TEST REPORT

Application No.:	KSCR2407001236AT
FCC ID:	2AH25K2A13
IC:	22621-K2A13
Applicant:	Shanghai Sunmi Technology Co.,Ltd.
Address of Applicant:	Room 505, No.388 Song Hu Road, Yang Pu District, Shanghai, China
Manufacturer:	Shanghai Sunmi Technology Co.,Ltd.
Address of Manufacturer:	Room 505, No.388 Song Hu Road, Yang Pu District, Shanghai, China
Equipment Under Test (EUT):	
EUT Name:	Self-Checkout Kiosk
Model No.:	F4E02
HVIN:	F4E02, F4E02(B)
Trade Mark:	SUNMI
Standard(s) :	47 CFR Part 15, Subpart C 15.247 RSS-247 Issue 3, August 2023 RSS-Gen Issue 5 Amendment 2 (February 2021)
Date of Receipt:	2024-07-03
Date of Test:	2024-08-08 to 2024-08-19
Date of Issue:	2024-08-19
Test Result:	**Pass***

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

Revision Record			
Version	**Description**	***Date***	***Remark***
00	Original	2024-08-19	/

Authorized for issue by:				
Tested By		Damon zhou **Damon Zhou /Project Engineer**		
Approved By		Terry Hou **Terry Hou /Reviewer**		

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 Average 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

Remark:
The product is divided into two different configurations (SKU1, SKU2).
SKU1: Large scan code window, the HVIN is F4E02(B)
SKU2: Small scan code window, the HVIN is F4E02
Except for the above differences, everything else is the same.
After Pre-scan test, only SKU2(HVIN: F4E02) was tested since their differences.

3 Contents

4 General Information

4.1 Details of E.U.T.

Power supply:	AC 120V/60Hz
Test Voltage:	AC 120V/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:	FPC Antenna
Antenna Gain:	2.1dBi (Provided by the manufacturer)
SN:	K288D45N00072
Firmware Version:	V 2.0

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Notebook	Lenovo	/	/

4.3 Power level setting using in test

Channel	DH	2DH	3DH
	Ant 1	Ant 1	Ant 1
1	9	9	9
3	9	9	9
5	9	9	9

4.4 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	8.4×10^{-8}
2	Timeout	2s
3	Duty Cycle	0.37%
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-18GHz)
		5.4dB (Above 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.		

4.5 Test Location

All tests were performed at:

Compliance Certification Services (Kunshan) Inc.

No.10 Weiye Rd, Innovation park, Eco&Tec, Development Zone, Kunshan City, Jiangsu, China.

Tel: +86 512 5735 5888 Fax: +86 512 5737 0818

No tests were sub-contracted.

Note:

1. SGS is not responsible for wrong test results due to incorrect information (e.g., max. internal working 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).

3. Sample source: sent by customer.

4.6 Test Facility

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

• A2LA

Compliance Certification Services (Kunshan) Inc. is accredited by the American Association for Laboratory Accreditation (A2LA). Certificate No. 2541.01.

• FCC

Compliance Certification Services (Kunshan) Inc. has been recognized as an accredited testing laboratory. Designation Number: CN1172.

• ISED

Compliance Certification Services (Kunshan) Inc. has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory. Company Number: 2324E

• VCCI

The 3m and 10m Semi-anechoic chamber and Shielded Room of Compliance Certification Services (Kunshan) Inc. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-20134, R-11600, C-11707, T-11499, G-10216 respectively.

