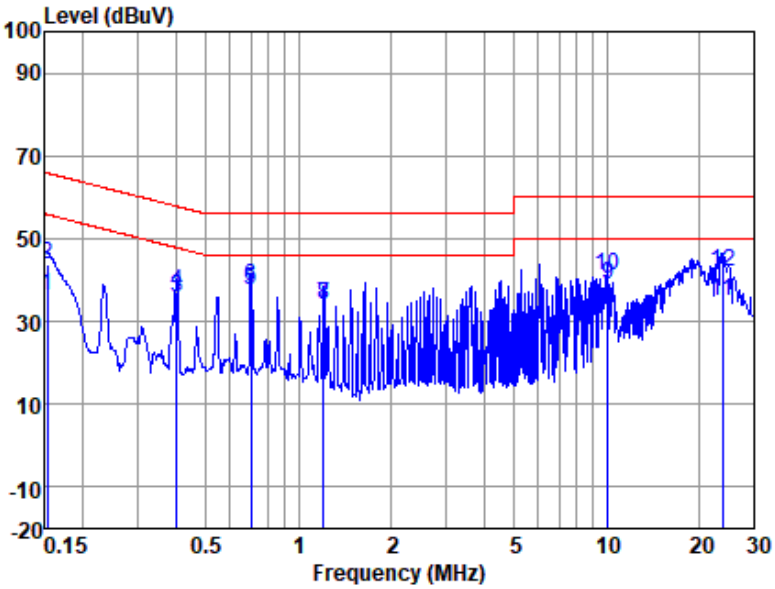
Test Mode: 00; Line: Live line



LISN : LINE
EUT/Project No : 02218AT
Test Mode : 00

	Freq (MHz)	Read level (dBuV)	LISN Factor (dB)	Cable Loss (dB)	Emission Level (dBuV)	Limit (dBuV)	Over Limit (dB)	Remark
1	0.15	26.13	0.14	10.01	36.28	55.87	-19.59	Average
2	0.15	33.82	0.14	10.01	43.97	65.87	-21.90	QP
3	0.40	25.79	0.10	10.07	35.96	47.81	-11.85	Average
4	0.40	26.76	0.10	10.07	36.93	57.81	-20.88	QP
5	0.70	27.16	0.10	10.09	37.35	46.00	-8.65	Average
6	0.70	28.17	0.10	10.09	38.36	56.00	-17.64	QP
7	1.20	23.98	0.10	10.13	34.21	46.00	-11.79	Average
8	1.20	23.94	0.10	10.13	34.17	56.00	-21.83	QP
9	10.07	28.33	0.30	10.32	38.95	50.00	-11.05	Average
10	10.07	30.42	0.30	10.32	41.04	60.00	-18.96	QP
11	23.76	23.50	0.90	10.39	34.79	50.00	-15.21	Average
12	23.76	30.71	0.90	10.39	42.00	60.00	-18.00	QP

Notes: Emission Level = Read Level +LISN Factor + Cable loss

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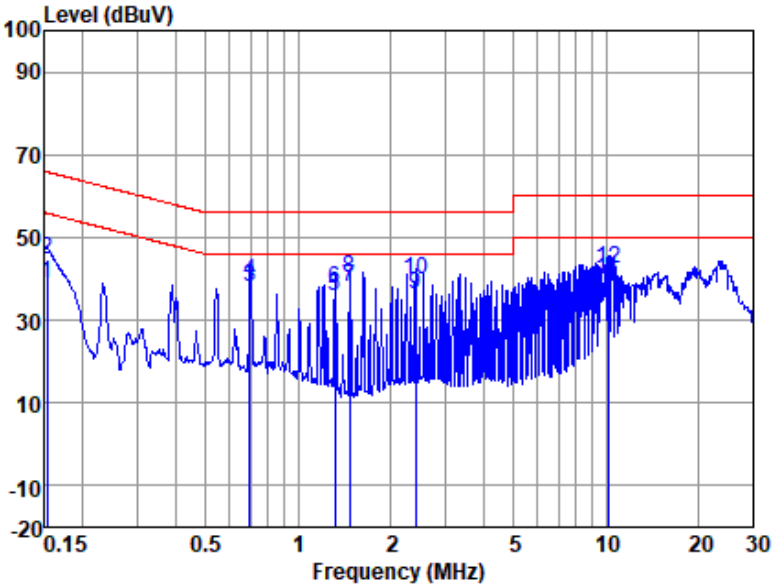
Test Mode: 00; Line: Neutral Line



LISN : NEUTRAL
EUT/Project No : 02218AT
Test Mode : 00

	Freq (MHz)	Read level (dBuV)	LISN Factor (dB)	Cable Loss (dB)	Emission Level (dBuV)	Limit (dBuV)	Over Limit (dB)	Remark
1	0.15	28.81	0.10	10.01	38.92	55.87	-16.95	Average
2	0.15	34.57	0.10	10.01	44.68	65.87	-21.19	QP
3	0.70	27.97	0.10	10.09	38.16	46.00	-7.84	Average
4	0.70	29.13	0.10	10.09	39.32	56.00	-16.68	QP
5	1.32	25.59	0.10	10.13	35.82	46.00	-10.18	Average
6	1.32	27.37	0.10	10.13	37.60	56.00	-18.40	QP
7	1.47	27.61	0.10	10.15	37.86	46.00	-8.14	Average
8	1.47	29.81	0.10	10.15	40.06	56.00	-15.94	QP
9	2.41	25.85	0.10	10.18	36.13	46.00	-9.87	Average
10	2.41	29.35	0.10	10.18	39.63	56.00	-16.37	QP
11	10.18	29.12	0.21	10.32	39.65	50.00	-10.35	Average
12	10.18	32.12	0.21	10.32	42.65	60.00	-17.35	QP

Notes: Emission Level = Read Level +LISN Factor + Cable loss

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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≤ 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

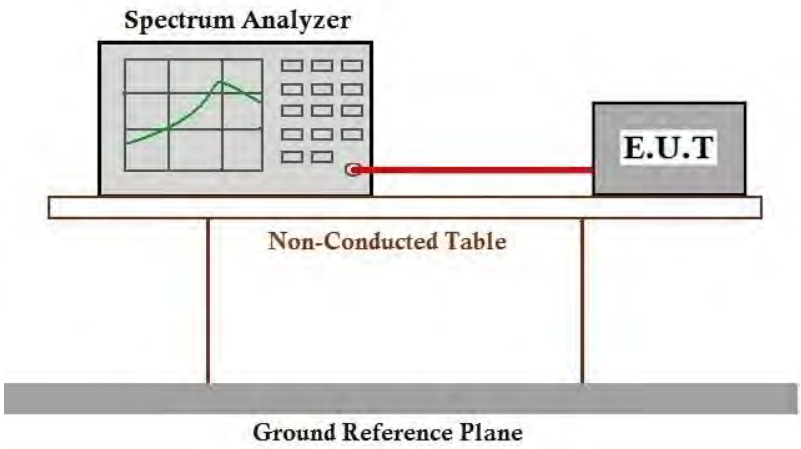
7.2.1 E.U.T. Operation

Operating Environment:
Temperature: 23.2 °C Humidity: 71.1 % RH Atmospheric Pressure: 1010 mbar

7.2.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.2.3 Test Setup Diagram



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7.2.4 Measurement Procedure and Data

Note: Since the verify power the same operating range bandwidth and smaller power can be covered by the higher power.

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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

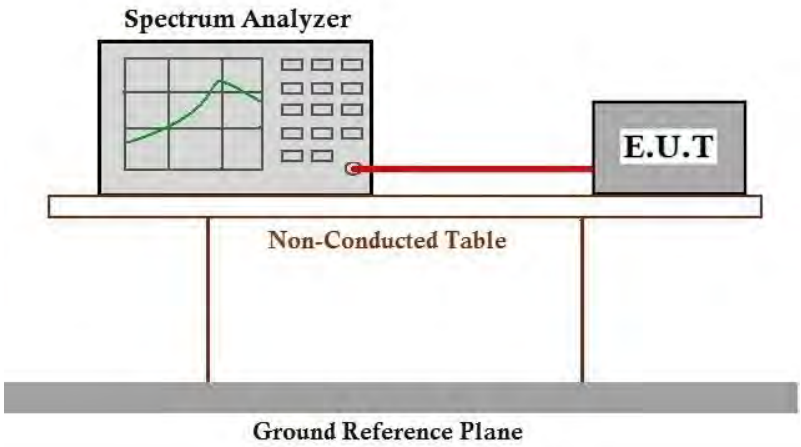
7.3.1 E.U.T. Operation

Operating Environment:
Temperature: 23.2 °C Humidity: 71.4 % RH Atmospheric Pressure: 1010 mbar

7.3.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.3.3 Test Setup Diagram



7.3.4 Measurement Procedure and Data

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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:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

7.4.1 E.U.T. Operation

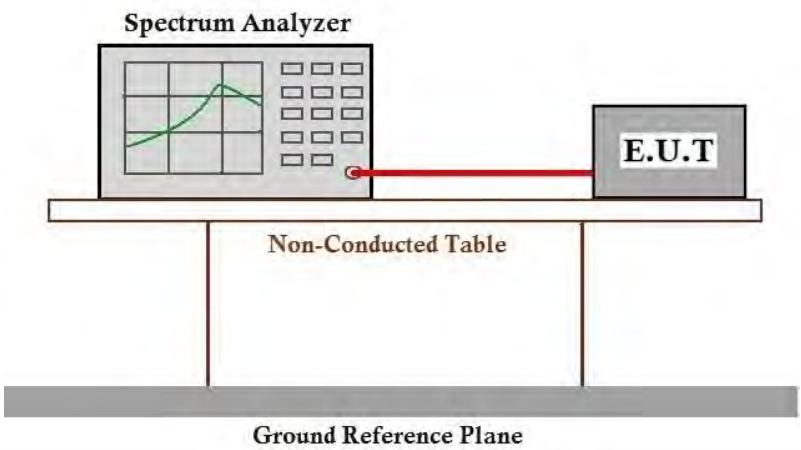
Operating Environment:

Temperature: 23.2 °C Humidity: 71.5 % RH Atmospheric Pressure: 1010 mbar

7.4.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	01	TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.4.3 Test Setup Diagram



7.4.4 Measurement Procedure and Data

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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

7.5.1 E.U.T. Operation

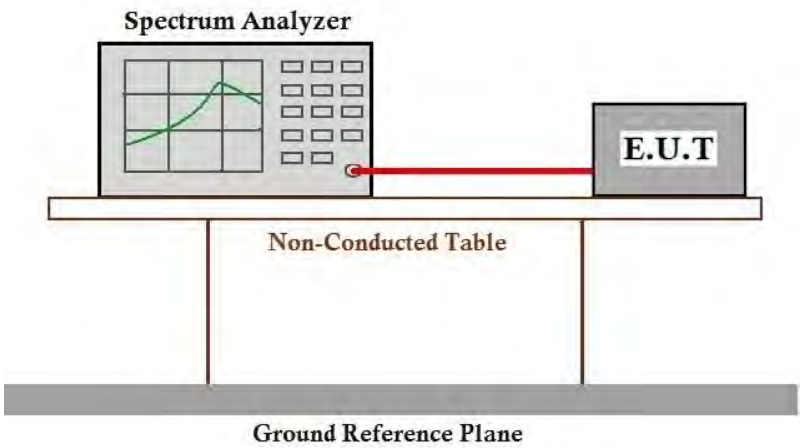
Operating Environment:

Temperature: 23.2 °C Humidity: 71.6 % RH Atmospheric Pressure: 1010 mbar

7.5.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	01	TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.5.3 Test Setup Diagram



7.5.4 Measurement Procedure and Data

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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

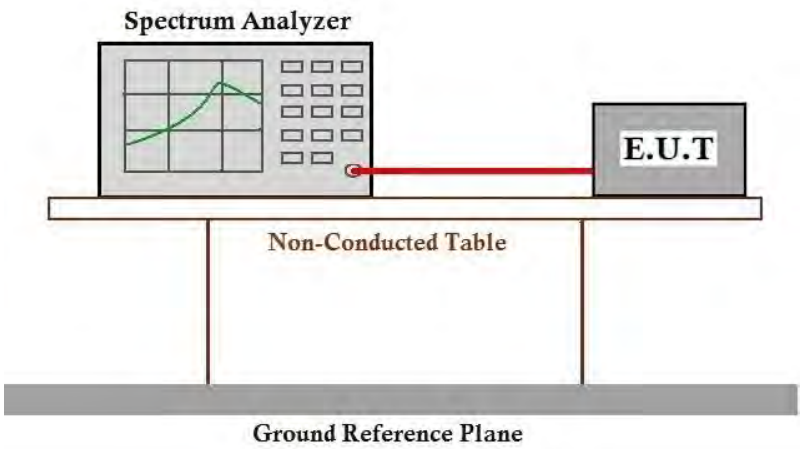
7.6.1 E.U.T. Operation

Operating Environment:
Temperature: 23.2 °C Humidity: 71.9 % RH Atmospheric Pressure: 1010 mbar

7.6.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	01	TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.6.3 Test Setup Diagram



7.6.4 Measurement Procedure and Data

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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: 23.2 °C Humidity: 71.8 % RH Atmospheric Pressure: 1010 mbar

7.7.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.
Final test	01	TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

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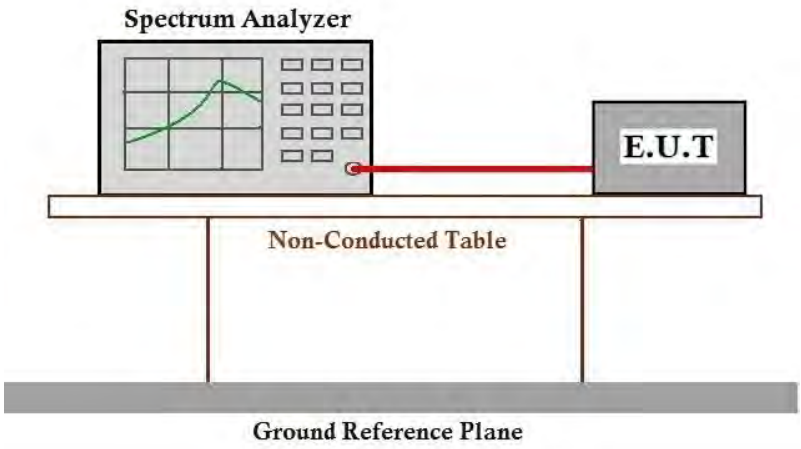
7.7.3 Test Setup Diagram



7.7.4 Measurement Procedure and Data

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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).

7.8.1 E.U.T. Operation

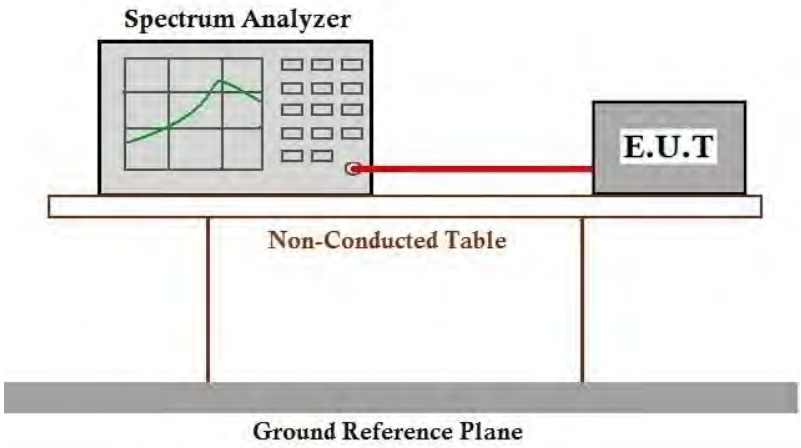
Operating Environment:

Temperature: 23.2 °C Humidity: 71.7 % RH Atmospheric Pressure: 1010 mbar

7.8.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.8.3 Test Setup Diagram



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7.8.4 Measurement Procedure and Data

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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

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: 23.2 °C Humidity: 71.7 % RH Atmospheric Pressure: 1010 mbar

7.9.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

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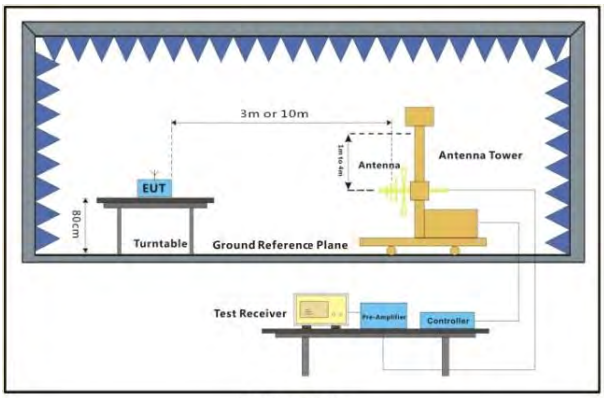
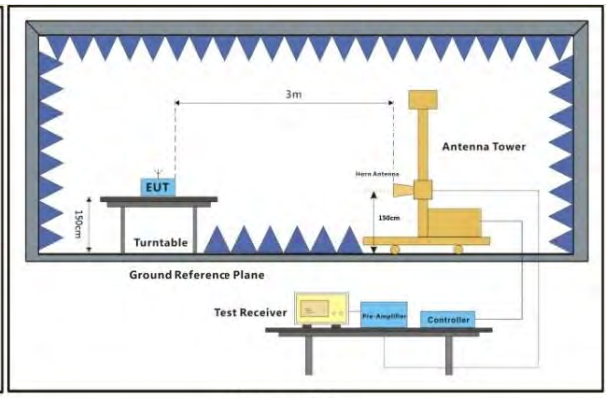
7.9.3 Test Setup Diagram



30MHz-1GHz



Above 1GHz

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7.9.4 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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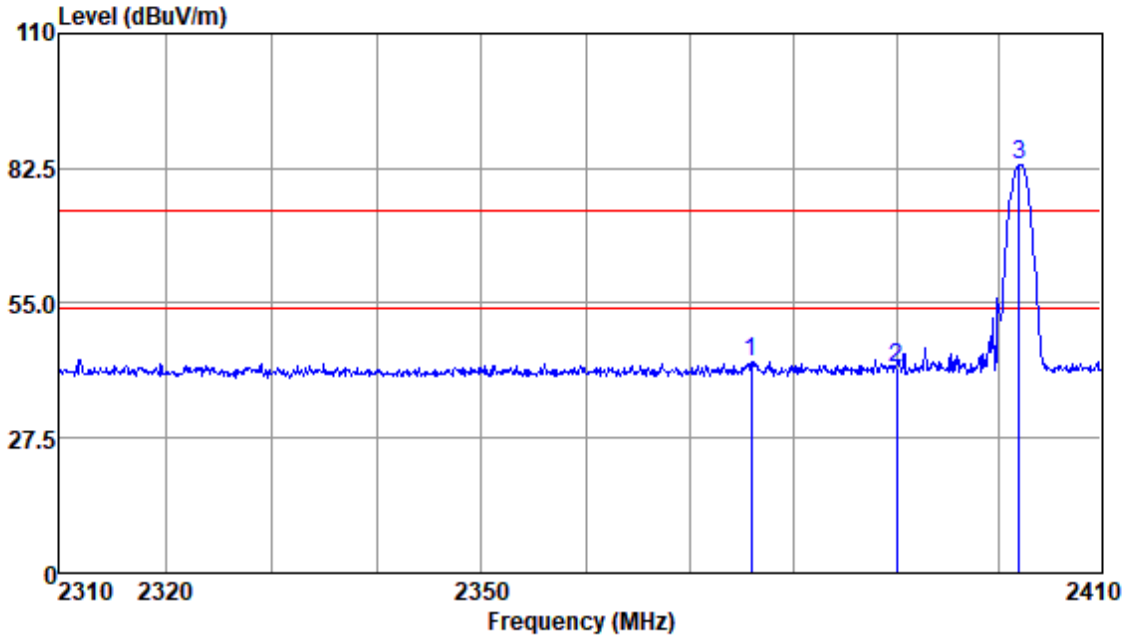
Member of the SGS Group (SGS SA)

Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:Low



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2375.93	44.89	28.71	4.57	35.17	43.00	74.00	-31.00	Peak
2390.00	43.59	28.80	4.60	35.18	41.81	74.00	-32.19	Peak
2401.95	84.88	28.85	4.62	35.19	83.16	74.00	9.16	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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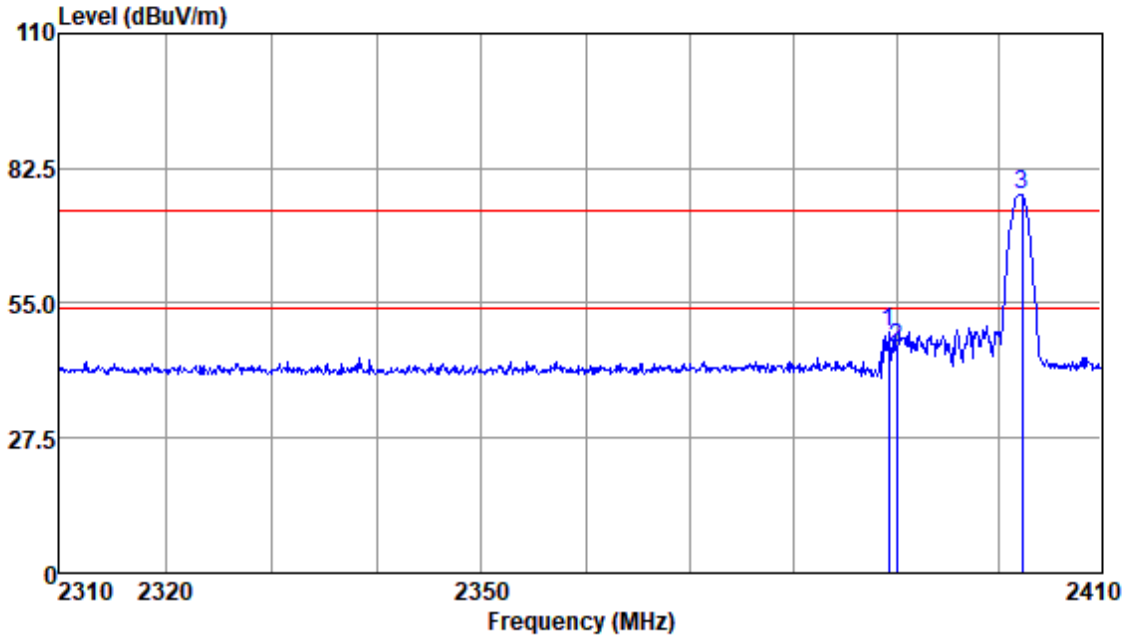
Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:Low