4.7 Deviation from Standards

None

4.8 Abnormalities from Standard Conditions

None

5 Equipment List

Item	Equipment	Manufacturer	Model	Inventory No	Cal Date	Cal. Due Date
Conducted Emission at Mains Terminals						
1	EMI Test Receive	R&S	ESCI	KS301101	01/15/2024	01/14/2025
2	LISN	R&S	ENV216	KS301197	01/15/2024	01/14/2025
3	LISN	Schwarzbeck	NNLK 8129	KS301091	01/15/2024	01/14/2025
4	Pulse Limiter	R&S	ESH3-Z2	KUS1902E001	01/15/2024	01/14/2025
5	CE test Cable	Thermax	/	CZ301102	01/15/2024	01/14/2025
6	Test Software	Farad	EZ-EMC	/	N.C.R	N.C.R
RF Conducted Test						
1	Spectrum Analyzer	Keysight	N9020A	KUS1911E004-2	08/24/2023	08/23/2024
2	Spectrum Analyzer	Keysight	N9020A	KUS2001M001-2	08/24/2023	08/23/2024
3	Spectrum Analyzer	Keysight	N9030B	KSEM021-1	01/15/2024	01/14/2025
4	Signal Generator	R&S	SMBV100B	KSEM032	03/19/2024	03/18/2025
5	Signal Generator	R&S	SMW200A	KSEM020-1	08/24/2023	08/23/2024
6	Signal Generator	Agilent	N5182A	KUS2001M001-1	08/24/2023	08/23/2024
7	Radio Communication Test Station	Anritsu	MT8000A	KSEM001-1	08/24/2023	08/23/2024
8	Radio Communication Analyzer	Anritsu	MT8821C	KSEM002-1	03/19/2024	03/18/2025
9	Universal Radio Communication Tester	R&S	CMW500	KUS1911E004-1	08/24/2023	08/23/2024
10	Switcher	TST	FY562	KUS2001M001-4	01/15/2024	01/14/2025
11	AC Power Source	EXTECH	6605	KS301178	N.C.R	N.C.R
12	DC Power Supply	Aglient	E3632A	KS301180	N.C.R	N.C.R
13	Conducted Test Cable	Thermax	RF01-RF04	CZ301111-CZ301120	01/15/2024	01/14/2025
14	Temp. / Humidity Chamber	TERCHY	MHK-120AK	KS301190	08/24/2023	08/23/2024
15	Temperature & Humidity Recorder	Renke Control	RS-WS-N01-6J	KSEM024-5	03/19/2024	03/18/2025
16	Software	BST	TST-PASS	/	NCR	NCR
RF Radiated Test						
1	Spectrum Analyzer	R&S	FSV40	KUS1806E003	08/24/2023	08/23/2024
2	Universal Radio Communication Tester	R&S	CMW500	KSEM009-1	03/19/2024	03/18/2025
3	Signal Generator	Agilent	E8257C	KS301066	08/24/2023	08/23/2024
4	Loop Antenna	COM-POWER	AL-130R	KUS1806E001	03/18/2023	03/17/2025
5	Bilog Antenna	TESEQ	CBL 6112D	KUS1806E005	06/29/2023	06/28/2025
6	Bilog Antenna	TESEQ	CBL 6112D	KUS1806E006	03/19/2024	03/18/2025
7	Horn-antenna(1-18GHz)	Schwarzbeck	BBHA9120D	KS301079	08/24/2023	08/23/2024
8	Horn-antenna(1-18GHz)	ETS-LINDGREN	3117	KS301186	04/07/2023	04/06/2025
9	Horn Antenna(18-40GHz)	Schwarzbeck	BBHA9170	CZ301058	01/07/2024	01/06/2026
10	Amplifier(30MHz~18GHz)	PANSHAN TECHNOLOGY	LNA:1~18G	KSEM010-1	01/15/2024	01/14/2025
11	Amplifier(18~40GHz)	PANSHAN TECHNOLOGY	LNA180400G40	KSEM038	08/24/2023	08/23/2024
12	RE Test Cable	REBES MICROWAVE	/	CZ301097	08/24/2023	08/23/2024
13	Temperature & Humidity Recorder	Renke Control	RS-WS-N01-6J	KSEM024-4	03/19/2024	03/18/2025
14	Software	Faratronic	EZ_EMC-v 3A1	/	NCR	NCR
15	Software	ESE	E3_V 6.111221a	/	NCR	NCR

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 FPC Antenna and no consideration of replacement. The best case gain of the antenna is 2.1 dBi.

Antenna location: Refer to internal photo.

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

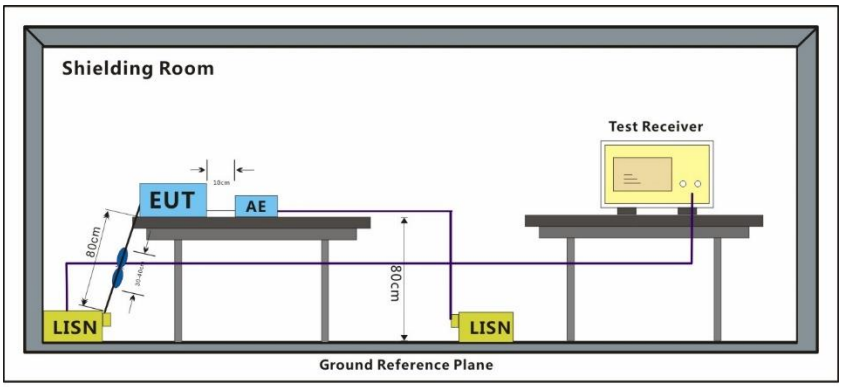
7.1.1 E.U.T. Operation

Operating Environment:
Temperature: 25.4 °C Humidity: 44.1 % 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.

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.