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2389.25	51.02	28.80	4.60	35.18	49.24	74.00	-24.76	Peak
2390.00	47.68	28.80	4.60	35.18	45.90	74.00	-28.10	Peak
2402.25	78.86	28.85	4.62	35.19	77.14	74.00	3.14	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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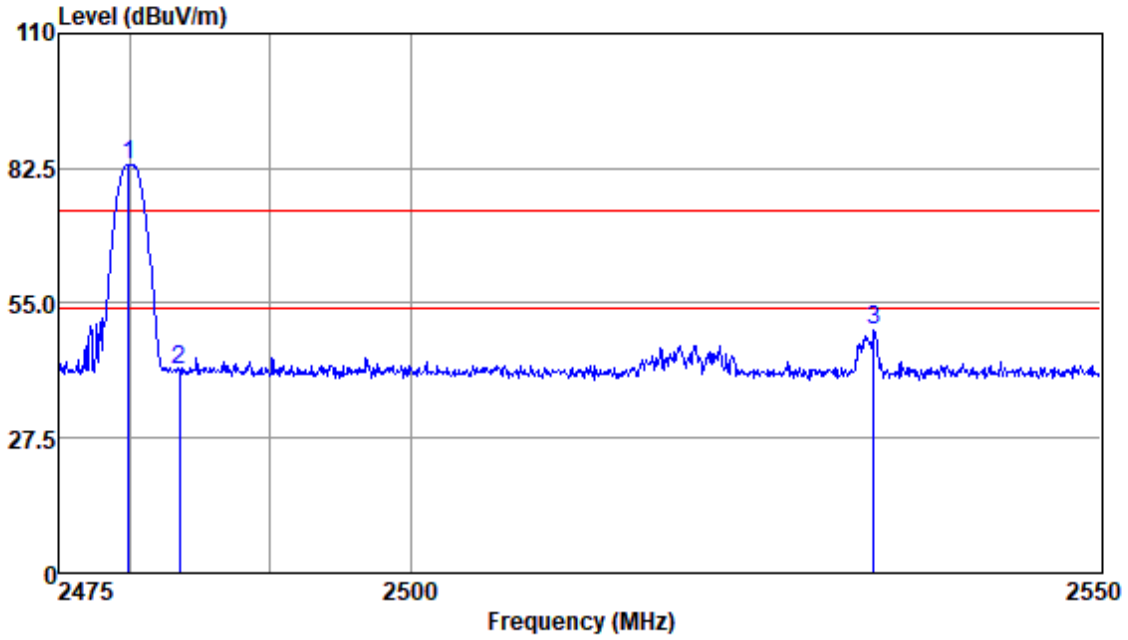
Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:High



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2479.88	84.60	29.08	4.76	35.25	83.19	74.00	9.19	Peak
2483.50	42.69	29.09	4.78	35.26	41.30	74.00	-32.70	Peak
2533.46	50.68	29.13	4.86	35.31	49.36	74.00	-24.64	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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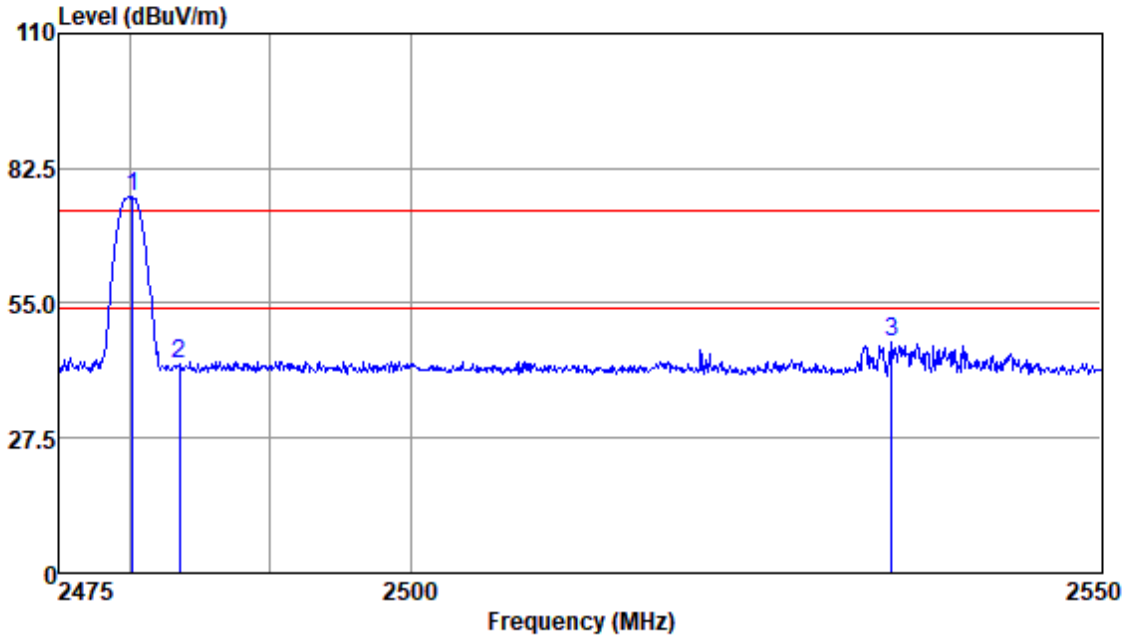
Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:High



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2480.18	78.05	29.08	4.76	35.25	76.64	74.00	2.64	Peak
2483.50	43.94	29.09	4.78	35.26	42.55	74.00	-31.45	Peak
2534.75	48.31	29.13	4.86	35.31	46.99	74.00	-27.01	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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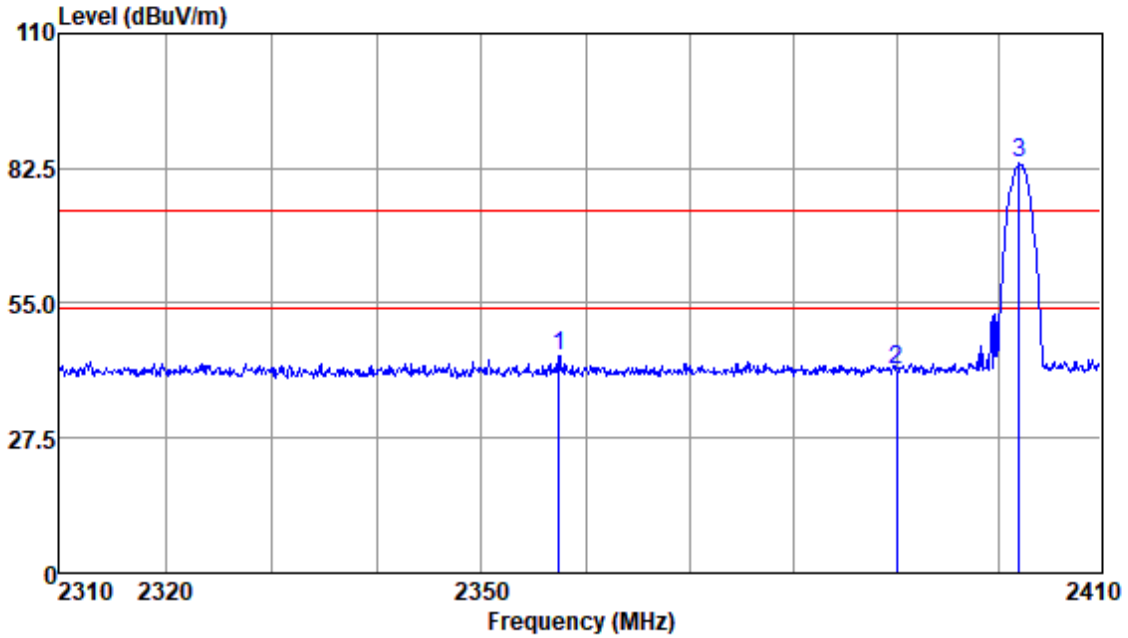
Test Mode: 00; Polarity: Horizontal; Modulation:π/4 DQPSK; Channel:Low



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2357.37	46.21	28.66	4.55	35.16	44.26	74.00	-29.74	Peak
2390.00	43.37	28.80	4.60	35.18	41.59	74.00	-32.41	Peak
2401.95	85.19	28.85	4.62	35.19	83.47	74.00	9.47	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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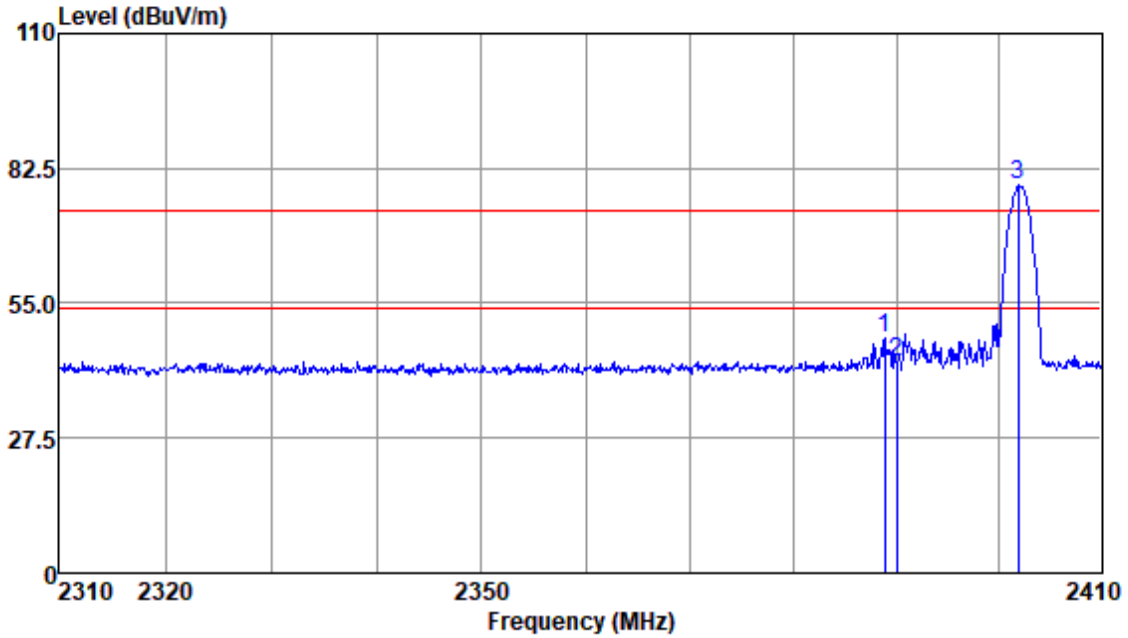
Test Mode: 00; Polarity: Vertical; Modulation:π/4 DQPSK; Channel:Low



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2388.85	49.77	28.80	4.60	35.18	47.99	74.00	-26.01	Peak
2390.00	44.66	28.80	4.60	35.18	42.88	74.00	-31.12	Peak
2401.84	80.70	28.85	4.62	35.19	78.98	74.00	4.98	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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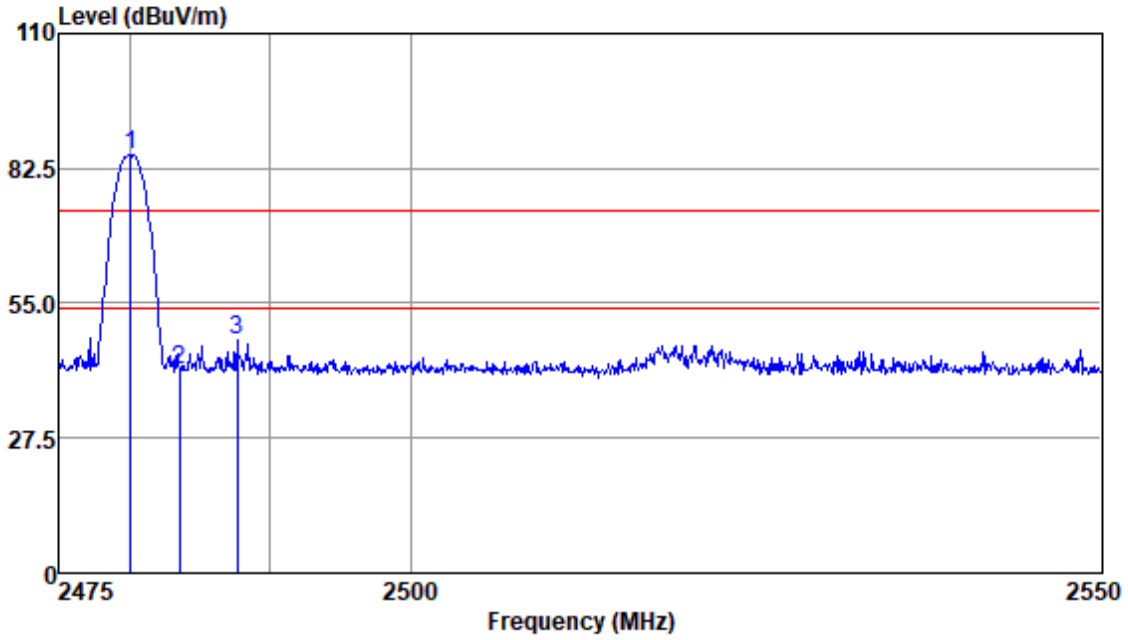
Test Mode: 00; Polarity: Horizontal; Modulation:π/4 DQPSK; Channel:High



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2480.03	86.83	29.08	4.76	35.25	85.42	74.00	11.42	Peak
2483.50	42.98	29.09	4.78	35.26	41.59	74.00	-32.41	Peak
2487.67	48.76	29.09	4.78	35.26	47.37	74.00	-26.63	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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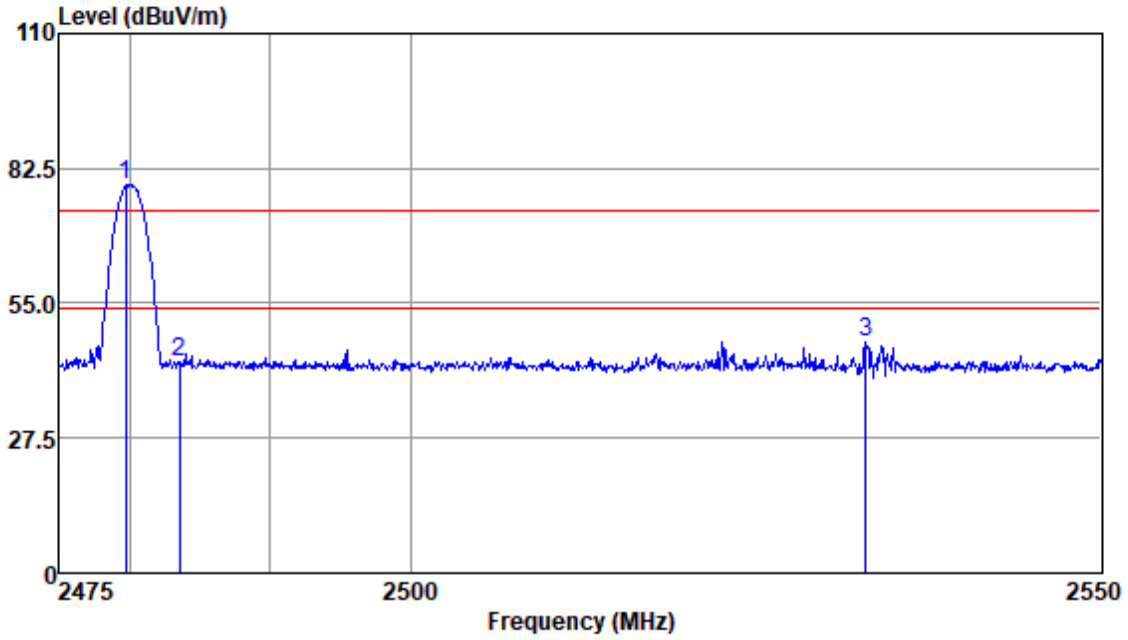
Test Mode: 00; Polarity: Vertical; Modulation:π/4 DQPSK; Channel:High



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2479.73	80.59	29.08	4.76	35.25	79.18	74.00	5.18	Peak
2483.50	44.50	29.09	4.78	35.26	43.11	74.00	-30.89	Peak
2532.85	48.51	29.13	4.86	35.31	47.19	74.00	-26.81	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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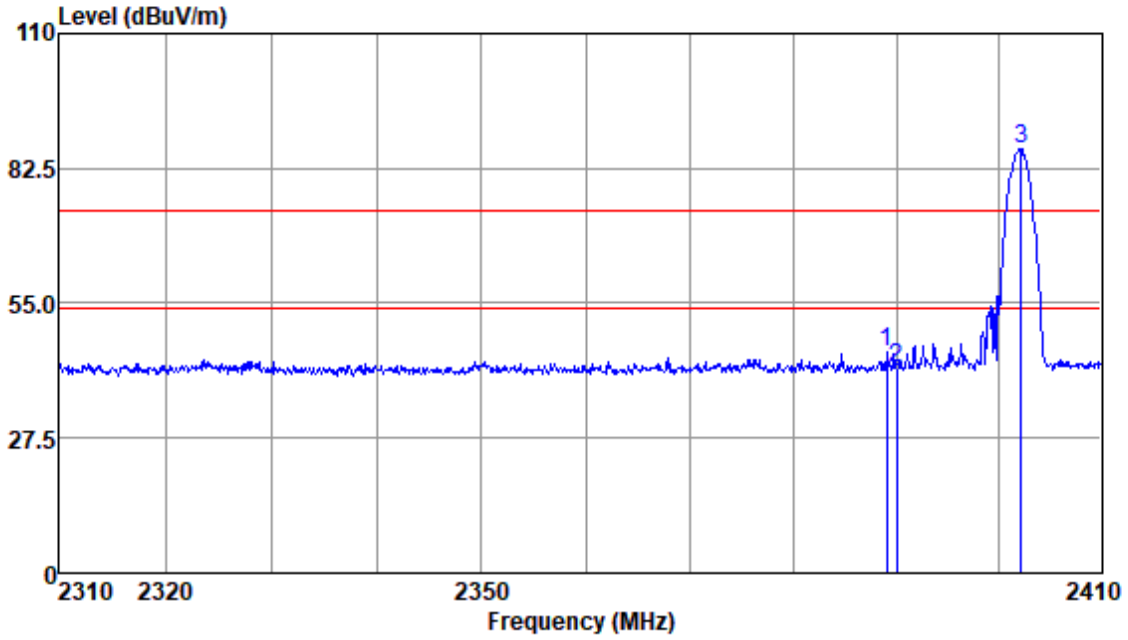
Test Mode: 00; Polarity: Horizontal; Modulation:8DPSK; Channel:Low



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2389.05	46.99	28.80	4.60	35.18	45.21	74.00	-28.79	Peak
2390.00	43.62	28.80	4.60	35.18	41.84	74.00	-32.16	Peak
2402.15	88.22	28.85	4.62	35.19	86.50	74.00	12.50	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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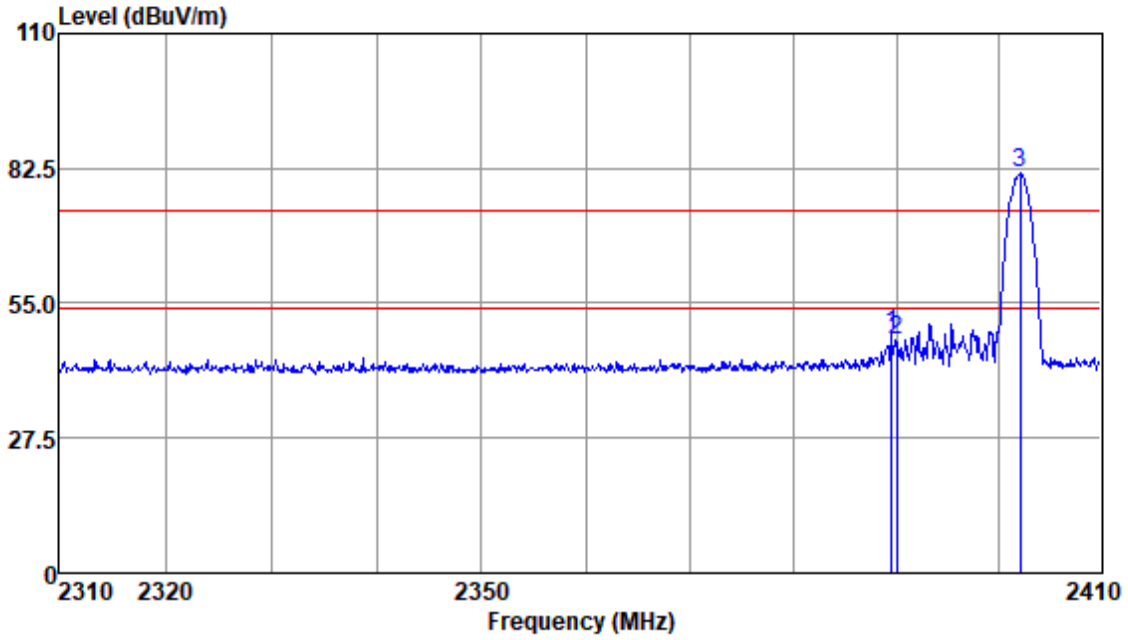
Test Mode: 00; Polarity: Vertical; Modulation:8DPSK; Channel:Low



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2389.56	50.41	28.80	4.60	35.18	48.63	74.00	-25.37	Peak
2390.00	49.27	28.80	4.60	35.18	47.49	74.00	-26.51	Peak
2402.05	83.41	28.85	4.62	35.19	81.69	74.00	7.69	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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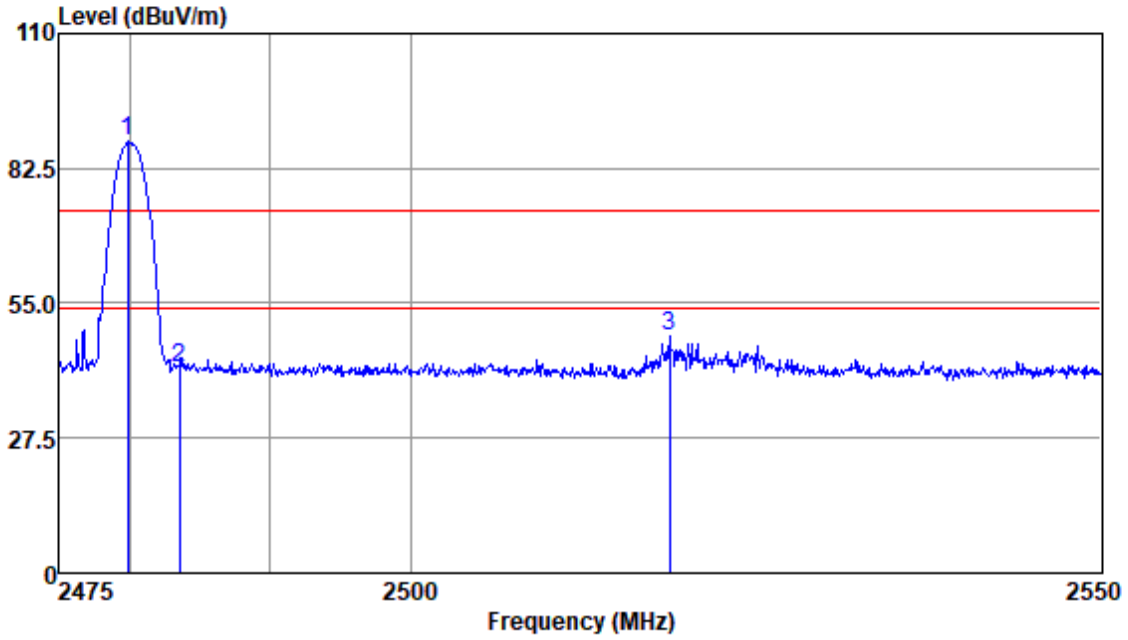
Test Mode: 00; Polarity: Horizontal; Modulation:8DPSK; Channel:High



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2479.81	89.30	29.08	4.76	35.25	87.89	74.00	13.89	Peak
2483.50	43.38	29.09	4.78	35.26	41.99	74.00	-32.01	Peak
2518.68	49.64	29.13	4.84	35.30	48.31	74.00	-25.69	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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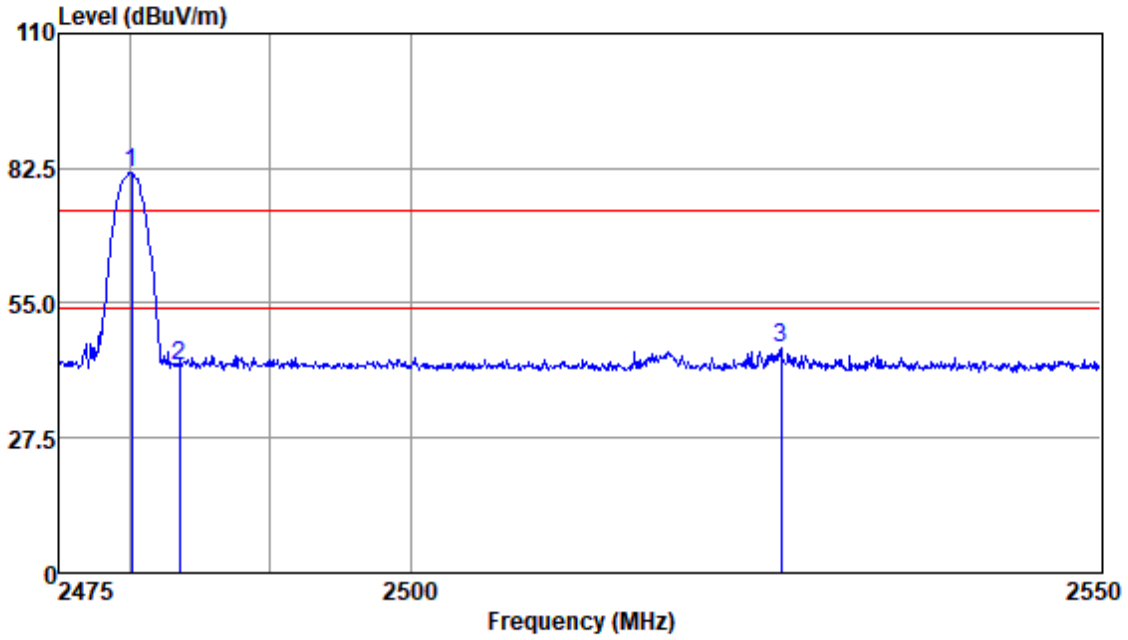
Test Mode: 00; Polarity: Vertical; Modulation:8DPSK; Channel:High



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2480.10	83.09	29.08	4.76	35.25	81.68	74.00	7.68	Peak
2483.50	43.46	29.09	4.78	35.26	42.07	74.00	-31.93	Peak
2526.74	47.38	29.13	4.85	35.31	46.05	74.00	-27.95	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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7.10 Radiated Spurious Emissions Below 1GHz

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209
Test Method: ANSI C63.10 (2013) Section 6.4,6.5

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
960-1000	500	3

7.10.1 E.U.T. Operation

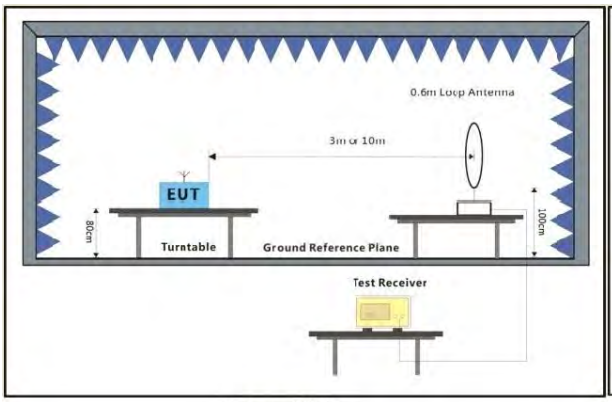
Operating Environment:

Temperature: 23.2 °C Humidity: 71.4 % RH Atmospheric Pressure: 1010 mbar

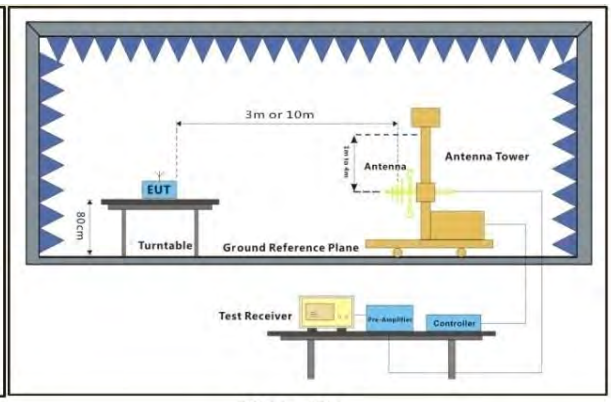
7.10.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.10.3 Test Setup Diagram



Below 30MHz



30MHz-1GHz

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7.10.4 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. 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.

c. 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.

d. 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.

e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. 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 quasi-peak method as specified and then reported in a data sheet.

g. Test the EUT in the lowest channel, the middle channel, the Highest channel.

h. 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.

i. Repeat above procedures until all frequencies measured was complete.

Remark:

1. Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

2. Scan from 9kHz to 30MHz, the disturbance 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.

3. The disturbance below 1GHz was very low and the harmonics were the highest point could be found when testing, so only the above harmonics had been displayed.

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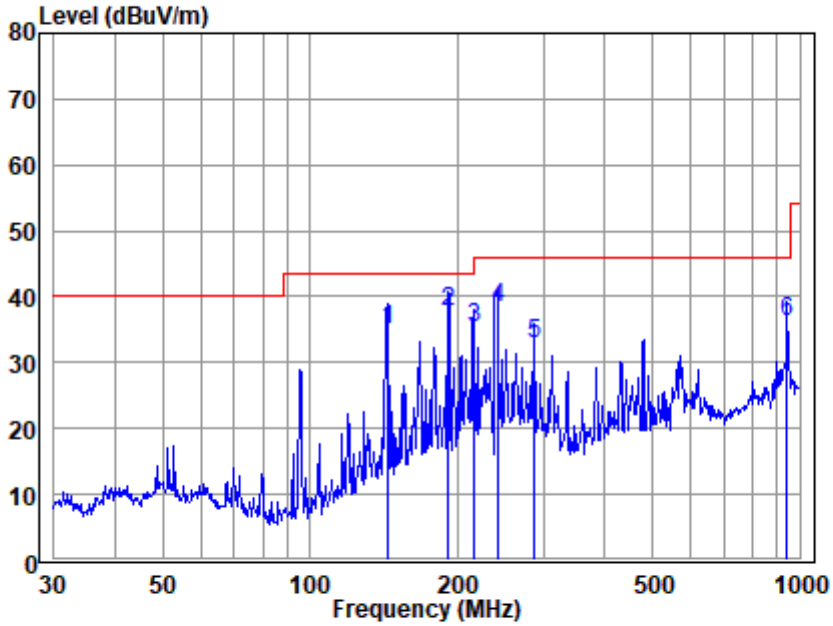
Test Mode: 00; Polarity: Horizontal



Antenna Polarity :Horizontal
EUT/Project :2218AT
Test mode :00

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
1	144.25	50.88	13.14	2.88	31.94	34.96	43.50	-8.54	QP
2	191.74	56.24	10.30	3.36	32.10	37.80	43.50	-5.70	QP
3	215.51	54.17	9.89	3.62	32.54	35.14	43.50	-8.36	QP
4	241.00	55.23	11.54	3.83	32.33	38.27	46.00	-7.73	QP
5	286.46	48.18	13.25	4.26	32.75	32.94	46.00	-13.06	QP
6	940.84	34.41	23.75	7.69	29.74	36.11	46.00	-9.89	QP

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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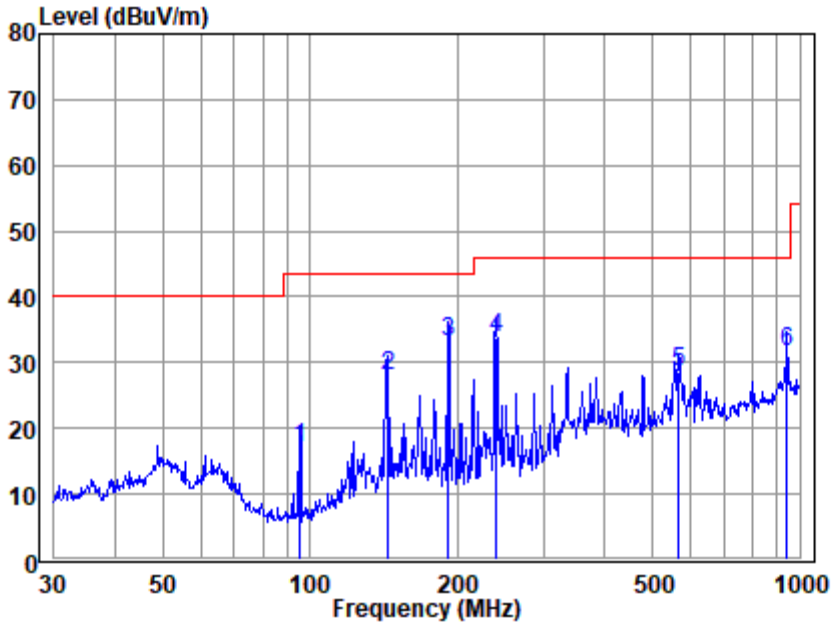
Test Mode: 00; Polarity: Vertical



Antenna Polarity :Vertical
EUT/Project :2218AT
Test mode :00

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
1	95.57	38.25	8.41	2.30	31.87	17.09	43.50	-26.41	QP
2	143.52	44.09	13.09	2.87	31.92	28.13	43.50	-15.37	QP
3	191.74	51.69	10.30	3.36	32.10	33.25	43.50	-10.25	QP
4	239.78	50.81	11.49	3.82	32.34	33.78	46.00	-12.22	QP
5	563.12	36.71	18.97	6.01	33.22	28.47	46.00	-17.53	QP
6	940.84	29.91	23.75	7.69	29.74	31.61	46.00	-14.39	QP

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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7.11 Radiated Spurious Emissions Above 1GHz

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209
Test Method: ANSI C63.10 (2013) Section 6.6

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
Above 1000	500	3

7.11.1 E.U.T. Operation

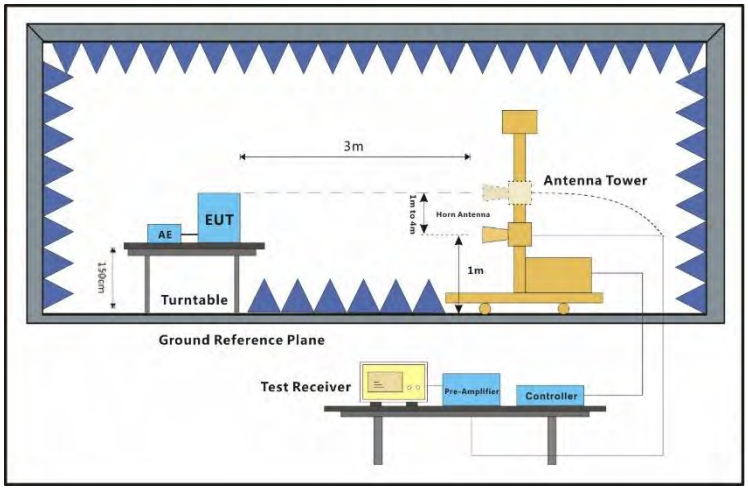
Operating Environment:

Temperature: 23.2 °C Humidity: 71.1 % RH Atmospheric Pressure: 1010 mbar

7.11.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.11.3 Test Setup Diagram



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7.11.4 Measurement Procedure and Data

a. 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.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. 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.

d. 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.

e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. 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 or average method as specified and then reported in a data sheet.

g. Test the EUT in the lowest channel, the middle channel, the Highest channel.

h. 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.

i. Repeat above procedures until all frequencies measured was complete.

Remark:

1. Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

2. Scan from 1GHz to 25GHz, the disturbance above 18GHz 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.

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. 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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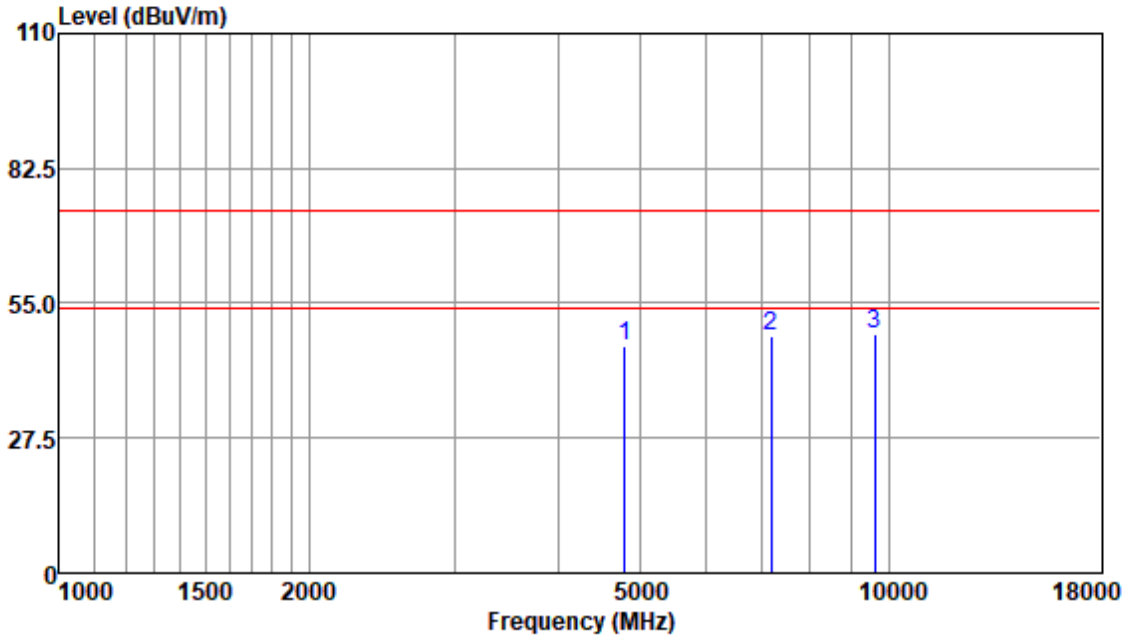
Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:Low



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00	42.10	33.57	7.46	36.79	46.34	74.00	-27.66	Peak
7206.00	39.95	36.24	7.79	35.53	48.45	74.00	-25.55	Peak
9608.00	35.95	37.75	8.57	33.58	48.69	74.00	-25.31	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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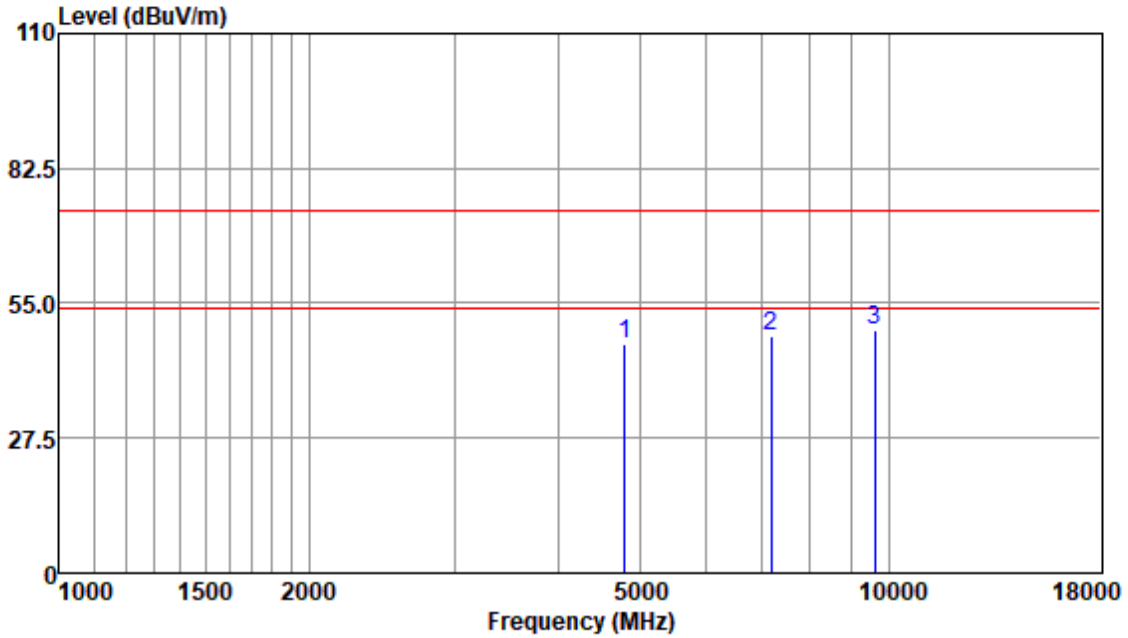
Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:Low



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00	42.31	33.57	7.46	36.79	46.55	74.00	-27.45	Peak
7206.00	39.71	36.24	7.79	35.53	48.21	74.00	-25.79	Peak
9608.00	36.90	37.75	8.57	33.58	49.64	74.00	-24.36	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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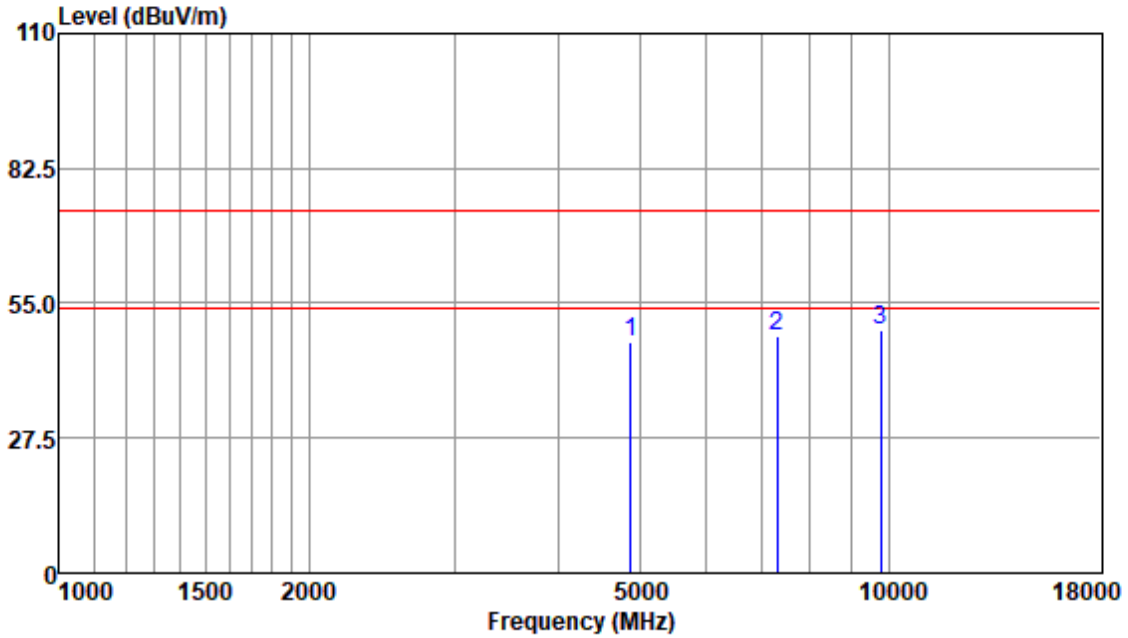
Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:middle



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4882.00	42.84	33.66	7.46	36.81	47.15	74.00	-26.85	Peak
7323.00	39.60	36.33	7.83	35.42	48.34	74.00	-25.66	Peak
9764.00	36.90	37.54	8.57	33.50	49.51	74.00	-24.49	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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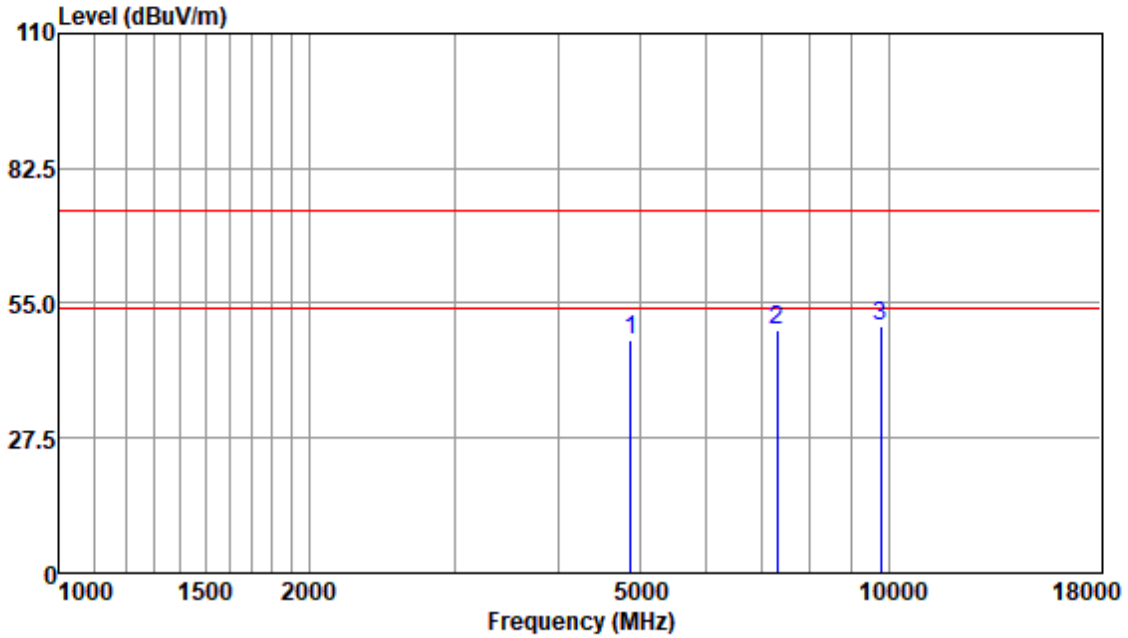
Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:middle



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4882.00	43.23	33.66	7.46	36.81	47.54	74.00	-26.46	Peak
7323.00	40.91	36.33	7.83	35.42	49.65	74.00	-24.35	Peak
9764.00	37.67	37.54	8.57	33.50	50.28	74.00	-23.72	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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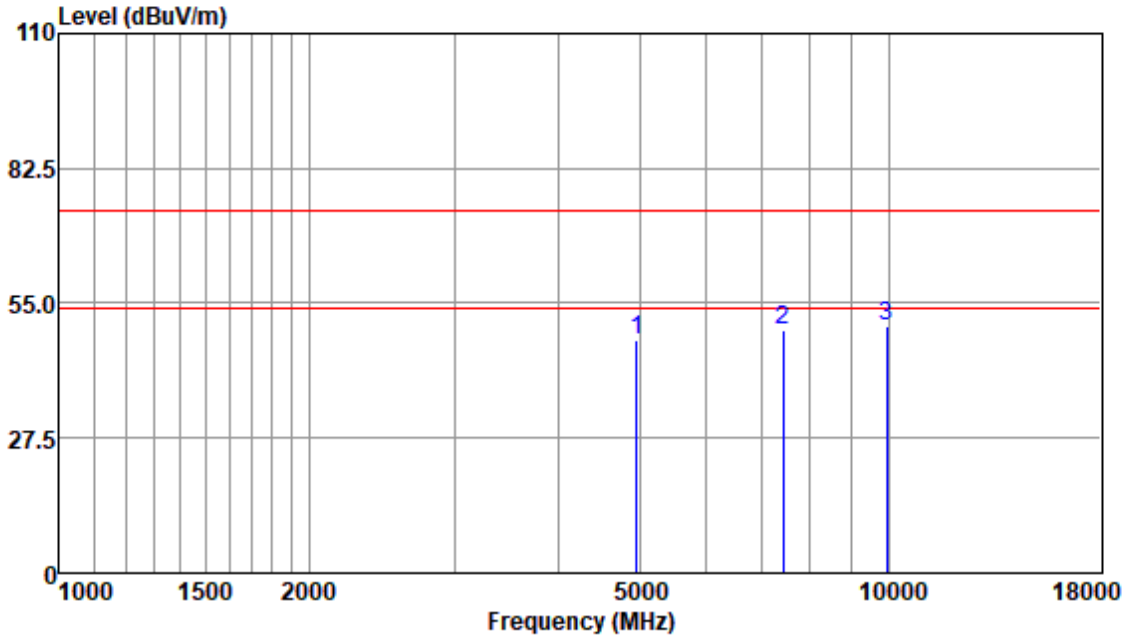
Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:High