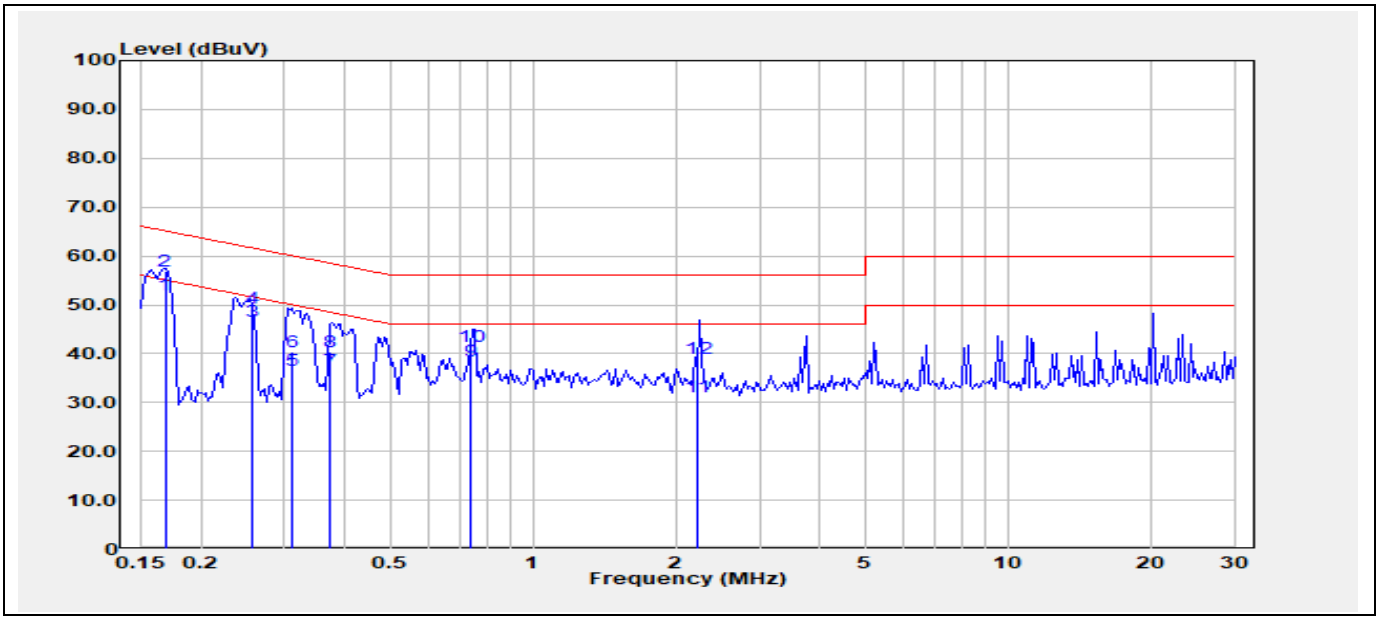
3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane.

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.

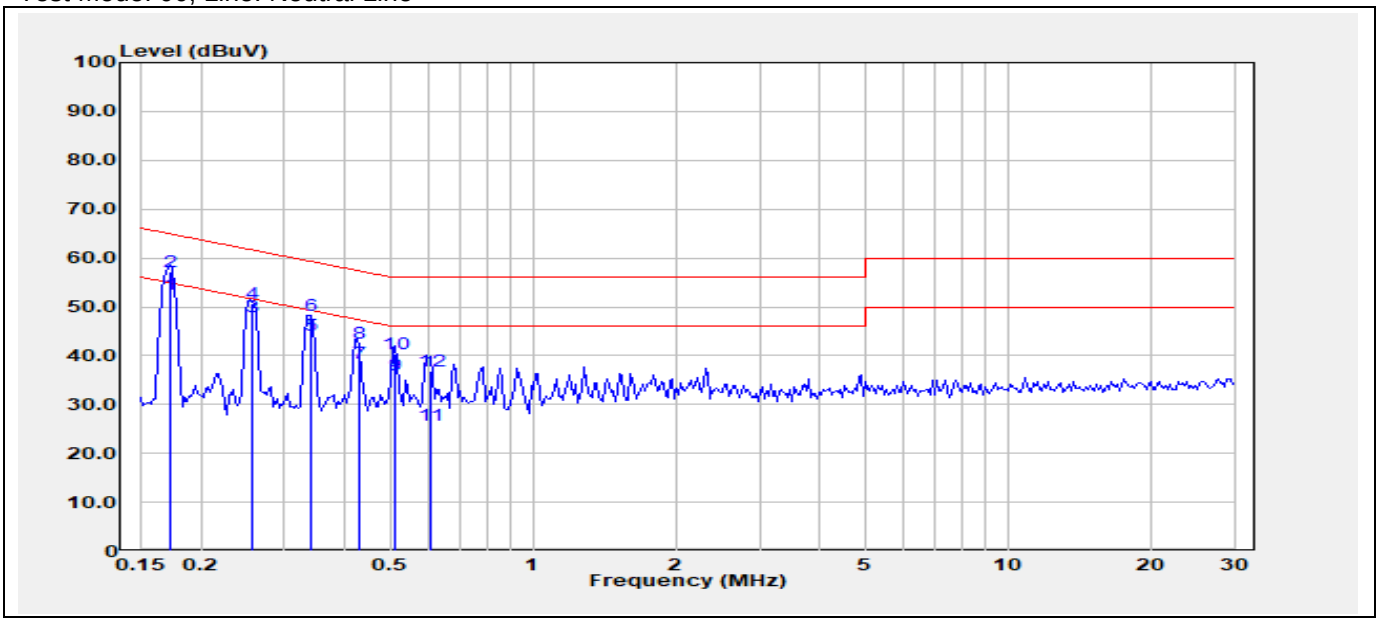
Remark: Level=Read Level+ Cable Loss+ LISN Factor

Test Mode: 00; Line: Live line



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1680	31.81	20.18	51.99	55.06	-3.07	Average
2	0.1680	36.81	20.18	56.99	65.06	-8.07	QP
3	0.2560	26.47	20.07	46.54	51.56	-5.02	Average
4	0.2560	29.38	20.07	49.45	61.56	-12.11	QP
5	0.3097	16.47	20.08	36.54	49.98	-13.43	Average
6	0.3097	20.36	20.08	40.43	59.98	-19.54	QP
7	0.3743	16.47	20.07	36.54	48.41	-11.87	Average
8	0.3743	20.44	20.07	40.51	58.41	-17.90	QP
9	0.7395	18.72	19.77	38.50	46.00	-7.50	Average
10	0.7395	21.69	19.77	41.47	56.00	-14.53	QP
11	2.2220	11.26	20.02	31.27	46.00	-14.73	Average
12	2.2220	19.12	20.02	39.14	56.00	-16.86	QP

Test Mode: 00; Line: Neutral Line



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1723	32.31	20.15	52.46	54.85	-2.39	Average
2	0.1723	37.11	20.15	57.26	64.85	-7.59	QP
3	0.2559	28.01	20.09	48.10	51.56	-3.46	Average
4	0.2559	30.70	20.09	50.79	61.56	-10.77	QP
5	0.3419	24.03	20.10	44.13	49.16	-5.03	Average
6	0.3419	28.13	20.10	48.23	59.16	-10.93	QP
7	0.4310	18.48	20.05	38.53	47.23	-8.70	Average
8	0.4310	22.62	20.05	42.67	57.23	-14.56	QP
9	0.5130	16.05	19.92	35.97	46.00	-10.03	Average
10	0.5130	20.53	19.92	40.45	56.00	-15.55	QP
11	0.6067	5.79	19.87	25.66	46.00	-20.34	Average
12	0.6067	17.04	19.87	36.91	56.00	-19.09	QP

7.2 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.		

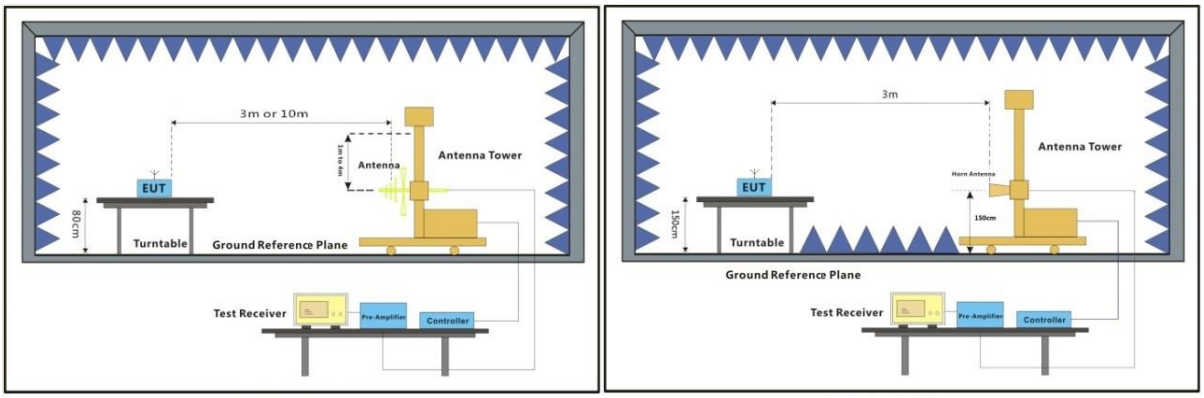
7.2.1 E.U.T. Operation

Operating Environment:
Temperature: °C Humidity: % 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



30MHz-1GHz　　Above 1GHz

7.2.4 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.