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.00	43.22	33.65	7.47	36.83	47.51	74.00	-26.49	Peak
7440.00	40.73	36.31	7.88	35.34	49.58	74.00	-24.42	Peak
9920.00	37.40	37.62	8.58	33.41	50.19	74.00	-23.81	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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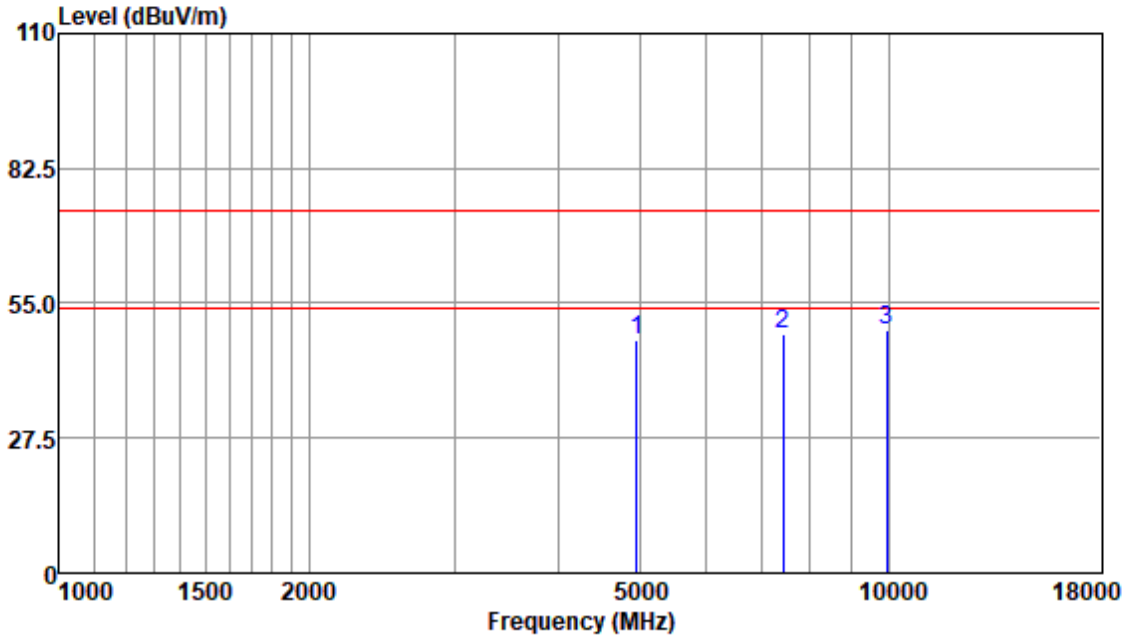
Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:High



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.00	43.29	33.65	7.47	36.83	47.58	74.00	-26.42	Peak
7440.00	39.74	36.31	7.88	35.34	48.59	74.00	-25.41	Peak
9920.00	36.82	37.62	8.58	33.41	49.61	74.00	-24.39	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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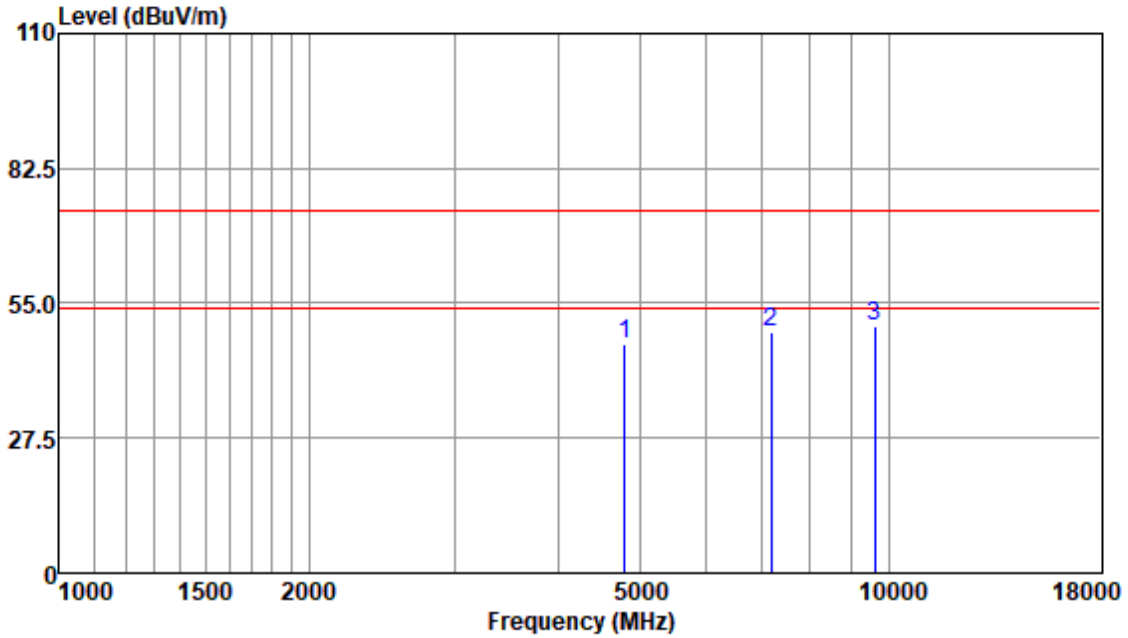
Test Mode: 00; Polarity: Horizontal; Modulation:π/4 DQPSK; Channel:Low



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00	42.57	33.57	7.46	36.79	46.81	74.00	-27.19	Peak
7206.00	40.64	36.24	7.79	35.53	49.14	74.00	-24.86	Peak
9608.00	37.48	37.75	8.57	33.58	50.22	74.00	-23.78	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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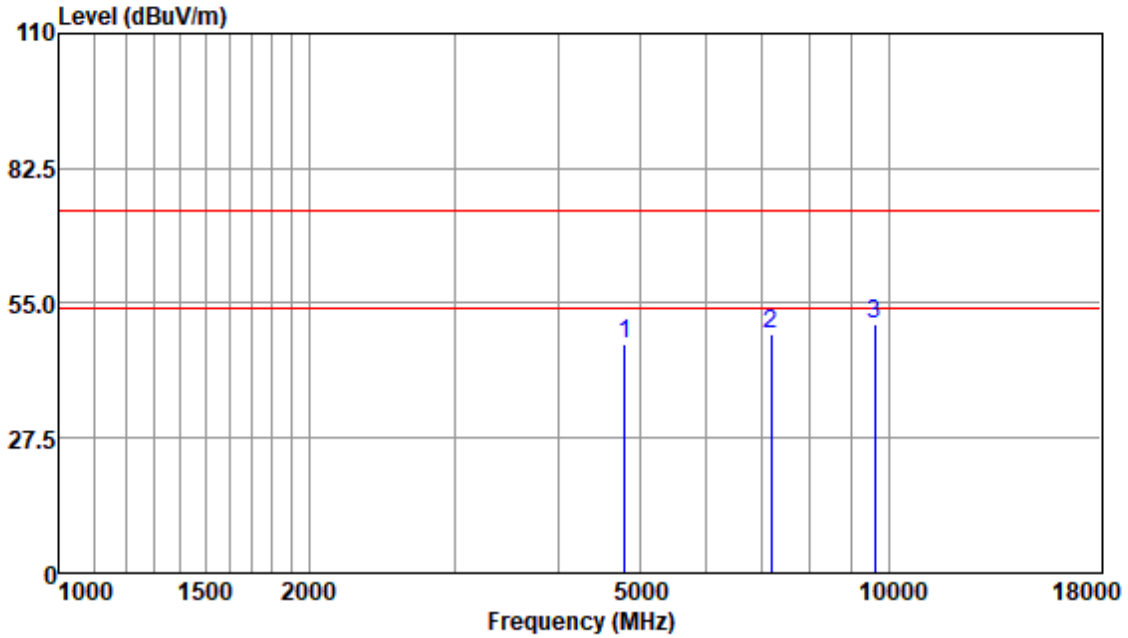
Test Mode: 00; Polarity: Vertical; Modulation:π/4 DQPSK; Channel:Low



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00	42.57	33.57	7.46	36.79	46.81	74.00	-27.19	Peak
7206.00	40.02	36.24	7.79	35.53	48.52	74.00	-25.48	Peak
9608.00	38.08	37.75	8.57	33.58	50.82	74.00	-23.18	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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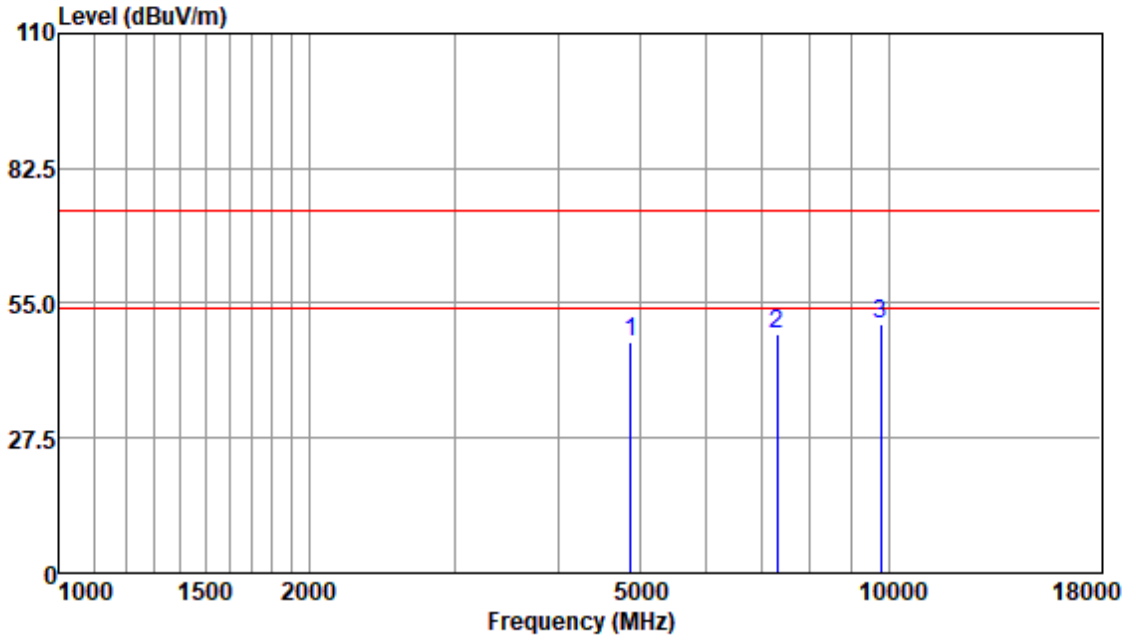
Test Mode: 00; Polarity: Horizontal; Modulation:π/4 DQPSK; Channel:middle



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4882.00	42.94	33.66	7.46	36.81	47.25	74.00	-26.75	Peak
7323.00	39.91	36.33	7.83	35.42	48.65	74.00	-25.35	Peak
9764.00	37.93	37.54	8.57	33.50	50.54	74.00	-23.46	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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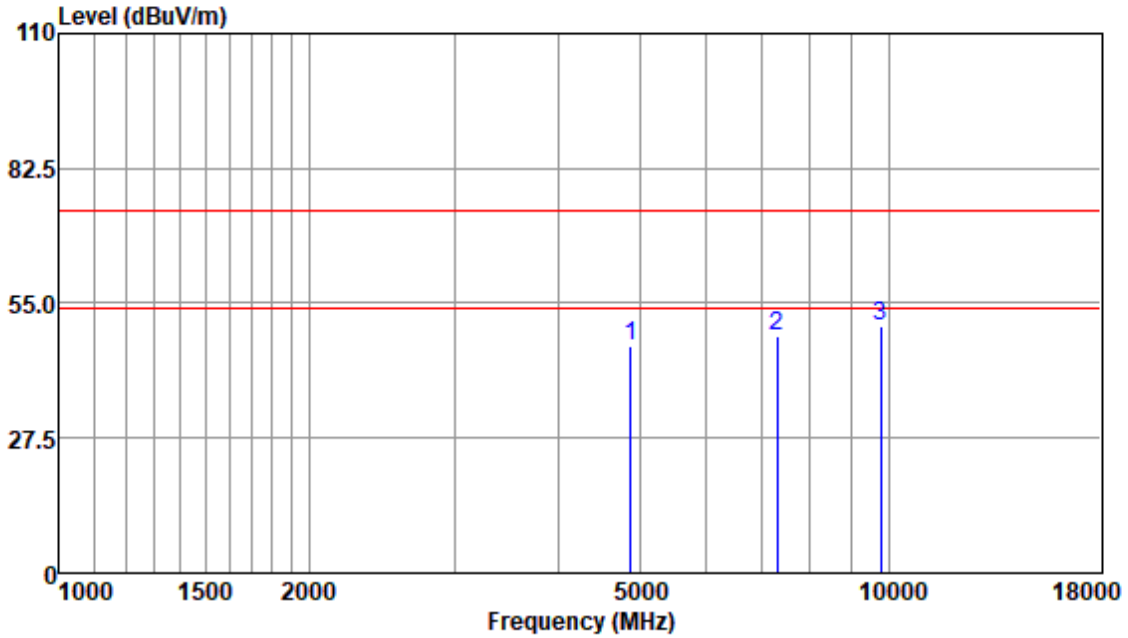
Test Mode: 00; Polarity: Vertical; Modulation:π/4 DQPSK; Channel:middle



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4882.00	41.84	33.66	7.46	36.81	46.15	74.00	-27.85	Peak
7323.00	39.37	36.33	7.83	35.42	48.11	74.00	-25.89	Peak
9764.00	37.75	37.54	8.57	33.50	50.36	74.00	-23.64	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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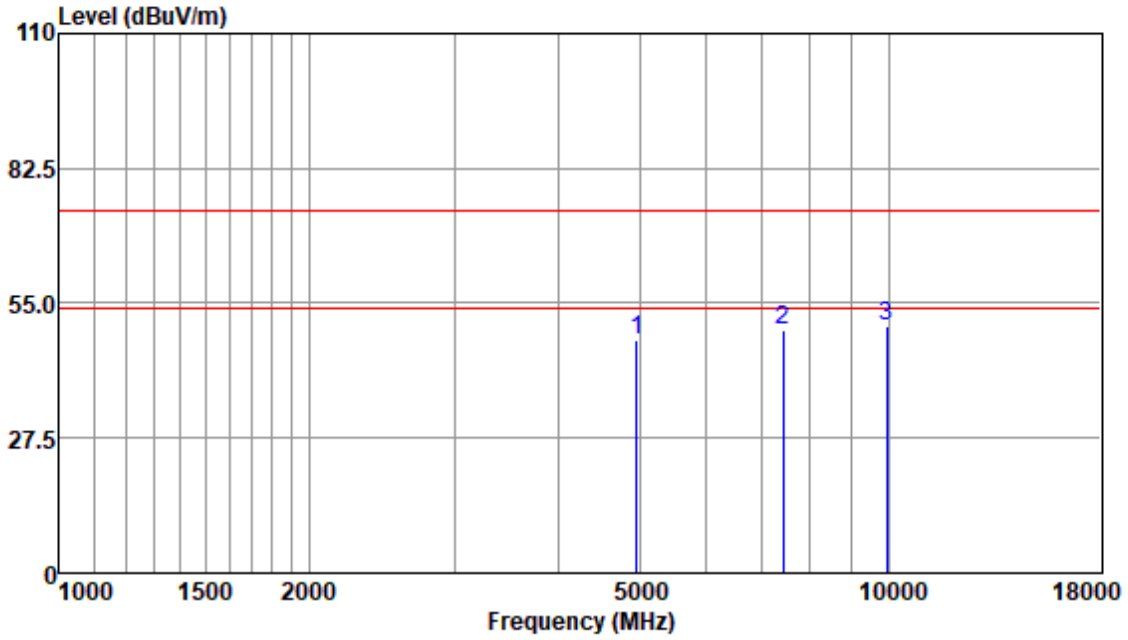
Test Mode: 00; Polarity: Horizontal; Modulation:π/4 DQPSK; Channel:High



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.00	43.26	33.65	7.47	36.83	47.55	74.00	-26.45	Peak
7440.00	40.76	36.31	7.88	35.34	49.61	74.00	-24.39	Peak
9920.00	37.38	37.62	8.58	33.41	50.17	74.00	-23.83	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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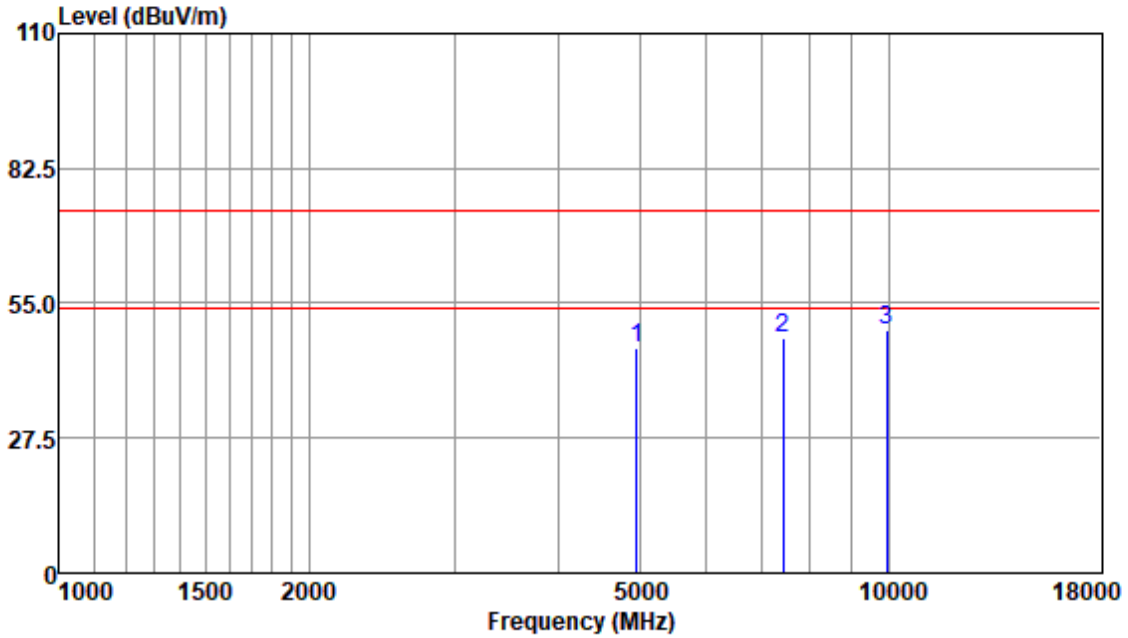
Test Mode: 00; Polarity: Vertical; Modulation:π/4 DQPSK; Channel:High



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.00	41.67	33.65	7.47	36.83	45.96	74.00	-28.04	Peak
7440.00	39.19	36.31	7.88	35.34	48.04	74.00	-25.96	Peak
9920.00	36.76	37.62	8.58	33.41	49.55	74.00	-24.45	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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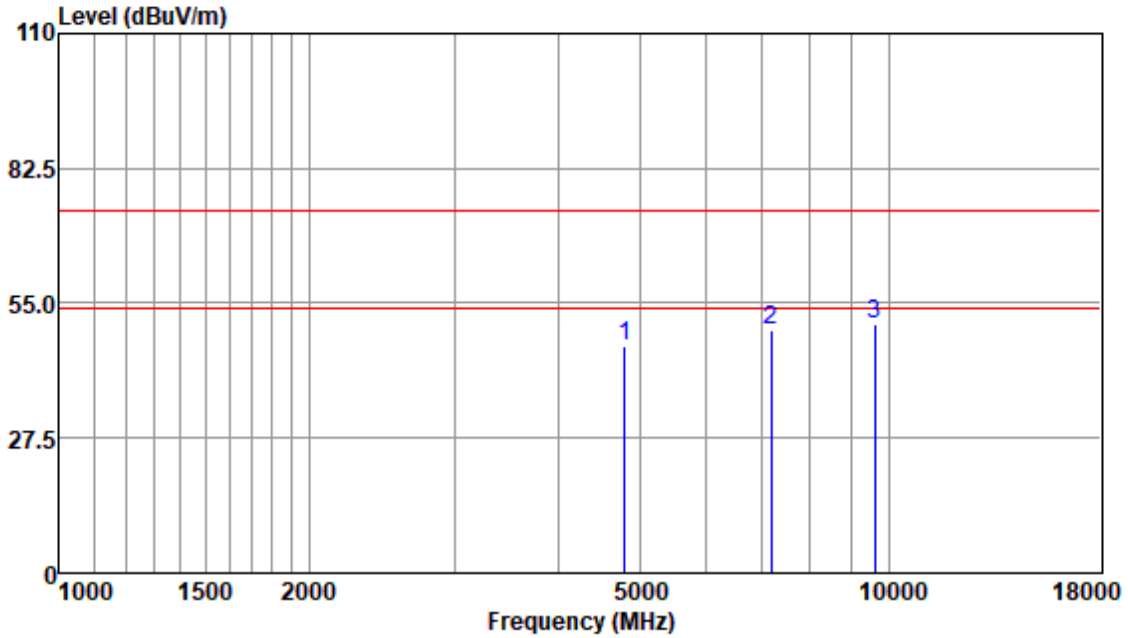
Test Mode: 00; Polarity: Horizontal; Modulation:8DPSK; Channel:Low



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00	42.01	33.57	7.46	36.79	46.25	74.00	-27.75	Peak
7206.00	41.05	36.24	7.79	35.53	49.55	74.00	-24.45	Peak
9608.00	37.97	37.75	8.57	33.58	50.71	74.00	-23.29	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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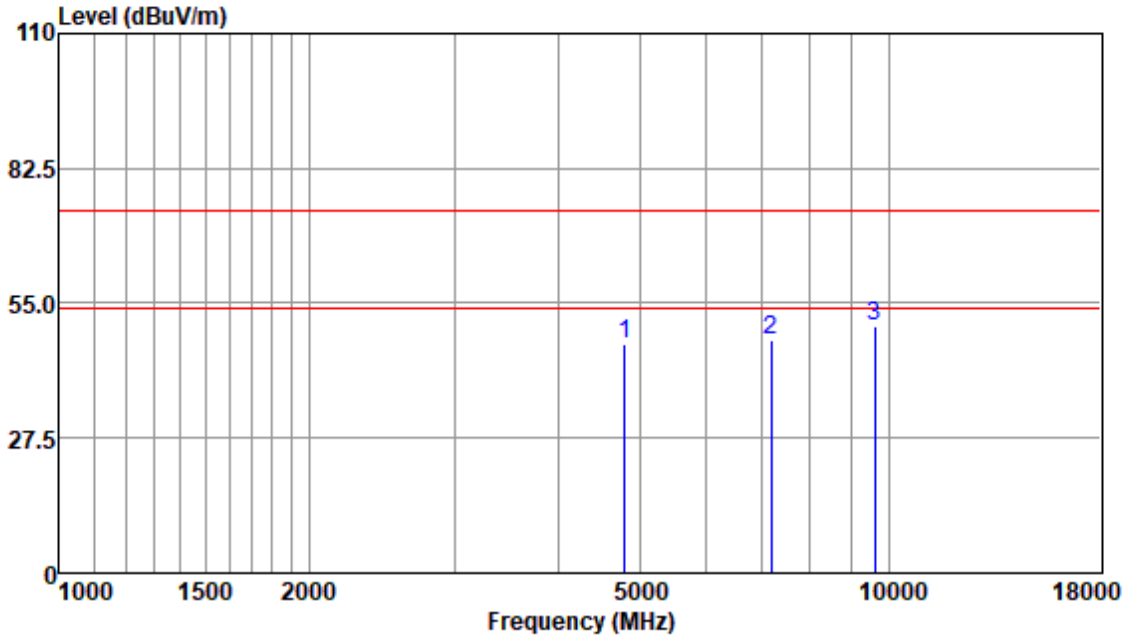
Test Mode: 00; Polarity: Vertical; Modulation:8DPSK; Channel:Low



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00	42.47	33.57	7.46	36.79	46.71	74.00	-27.29	Peak
7206.00	39.02	36.24	7.79	35.53	47.52	74.00	-26.48	Peak
9608.00	37.53	37.75	8.57	33.58	50.27	74.00	-23.73	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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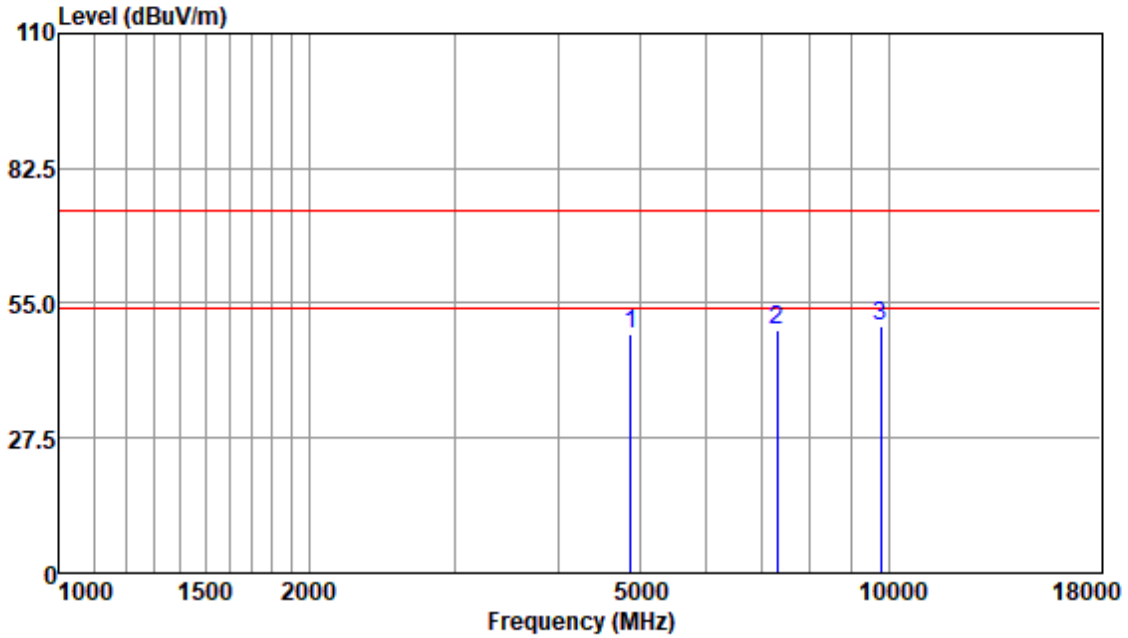
Test Mode: 00; Polarity: Horizontal; Modulation:8DPSK; Channel:middle



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4882.00	44.33	33.66	7.46	36.81	48.64	74.00	-25.36	Peak
7323.00	40.77	36.33	7.83	35.42	49.51	74.00	-24.49	Peak
9764.00	37.66	37.54	8.57	33.50	50.27	74.00	-23.73	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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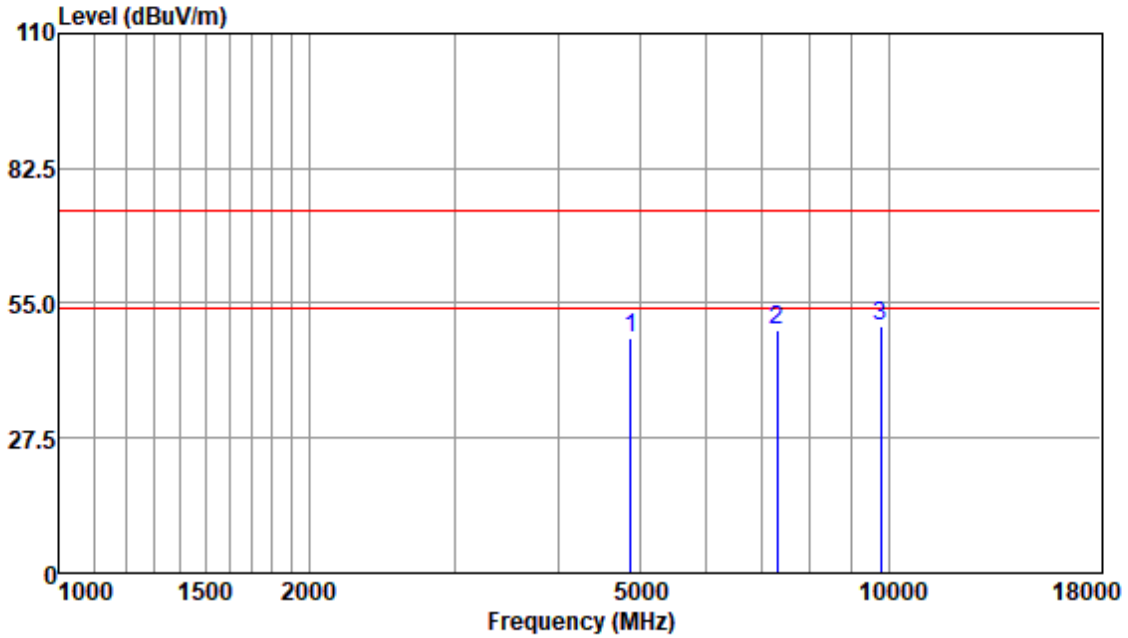
Test Mode: 00; Polarity: Vertical; Modulation:8DPSK; Channel:middle



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4882.00	43.54	33.66	7.46	36.81	47.85	74.00	-26.15	Peak
7323.00	40.82	36.33	7.83	35.42	49.56	74.00	-24.44	Peak
9764.00	37.66	37.54	8.57	33.50	50.27	74.00	-23.73	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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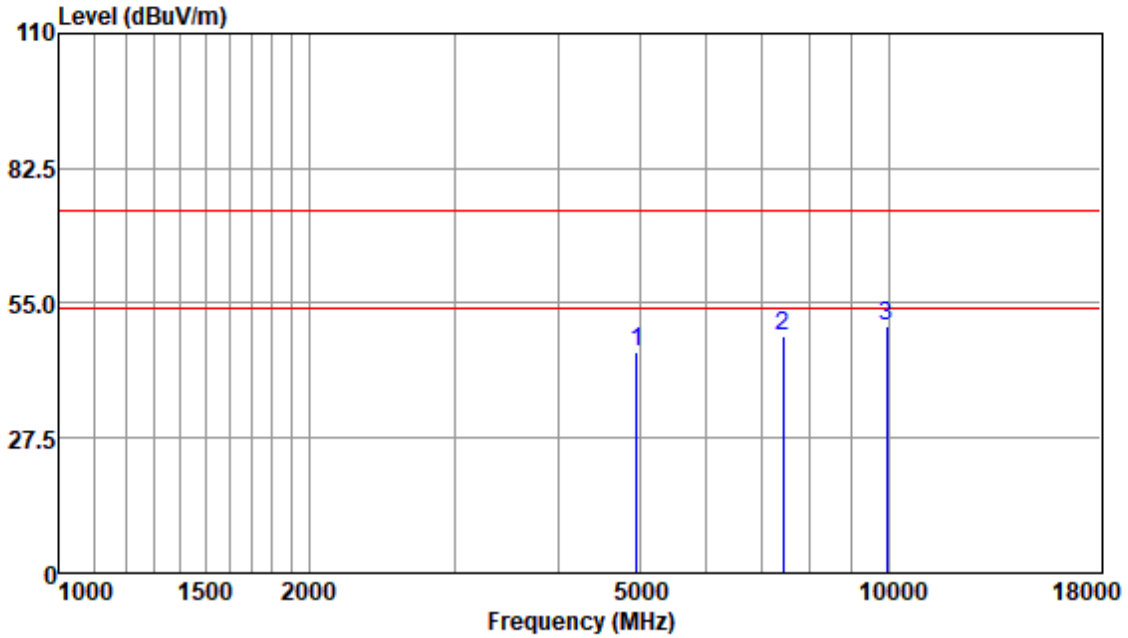
Test Mode: 00; Polarity: Horizontal; Modulation:8DPSK; Channel:High



Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.00	40.85	33.65	7.47	36.83	45.14	74.00	-28.86	Peak
7440.00	39.38	36.31	7.88	35.34	48.23	74.00	-25.77	Peak
9920.00	37.48	37.62	8.58	33.41	50.27	74.00	-23.73	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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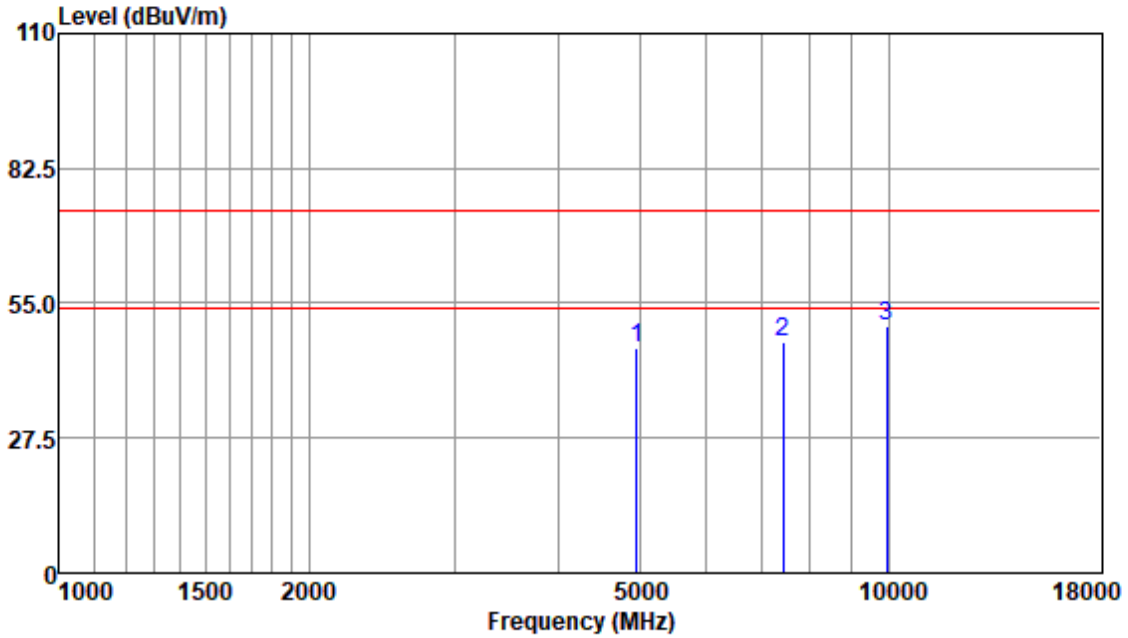
Test Mode: 00; Polarity: Vertical; Modulation:8DPSK; Channel:High



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.00	41.63	33.65	7.47	36.83	45.92	74.00	-28.08	Peak
7440.00	38.30	36.31	7.88	35.34	47.15	74.00	-26.85	Peak
9920.00	37.54	37.62	8.58	33.41	50.33	74.00	-23.67	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

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7.12 99% Bandwidth

Test Requirement RSS-Gen Section 6.7
Test Method: ANSI C63.10 Section 6.9.3

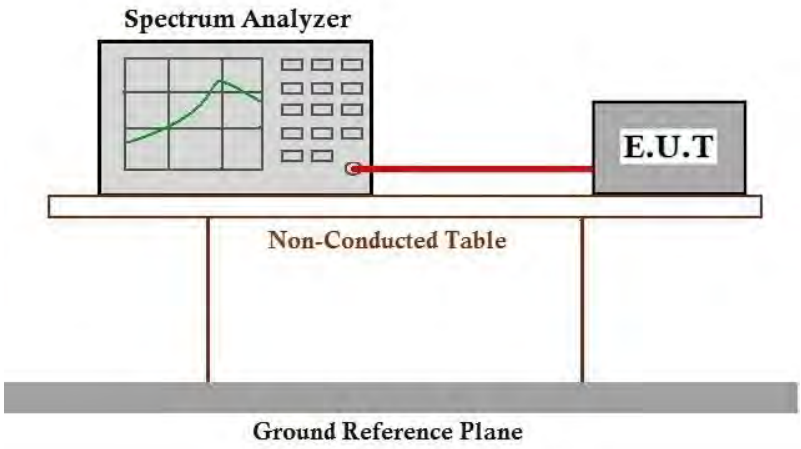
7.12.1 E.U.T. Operation

Operating Environment:
Temperature: 20 °C Humidity: 56 % RH Atmospheric Pressure: 1010 mbar

7.12.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, Pi/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.12.3 Test Setup Diagram



7.12.4 Measurement Procedure and Data

Please Refer to Appendix for Details

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8 Test Setup Photo

Refer to Appendix - Photographs of EUT Constructional Details for SHCR2210002218AT

9 EUT Constructional Details (EUT Photos)

Refer to Appendix - Photographs of EUT Constructional Details for SHCR2210002218AT

10 Appendix

10.1 Appendix A: 20dB Emission Bandwidth

10.1.1 Test Result

TestMode	Antenna	Channel	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	1.023	2401.457	2402.480	---	---
		2441	0.948	2440.523	2441.471	---	---
		2480	0.954	2479.523	2480.477	---	---
2DH5	Ant1	2402	1.320	2401.325	2402.645	---	---
		2441	1.341	2440.316	2441.657	---	---
		2480	1.323	2479.331	2480.654	---	---
3DH5	Ant1	2402	1.293	2401.337	2402.630	---	---
		2441	1.305	2440.334	2441.639	---	---
		2480	1.314	2479.334	2480.648	---	---

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10.1.2 Test Graphs

DH5_Ant1_2402

DH5_Ant1_2441

DH5_Ant1_2480

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2DH5_Ant1_2402

2DH5_Ant1_2441

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2DH5_Ant1_2480

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3DH5_Ant1_2402

3DH5_Ant1_2441

3DH5_Ant1_2480

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10.2 Appendix B: Occupied Channel Bandwidth

10.2.1 Test Result

TestMode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.86584	2401.5526	2402.4184	---	---
		2441	0.86875	2440.5536	2441.4223	---	---
		2480	0.87401	2479.5516	2480.4256	---	---
2DH5	Ant1	2402	1.1985	2401.3890	2402.5875	---	---
		2441	1.1957	2440.3917	2441.5874	---	---
		2480	1.1868	2479.3974	2480.5842	---	---
3DH5	Ant1	2402	1.2058	2401.3766	2402.5824	---	---
		2441	1.1928	2440.3865	2441.5793	---	---
		2480	1.1883	2479.3919	2480.5802	---	---

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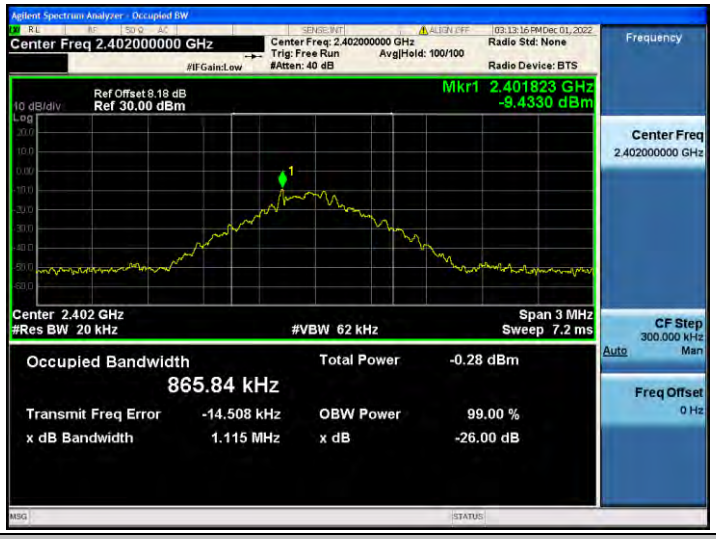
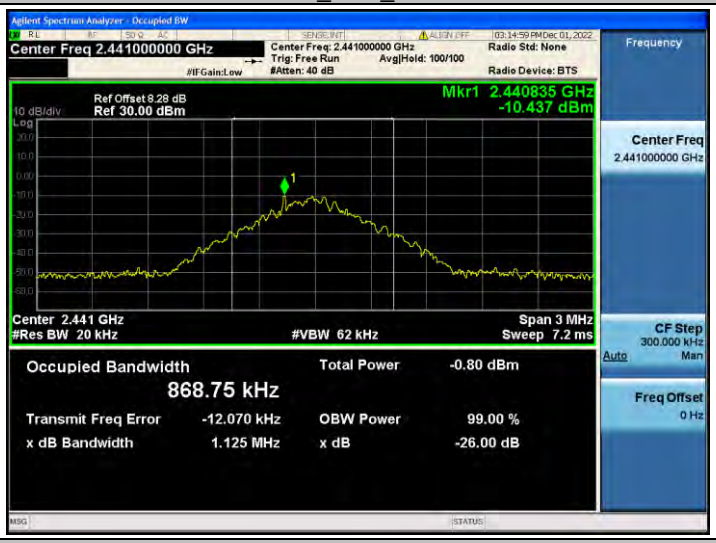
10.2.2 Test Graphs

DH5_Ant1_2402



DH5_Ant1_2441



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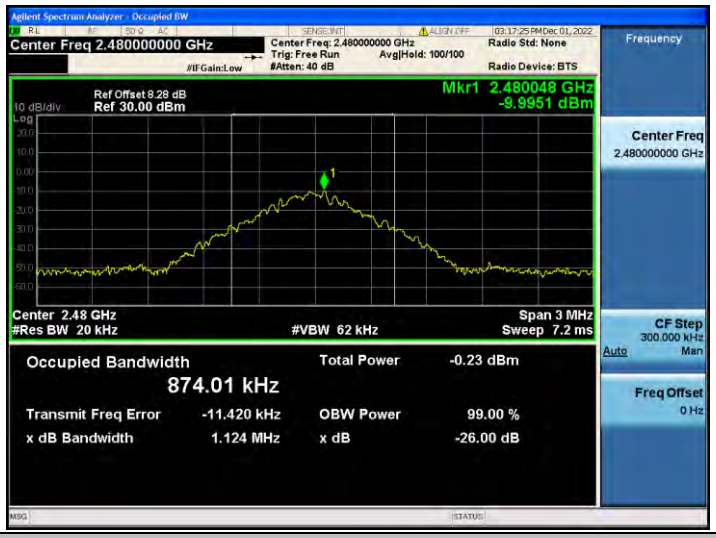
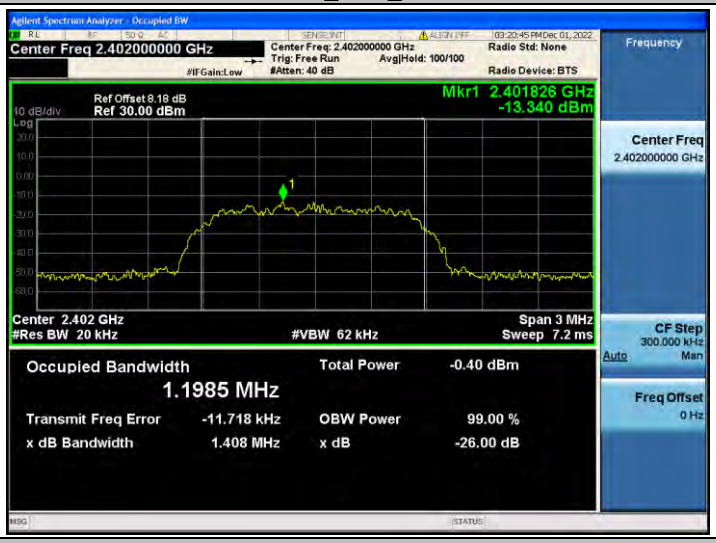


2DH5_Ant1_2402



2DH5_Ant1_2441

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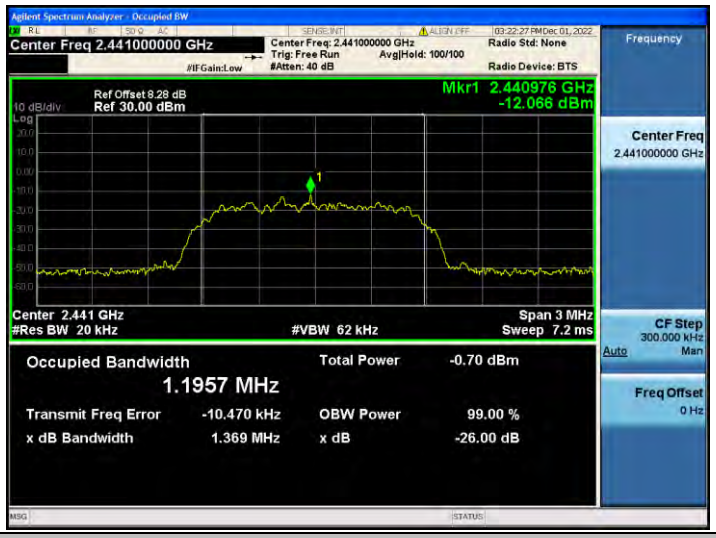

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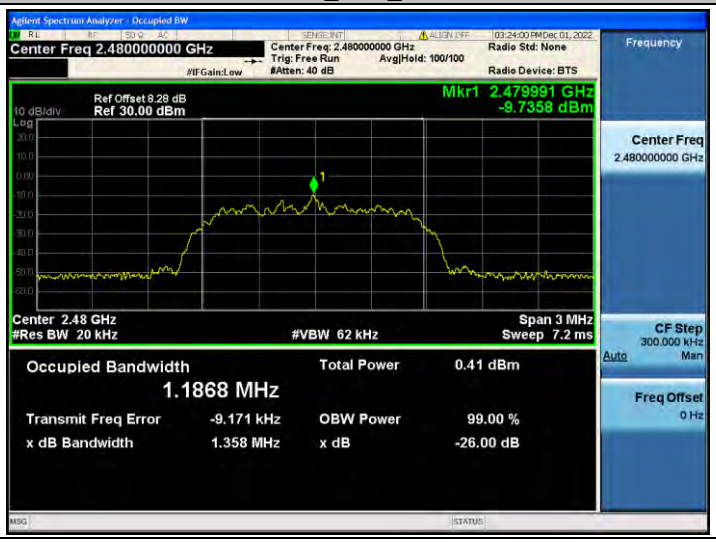