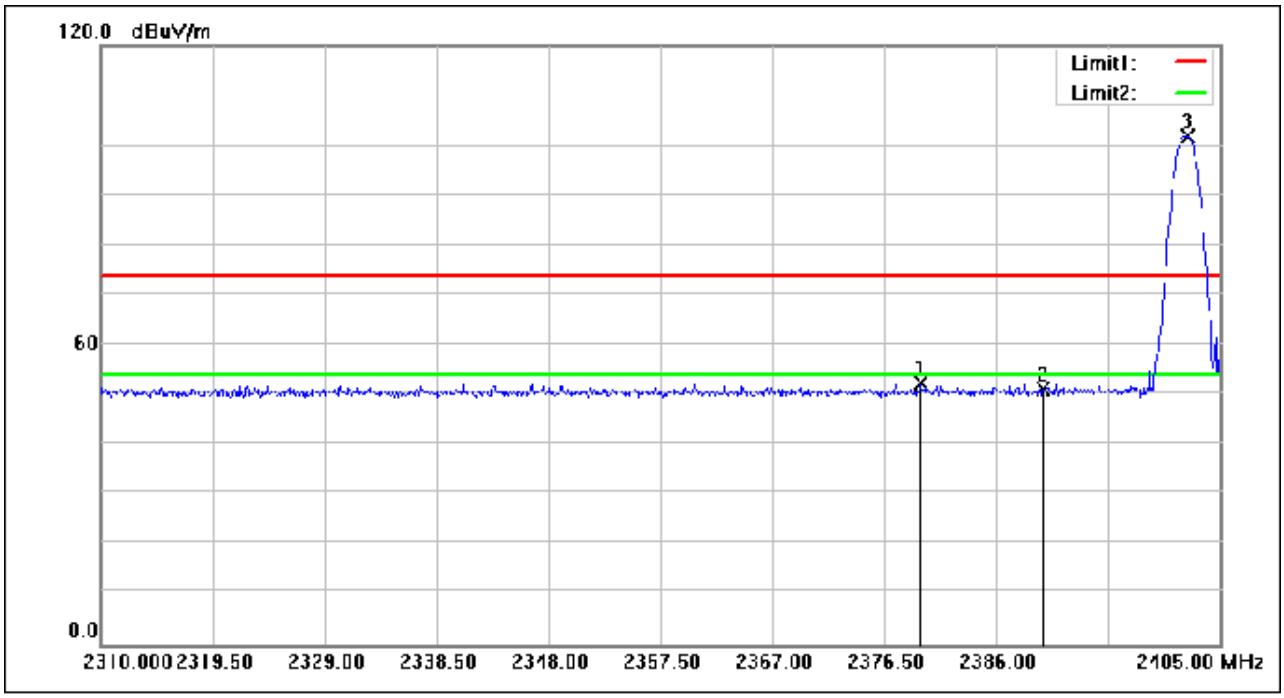
i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

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

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

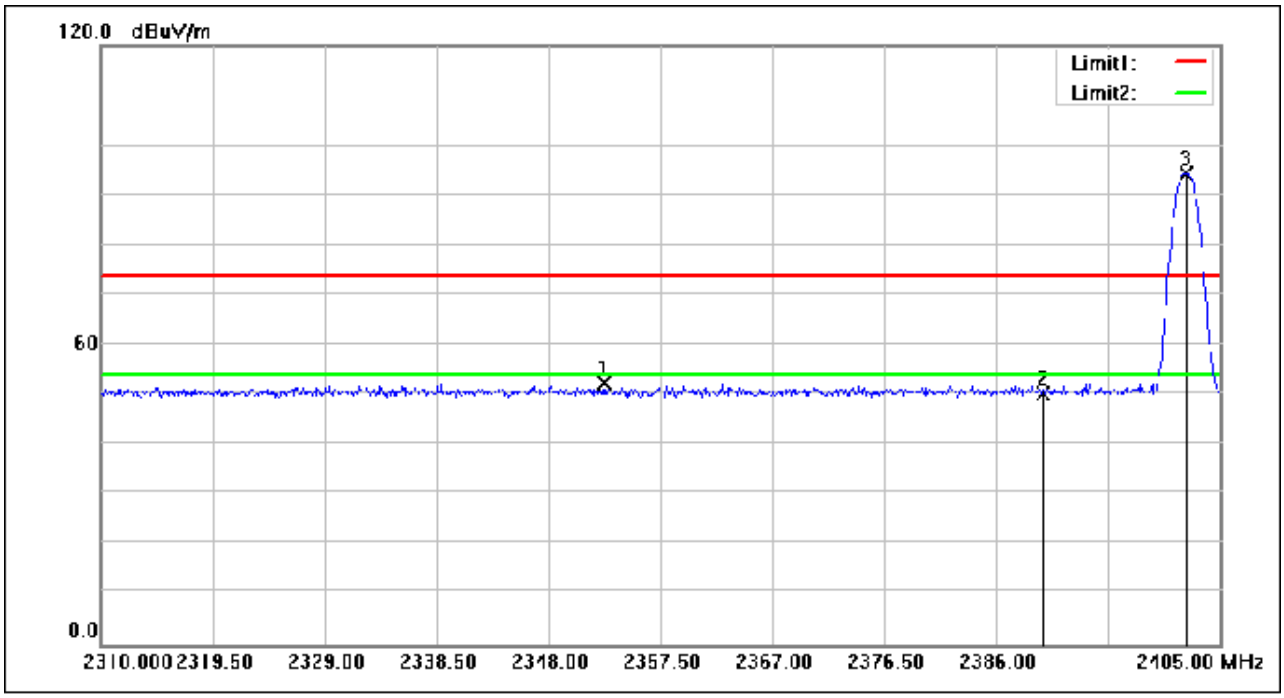
Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