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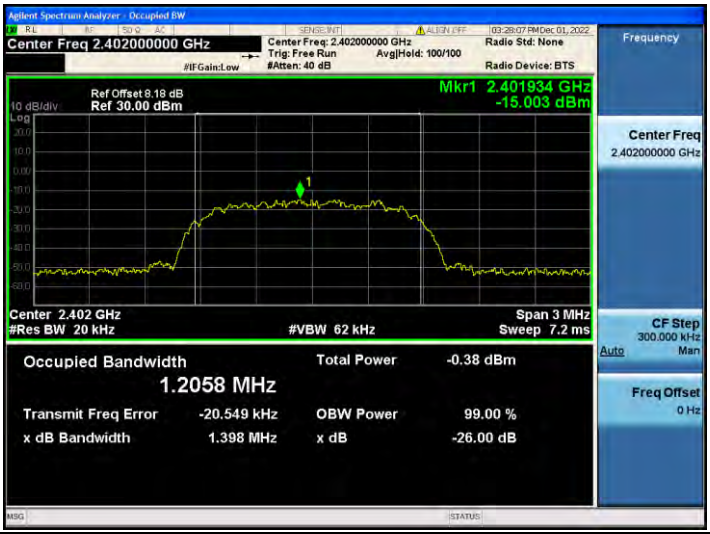
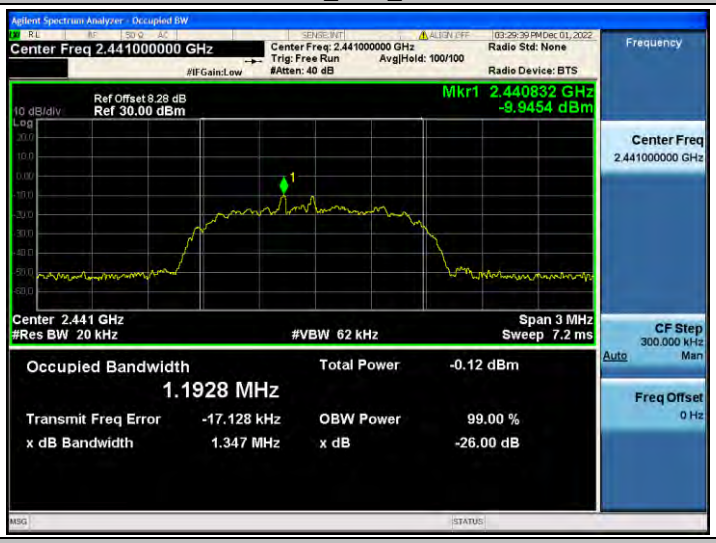


3DH5_Ant1_2441



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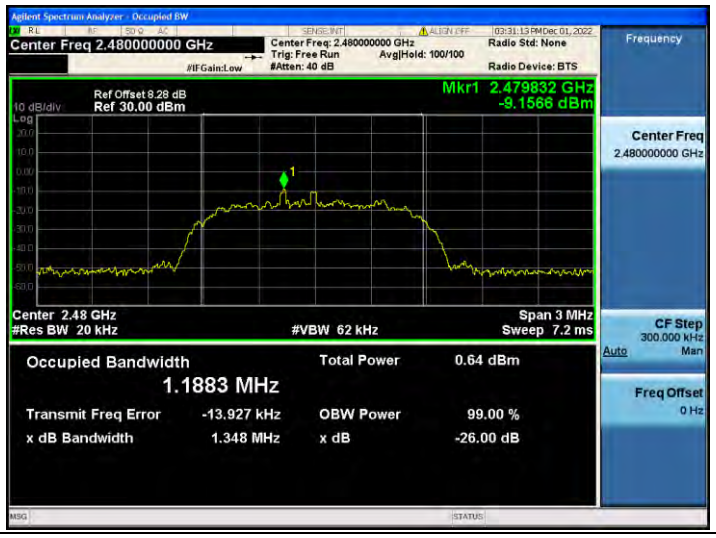

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10.3 Appendix C: Maximum conducted output power

10.3.1 Test Result

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH5	Ant1	2402	-6.2	≤20.97	PASS
		2441	-6.7	≤20.97	PASS
		2480	-5.82	≤20.97	PASS
2DH5	Ant1	2402	-3.96	≤20.97	PASS
		2441	-4.49	≤20.97	PASS
		2480	-3.54	≤20.97	PASS
3DH5	Ant1	2402	-3.4	≤20.97	PASS
		2441	-3.88	≤20.97	PASS
		2480	**-3.01**	≤20.97	PASS

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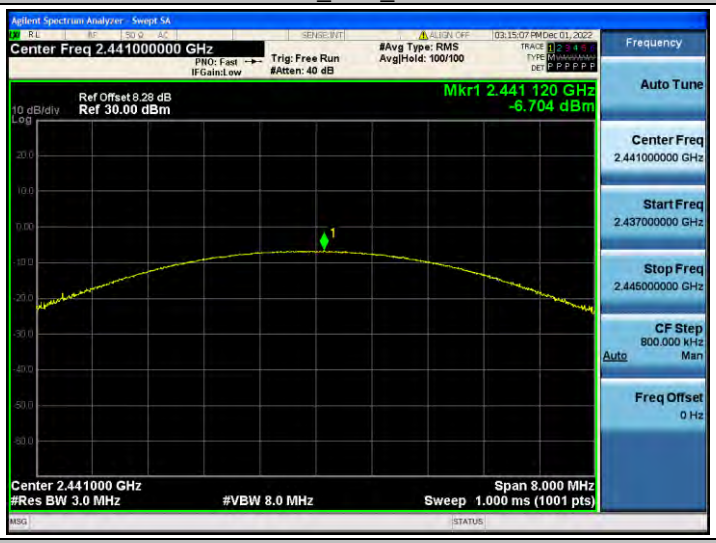
10.3.2 Test Graphs

DH5_Ant1_2402

DH5_Ant1_2441



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10.4 Appendix D: Carrier frequency separation

10.4.1 Test Result

TestMode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict
DH5	Ant1	Hop	0.998	≥0.682	PASS
2DH5	Ant1	Hop	1.272	≥0.894	PASS
3DH5	Ant1	Hop	1.068	≥0.876	PASS

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10.4.2 Test Graphs

DH5_Ant1_Hop

2DH5_Ant1_Hop

3DH5_Ant1_Hop

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10.5 Appendix E: Time of occupancy

10.5.1 Test Result

TestMode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.371	330	0.122	≤0.4	PASS
DH3	Ant1	Hop	1.644	170	0.279	≤0.4	PASS
DH5	Ant1	Hop	2.891	110	0.318	≤0.4	PASS
2DH1	Ant1	Hop	0.377	330	0.124	≤0.4	PASS
2DH3	Ant1	Hop	1.629	170	0.277	≤0.4	PASS
2DH5	Ant1	Hop	2.877	110	0.316	≤0.4	PASS
3DH1	Ant1	Hop	0.377	320	0.121	≤0.4	PASS
3DH3	Ant1	Hop	1.628	170	0.277	≤0.4	PASS
3DH5	Ant1	Hop	2.878	110	0.317	≤0.4	PASS

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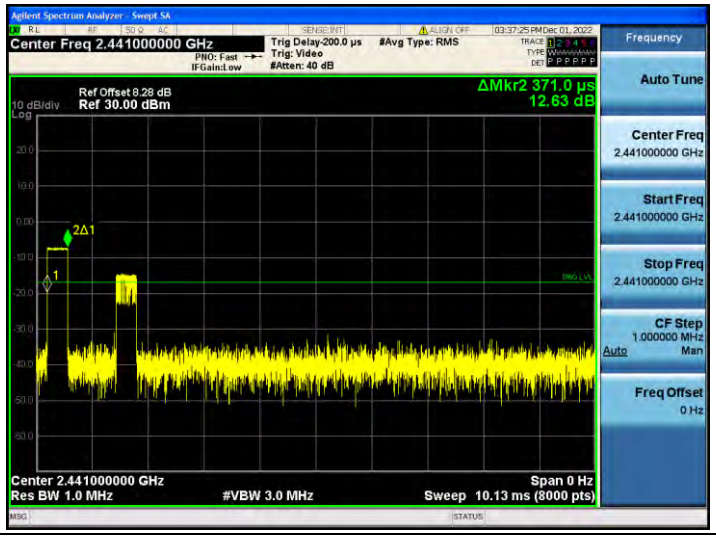
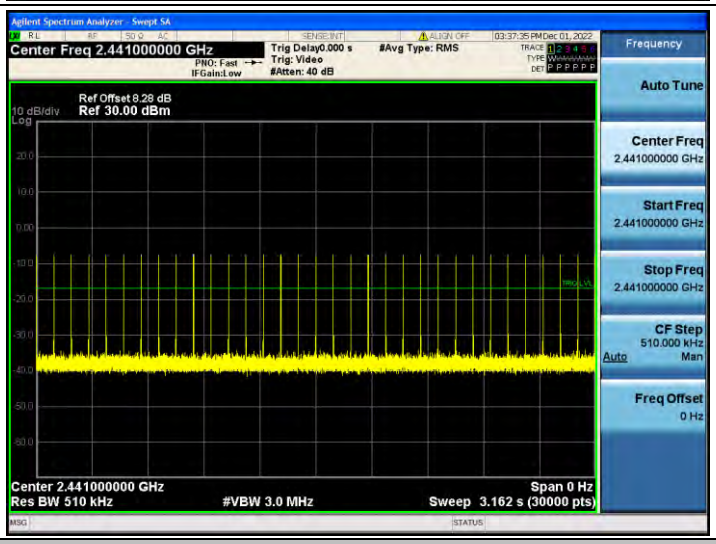
10.5.2 Test Graphs

DH1_Ant1_Hop


DH3_Ant1_Hop

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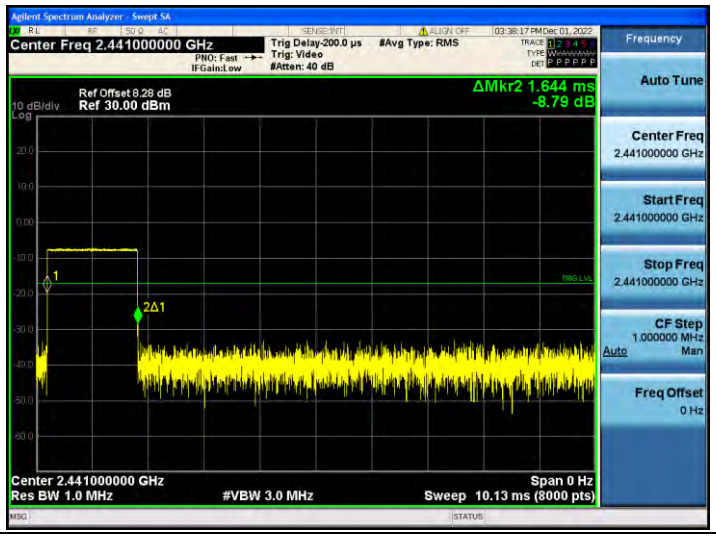

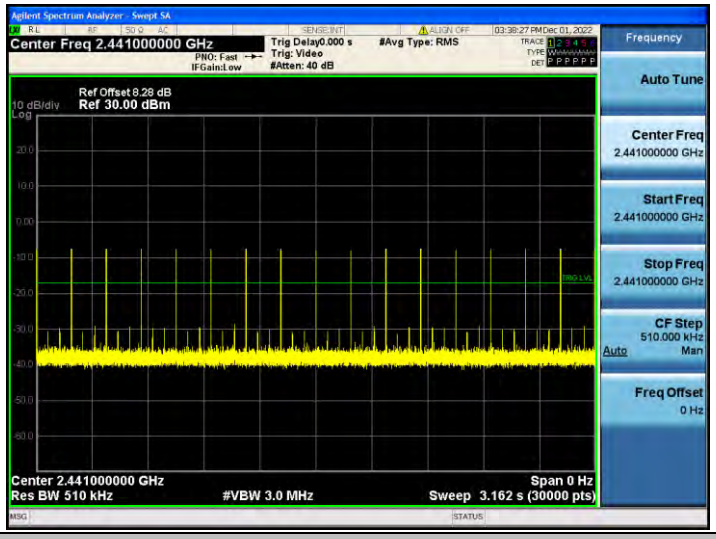

DH5_Ant1_Hop

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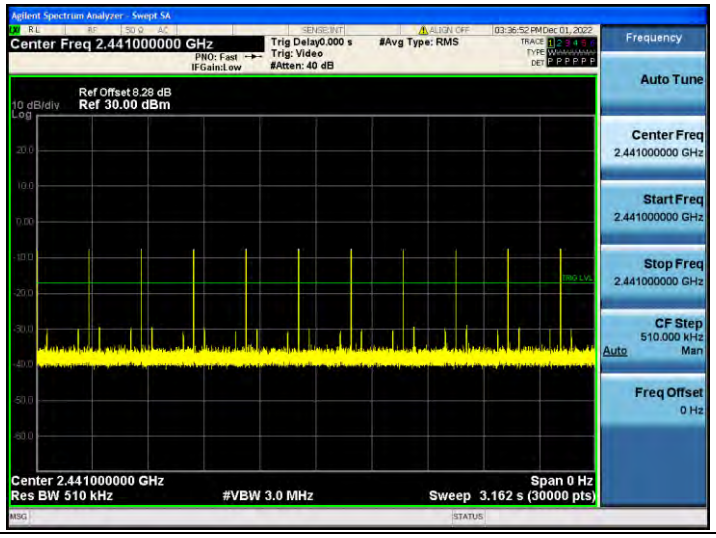

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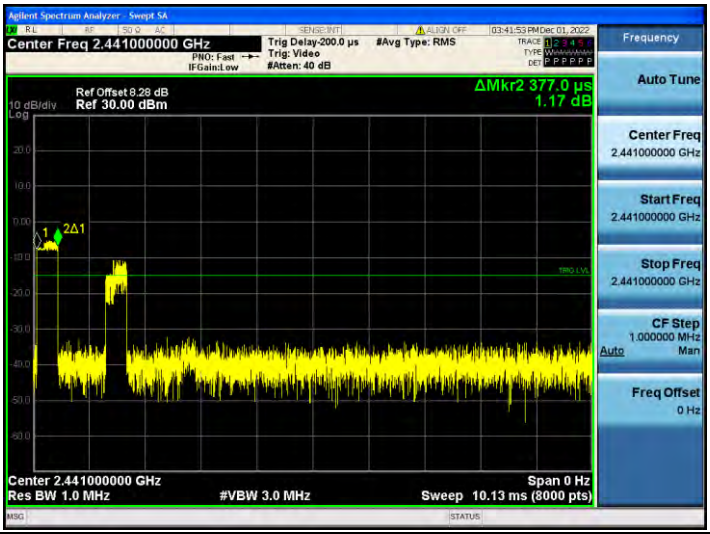
2DH1_Ant1_Hop



2DH3_Ant1_Hop

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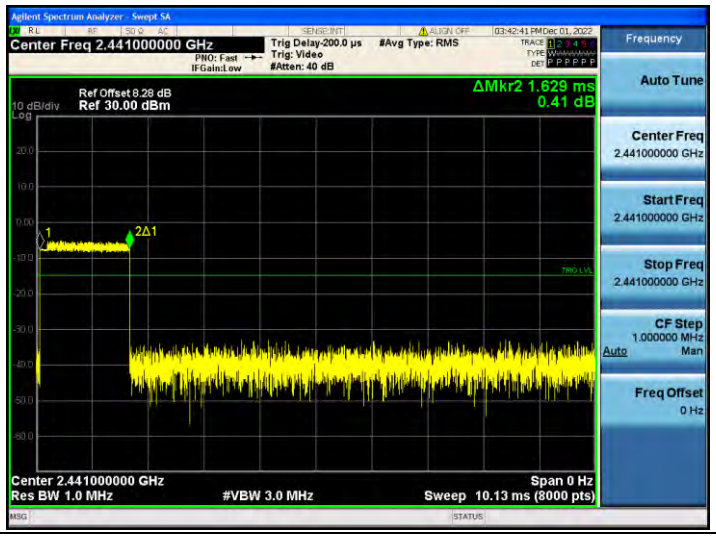

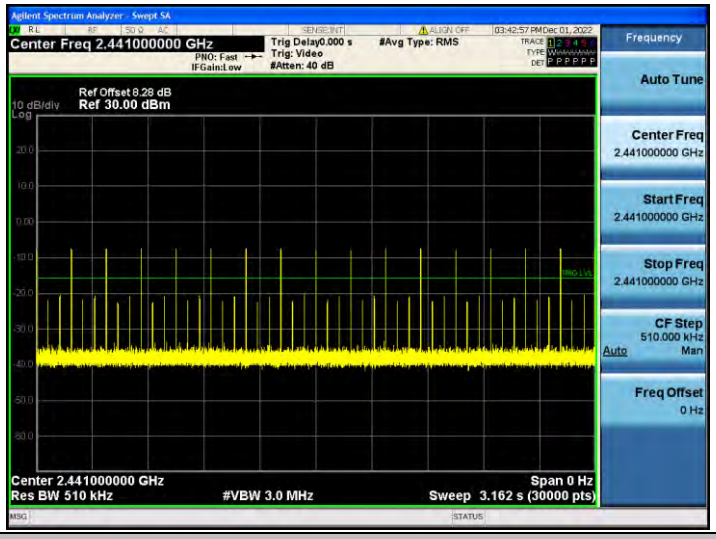

2DH5_Ant1_Hop

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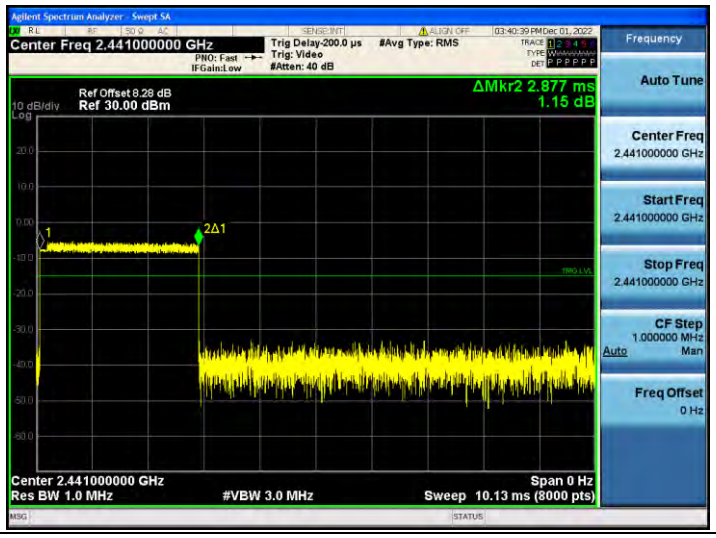

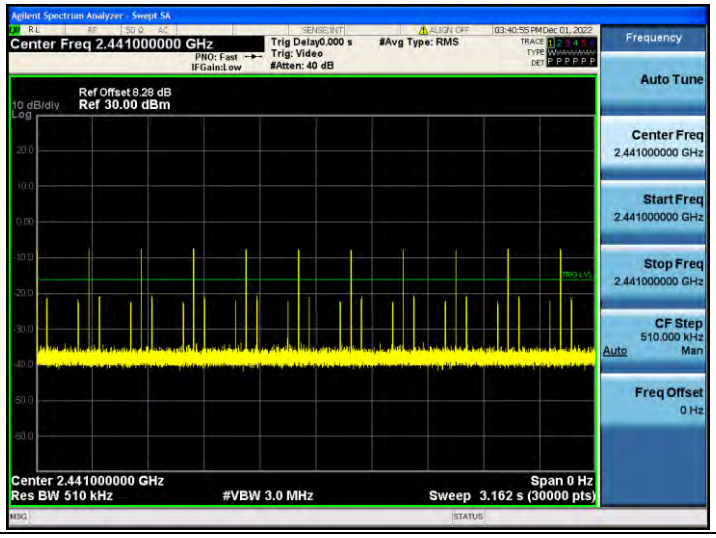

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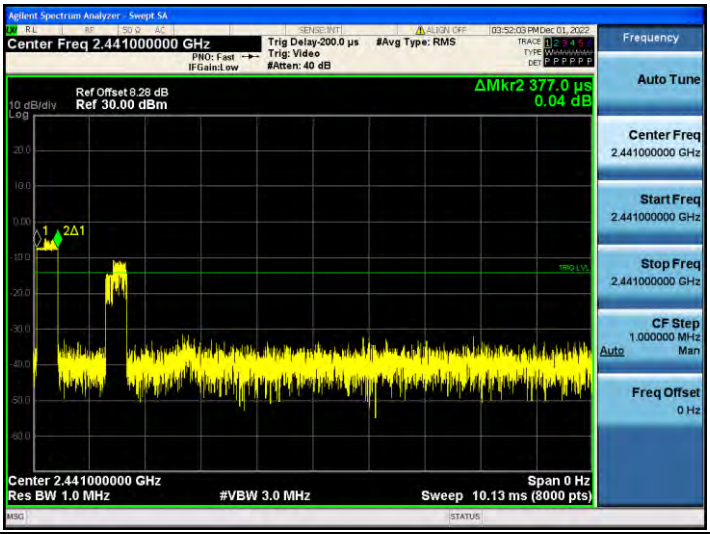
3DH1_Ant1_Hop



3DH3_Ant1_Hop

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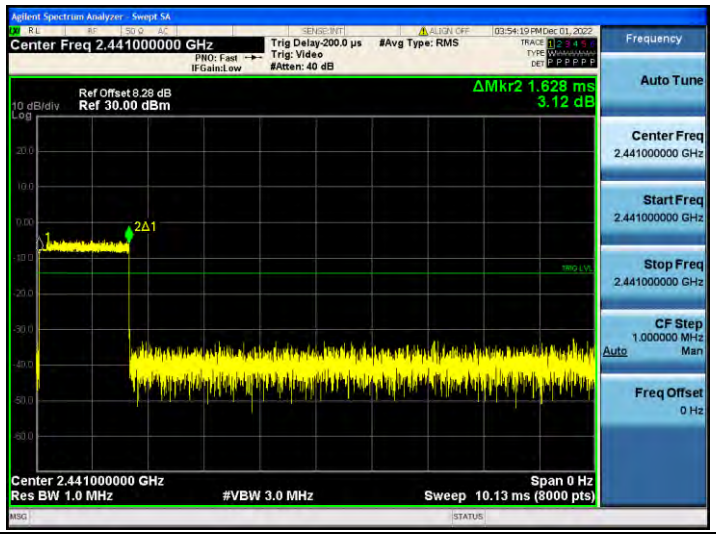

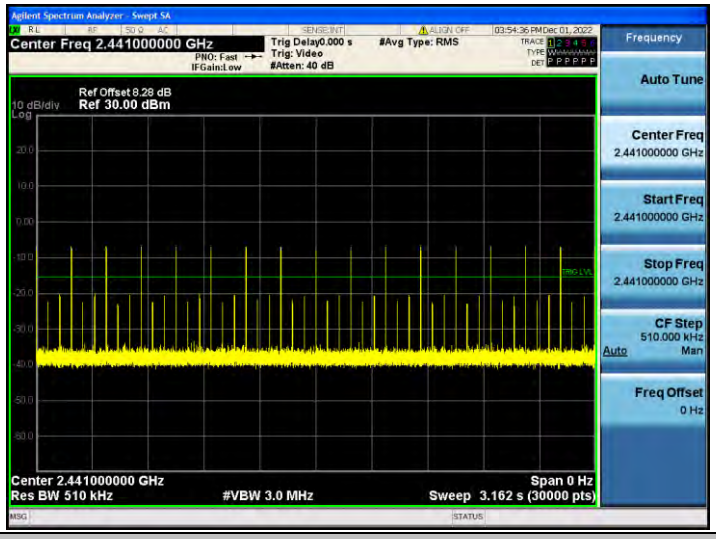

3DH5_Ant1_Hop

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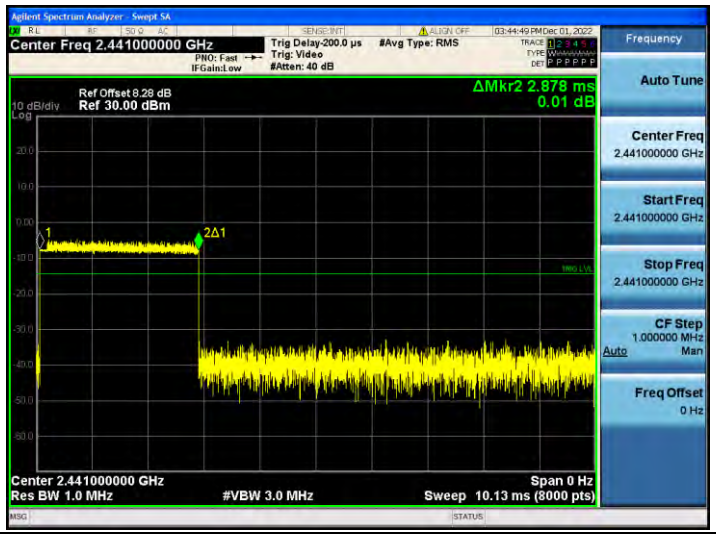

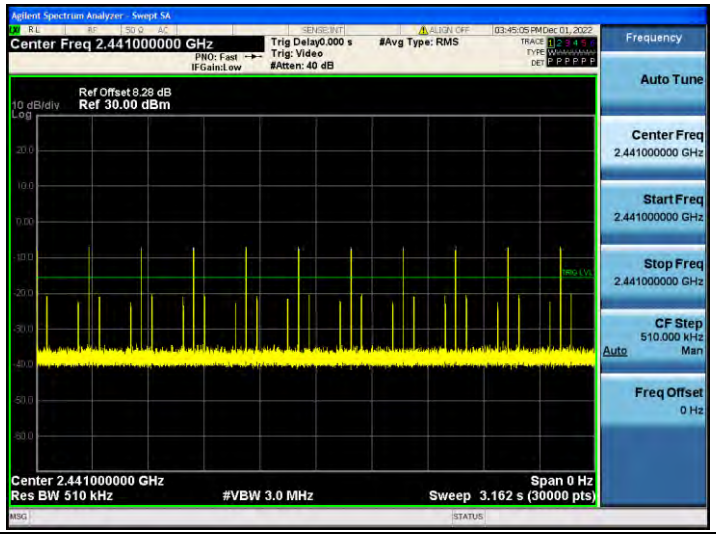

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10.6 Appendix F: Number of hopping channels

10.6.1 Test Result

TestMode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
DH5	Ant1	Hop	79	≥15	PASS
2DH5	Ant1	Hop	79	≥15	PASS
3DH5	Ant1	Hop	79	≥15	PASS

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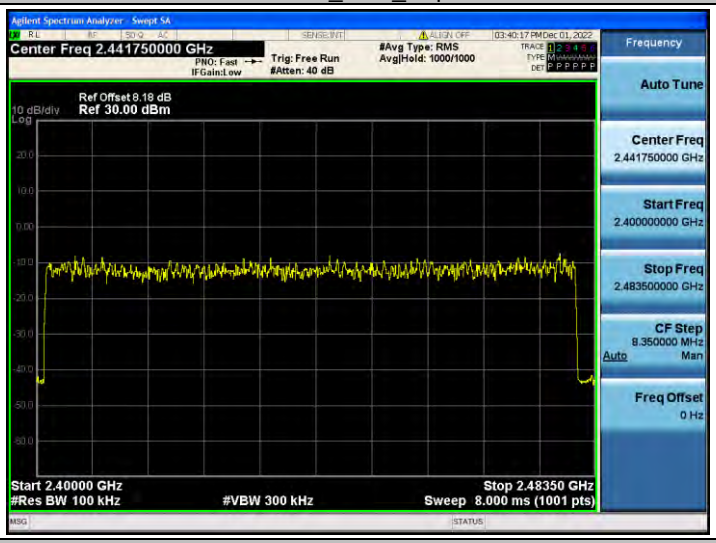
10.6.2 Test Graphs

DH5_Ant1_Hop

2DH5_Ant1_Hop



3DH5_Ant1_Hop

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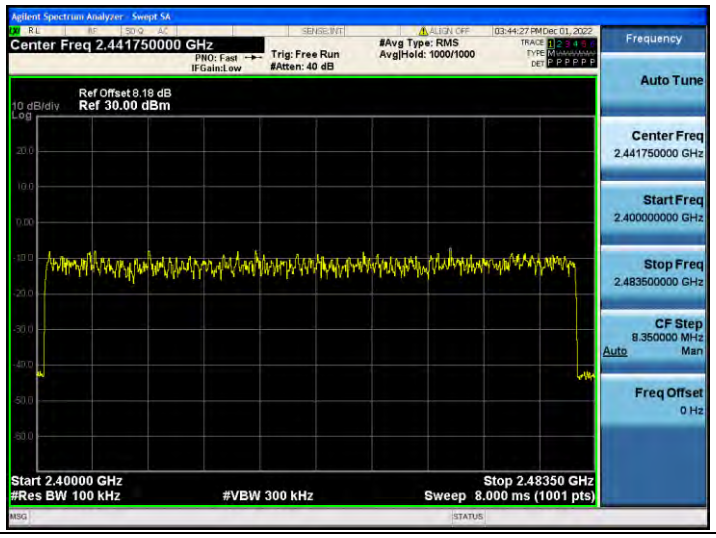

10.7 Appendix G: Band edge measurements

10.7.1 Test Result

TestMode	Antenna	ChName	Channel	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	Low	2402	-7.07	-50.59	≤-27.07	PASS
		High	2480	-6.70	-49.98	≤-26.7	PASS
		Low	Hop_2402	-7.98	-51.11	≤-27.98	PASS
		High	Hop_2480	-7.78	-50.49	≤-27.78	PASS
2DH5	Ant1	Low	2402	-7.43	-48.66	≤-27.43	PASS
		High	2480	-7.28	-44.08	≤-27.28	PASS
		Low	Hop_2402	-9.61	-51.58	≤-29.61	PASS
		High	Hop_2480	-8.48	-49.85	≤-28.48	PASS
3DH5	Ant1	Low	2402	-7.15	-51.16	≤-27.15	PASS
		High	2480	-6.81	-41.88	≤-26.81	PASS
		Low	Hop_2402	-9.47	-51.05	≤-29.47	PASS
		High	Hop_2480	-8.95	-50.52	≤-28.95	PASS

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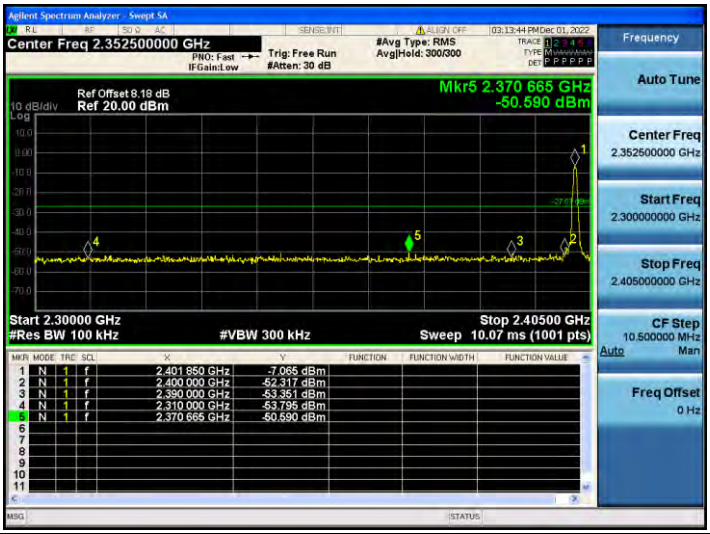
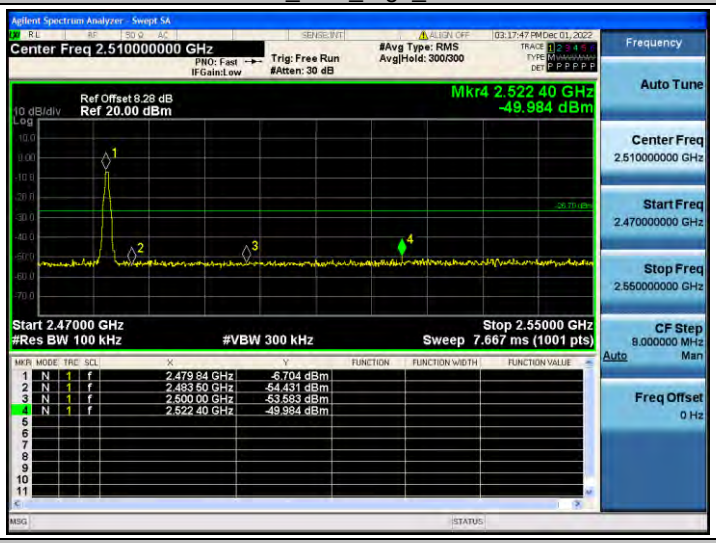
10.7.2 Test Graphs

DH5_Ant1_Low_2402



DH5_Ant1_High_2480



DH5_Ant1_Low_Hop_2402

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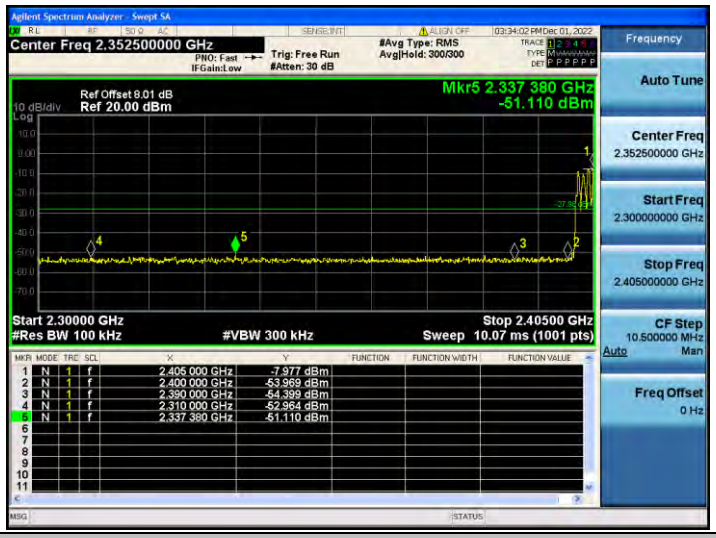
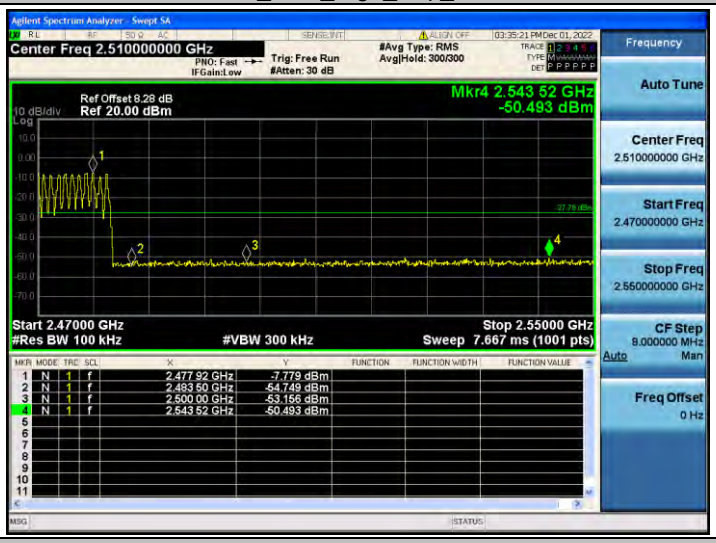


DH5_Ant1_High_Hop_2480



2DH5_Ant1_Low_2402

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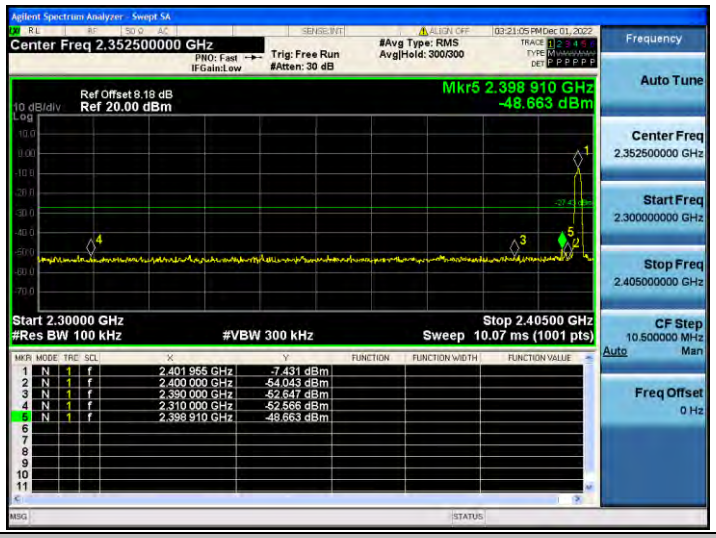

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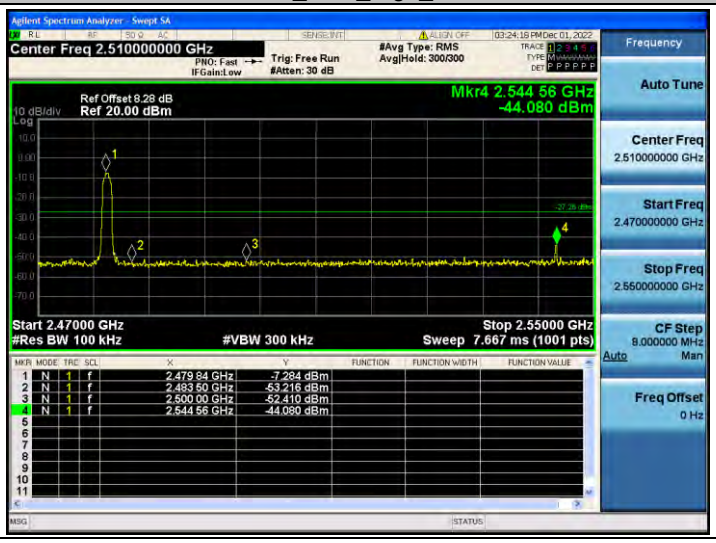

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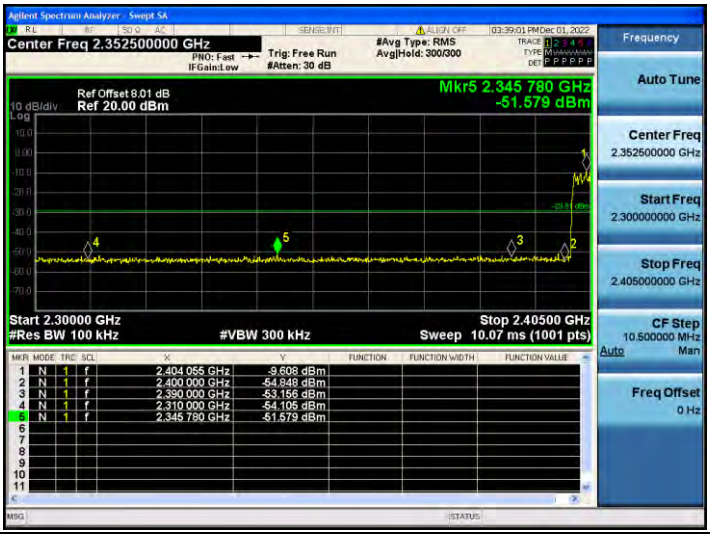
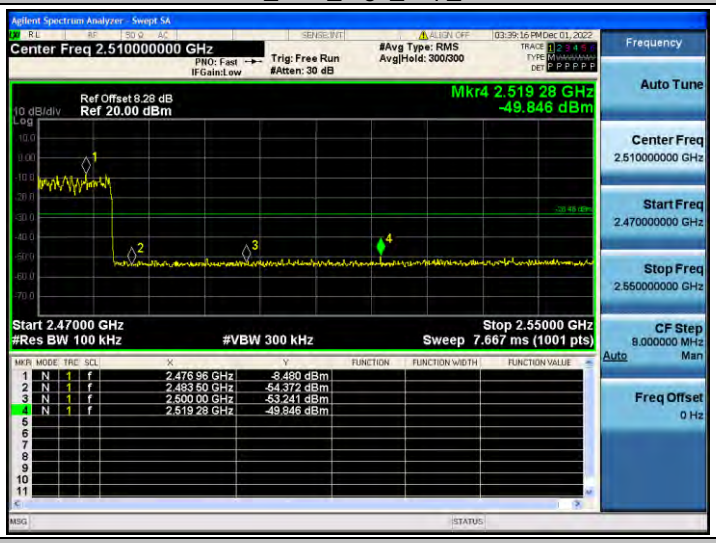
2DH5_Ant1_Low_Hop_2402



2DH5_Ant1_High_Hop_2480



3DH5_Ant1_Low_2402

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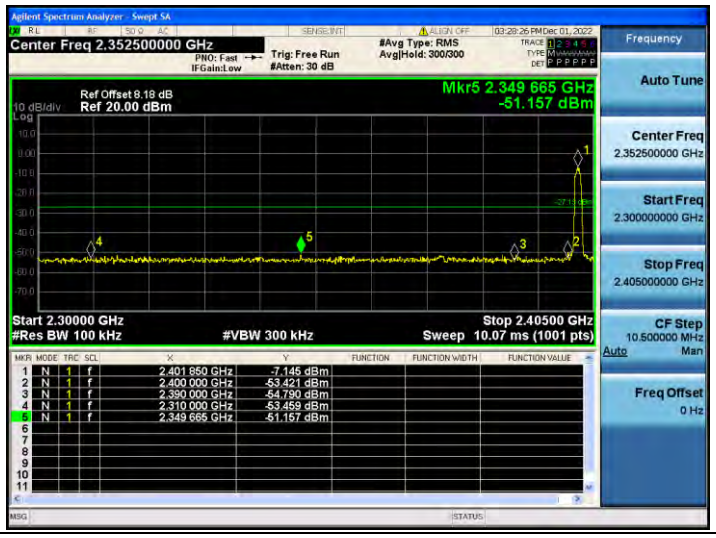

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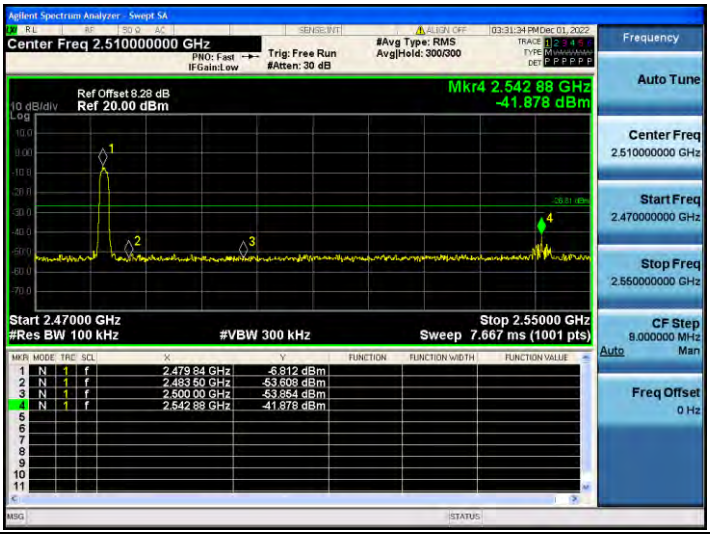
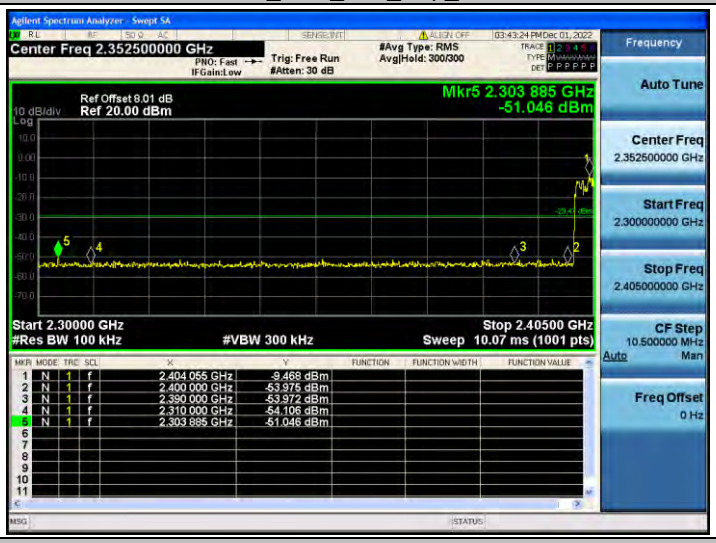
3DH5_Ant1_High_2480



3DH5_Ant1_Low_Hop_2402



3DH5_Ant1_High_Hop_2480

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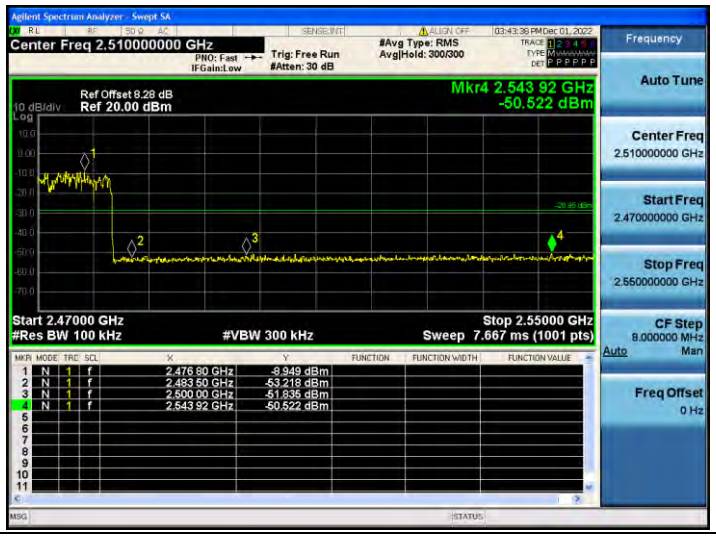

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10.8 Appendix H: Conducted Spurious Emission

10.8.1 Test Result

TestMode	Antenna	Channel	FreqRange [MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	Reference	-7.89	-7.89	---	PASS
			30~1000	-7.89	-57.79	≤-27.89	PASS
			1000~26500	-7.89	-44.83	≤-27.89	PASS
		2441	Reference	-8.48	-8.48	---	PASS
			30~1000	-8.48	-58.27	≤-28.48	PASS
			1000~26500	-8.48	-43.79	≤-28.48	PASS
		2480	Reference	-7.43	-7.43	---	PASS
			30~1000	-7.43	-57.77	≤-27.43	PASS
			1000~26500	-7.43	-44.17	≤-27.43	PASS
2DH5	Ant1	2402	Reference	-8.18	-8.18	---	PASS
			30~1000	-8.18	-58.32	≤-28.18	PASS
			1000~26500	-8.18	-44.98	≤-28.18	PASS
		2441	Reference	-9.02	-9.02	---	PASS
			30~1000	-9.02	-56.66	≤-29.02	PASS
			1000~26500	-9.02	-44.56	≤-29.02	PASS
		2480	Reference	-8.88	-8.88	---	PASS
			30~1000	-8.88	-57.57	≤-28.88	PASS
			1000~26500	-8.88	-45.23	≤-28.88	PASS
3DH5	Ant1	2402	Reference	-8.00	-8.00	---	PASS
			30~1000	-8.00	-58.57	≤-28	PASS
			1000~26500	-8.00	-44.74	≤-28	PASS
		2441	Reference	-8.27	-8.27	---	PASS
			30~1000	-8.27	-58.58	≤-28.27	PASS
			1000~26500	-8.27	-44.95	≤-28.27	PASS
		2480	Reference	-7.77	-7.77	---	PASS
			30~1000	-7.77	-59.09	≤-27.77	PASS
			1000~26500	-7.77	-44.78	≤-27.77	PASS