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



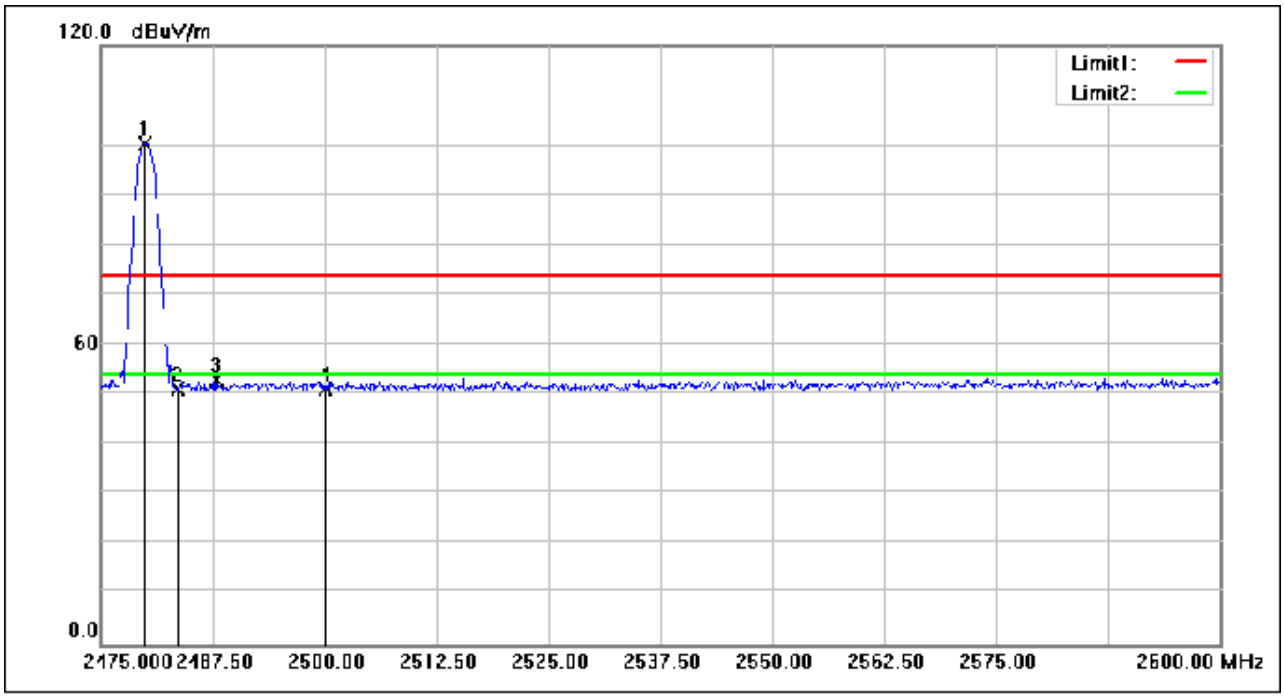
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2379.540	77.08	-24.75	52.33	74.00	-21.67	peak
2	2390.000	75.85	-24.71	51.14	74.00	-22.86	peak
3	2402.245	126.43	-24.65	101.78	74.00	27.78	peak