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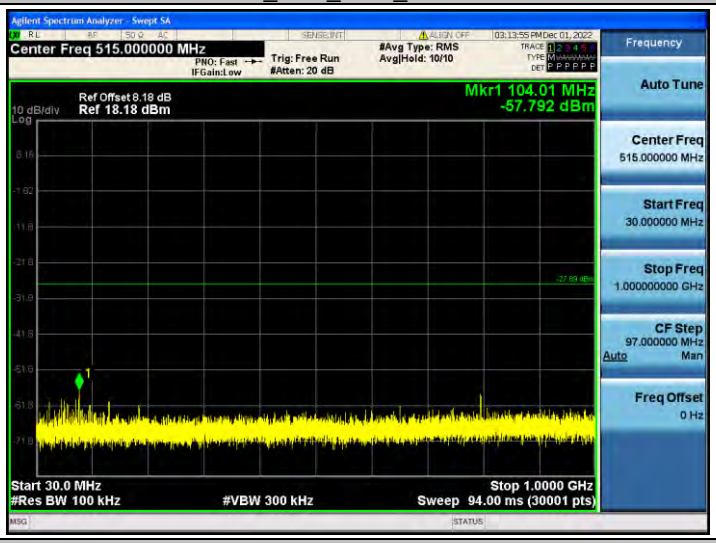
10.8.2 Test Graphs

DH5_Ant1_2402_0~Reference

DH5_Ant1_2402_30~1000



DH5_Ant1_2402_1000~26500

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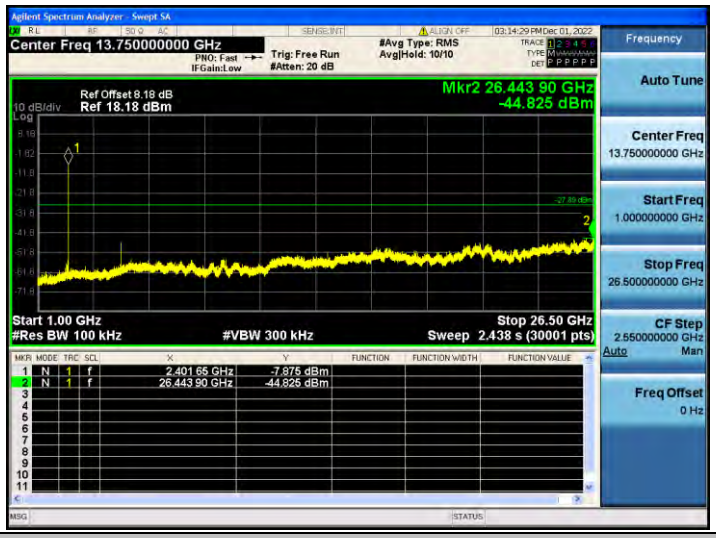

DH5_Ant1_2441_0~Reference

DH5_Ant1_2441_30~1000

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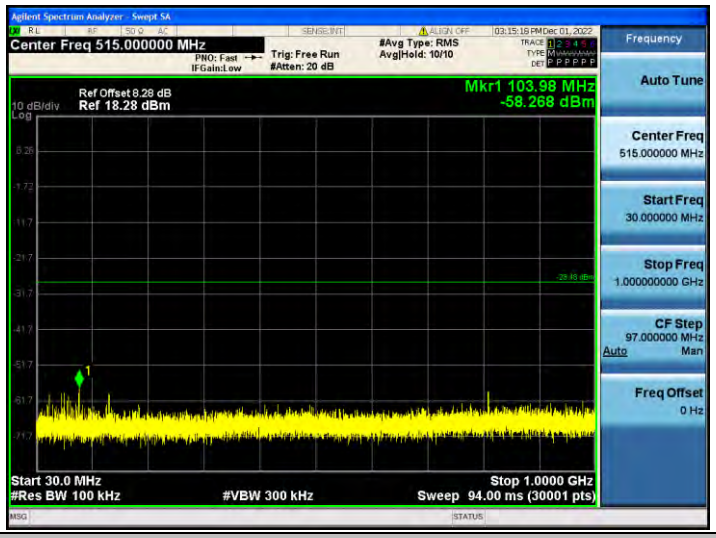
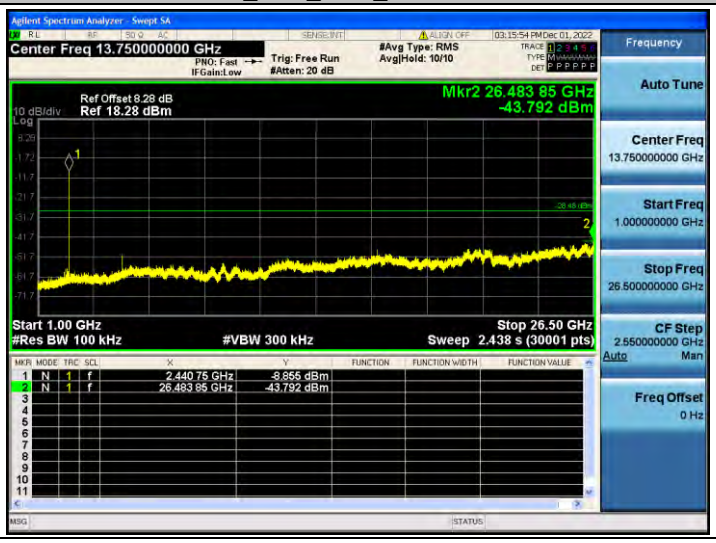


DH5_Ant1_2441_1000~26500



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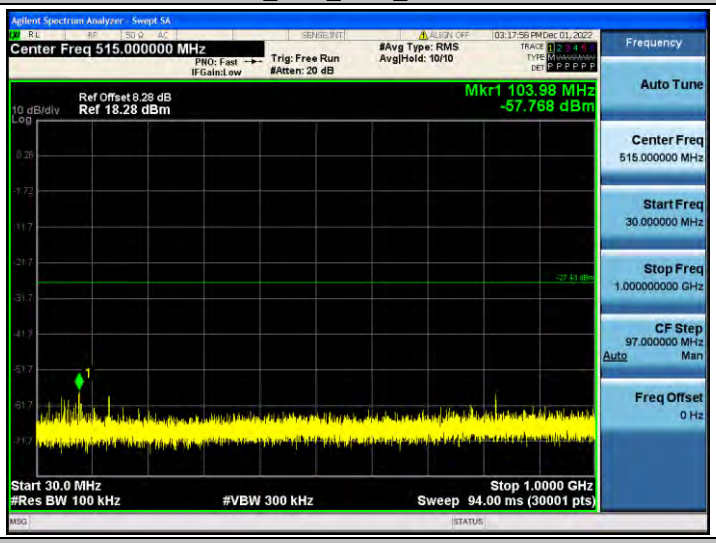

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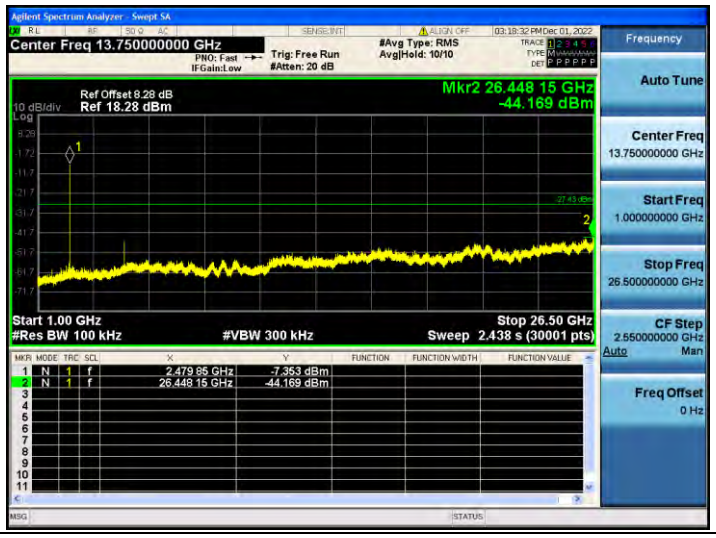

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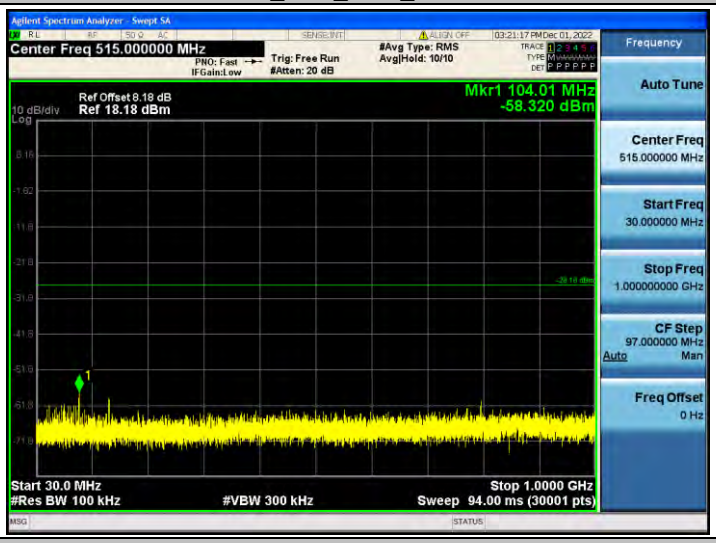

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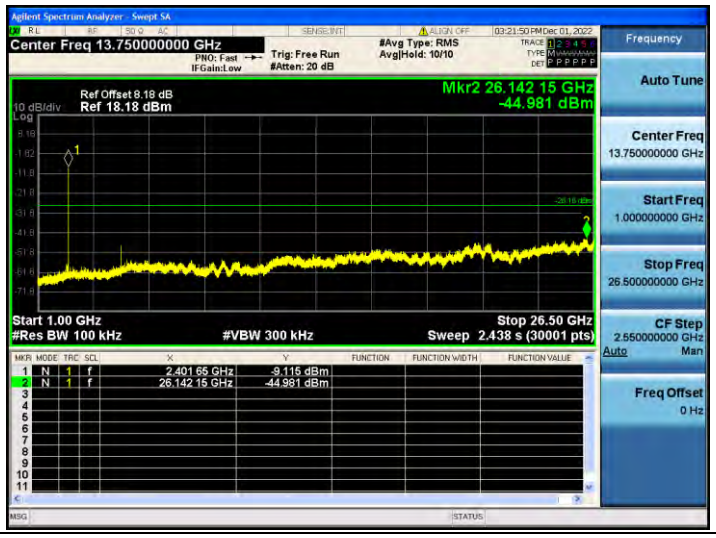

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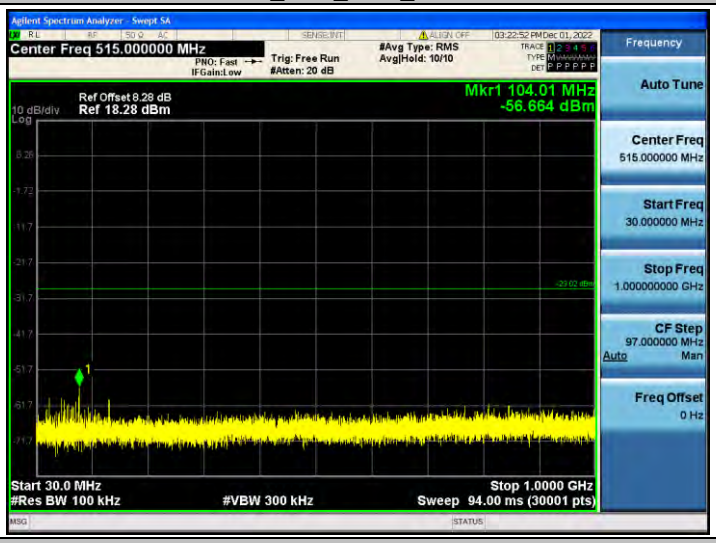

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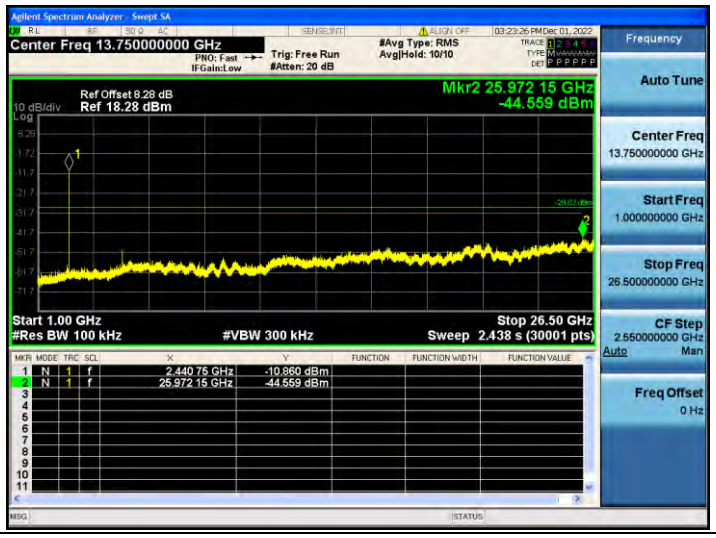

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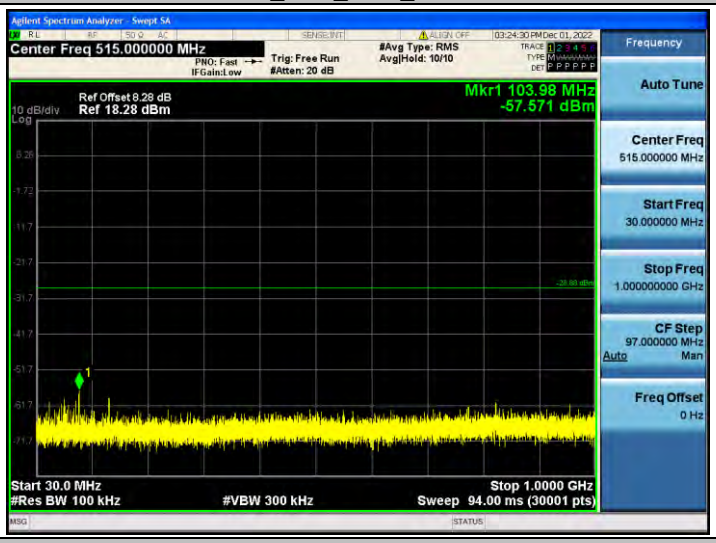

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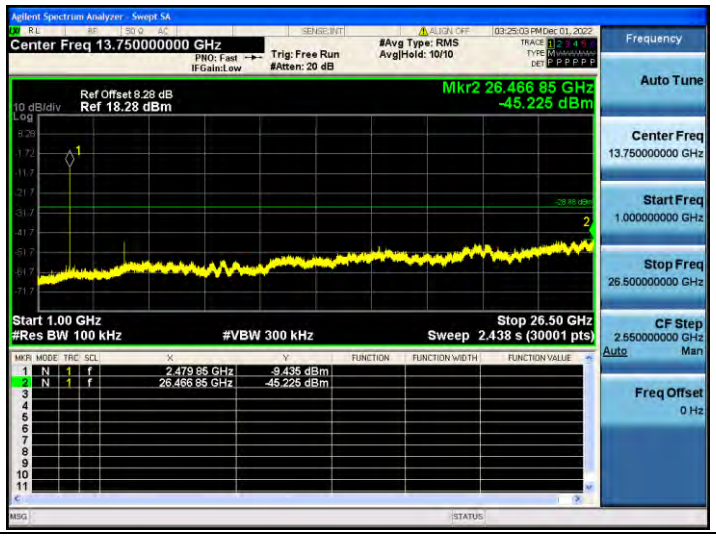

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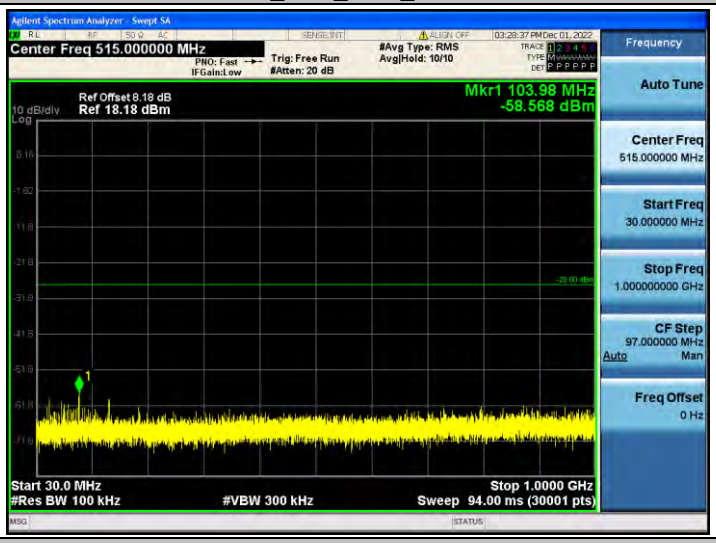

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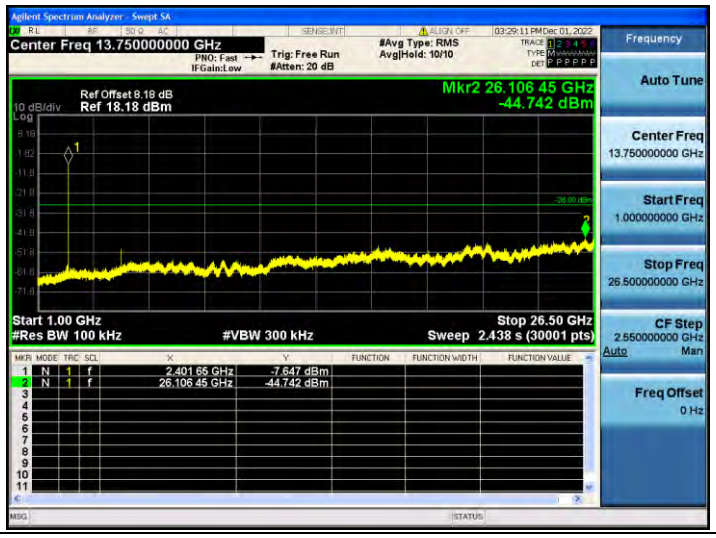

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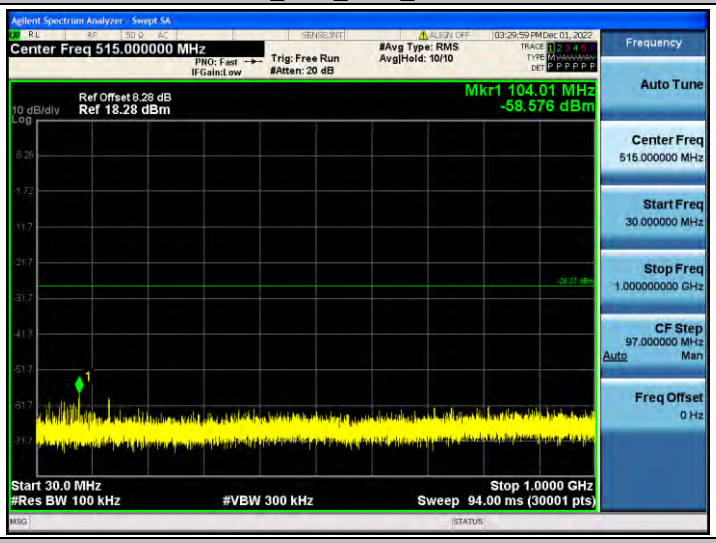

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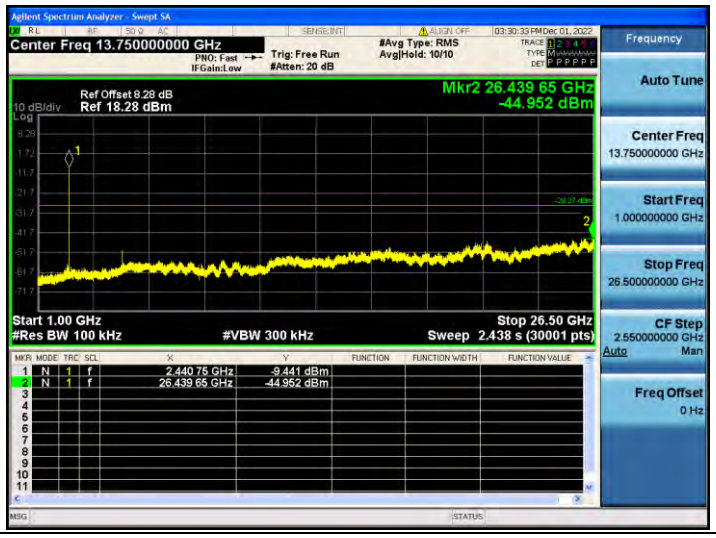

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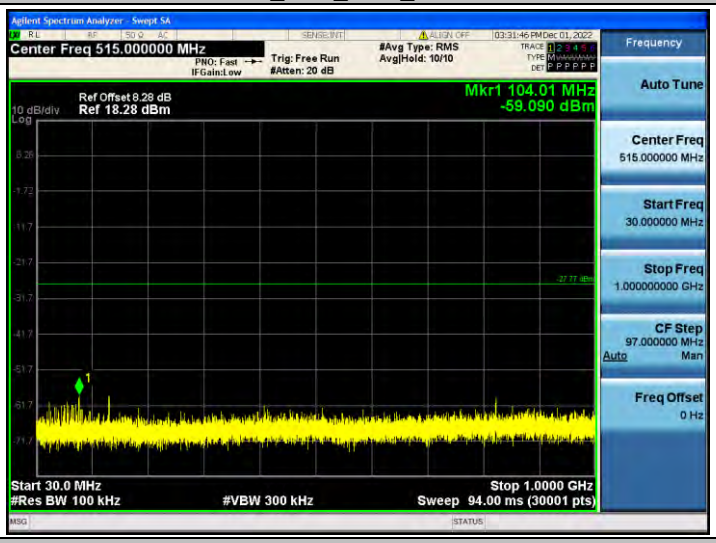

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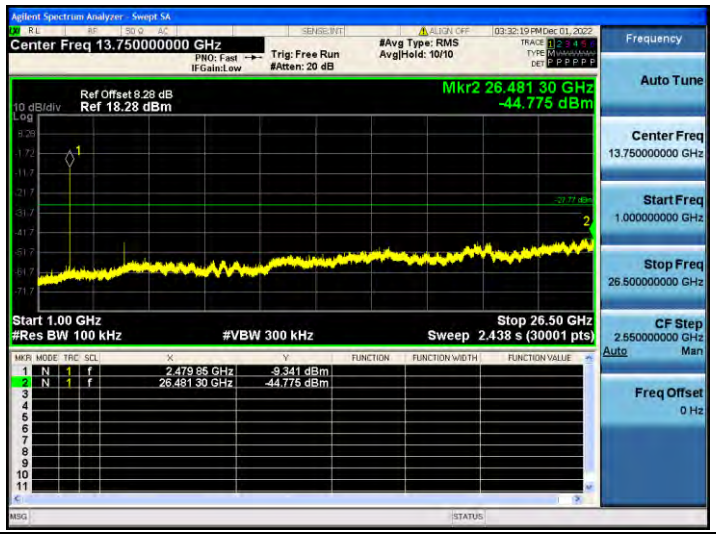

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