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



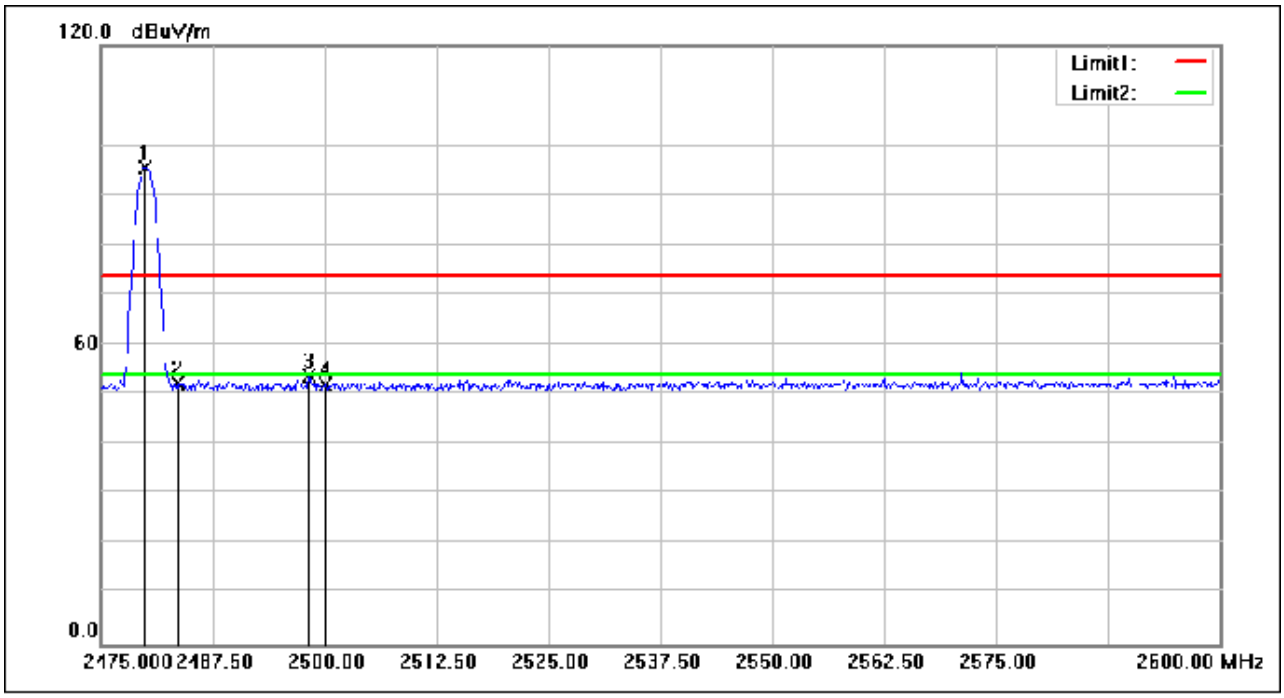
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2352.750	77.18	-24.87	52.31	74.00	-21.69	peak
2	2390.000	75.05	-24.71	50.34	74.00	-23.66	peak
3	2402.150	119.04	-24.65	94.39	74.00	20.39	peak

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



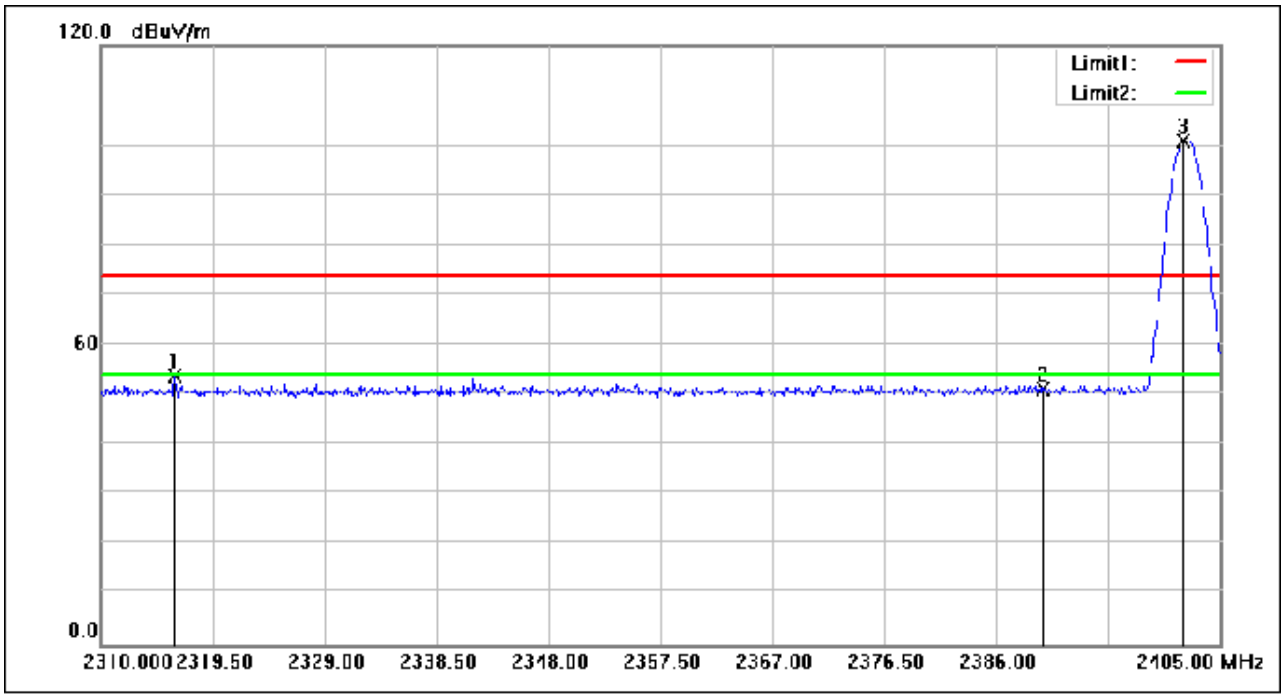
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2479.875	124.64	-24.28	100.36	74.00	26.36	peak
2	2483.500	75.47	-24.27	51.20	74.00	-22.80	peak
3	2487.875	77.16	-24.25	52.91	74.00	-21.09	peak
4	2500.000	75.36	-24.19	51.17	74.00	-22.83	peak

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



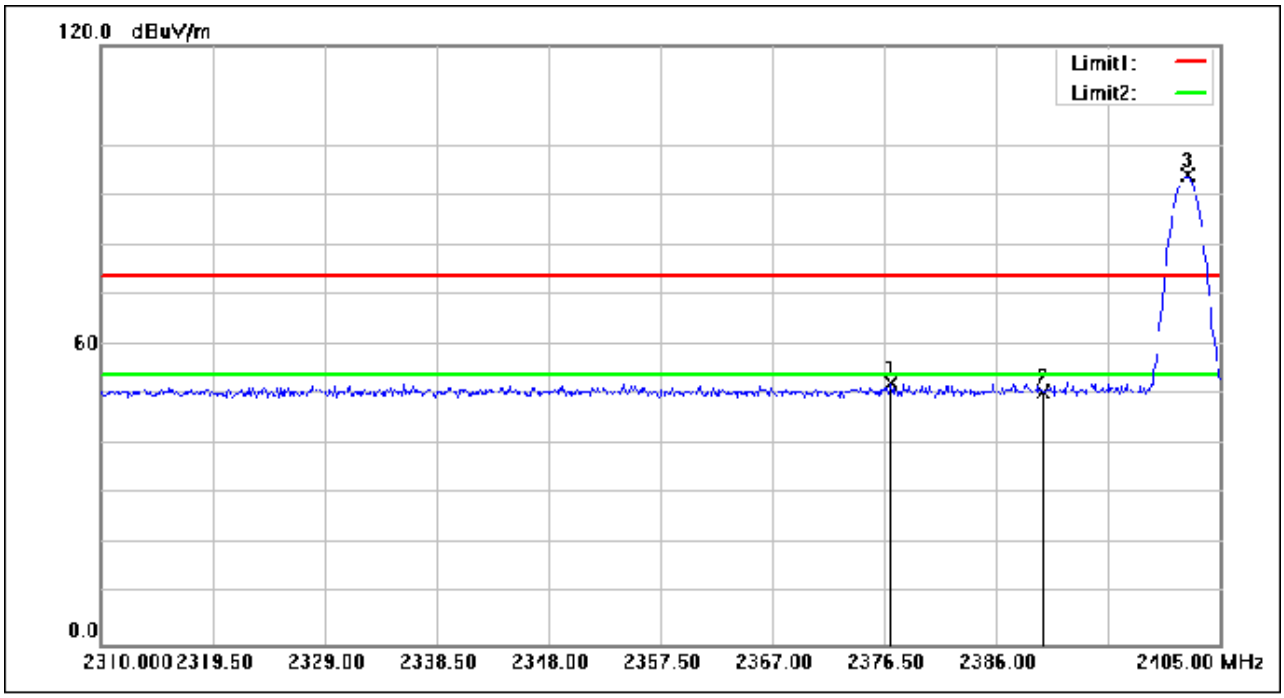
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2479.875	119.74	-24.28	95.46	74.00	21.46	peak
2	2483.500	76.55	-24.27	52.28	74.00	-21.72	peak
3	2498.250	78.06	-24.20	53.86	74.00	-20.14	peak
4	2500.000	76.14	-24.19	51.95	74.00	-22.05	peak

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



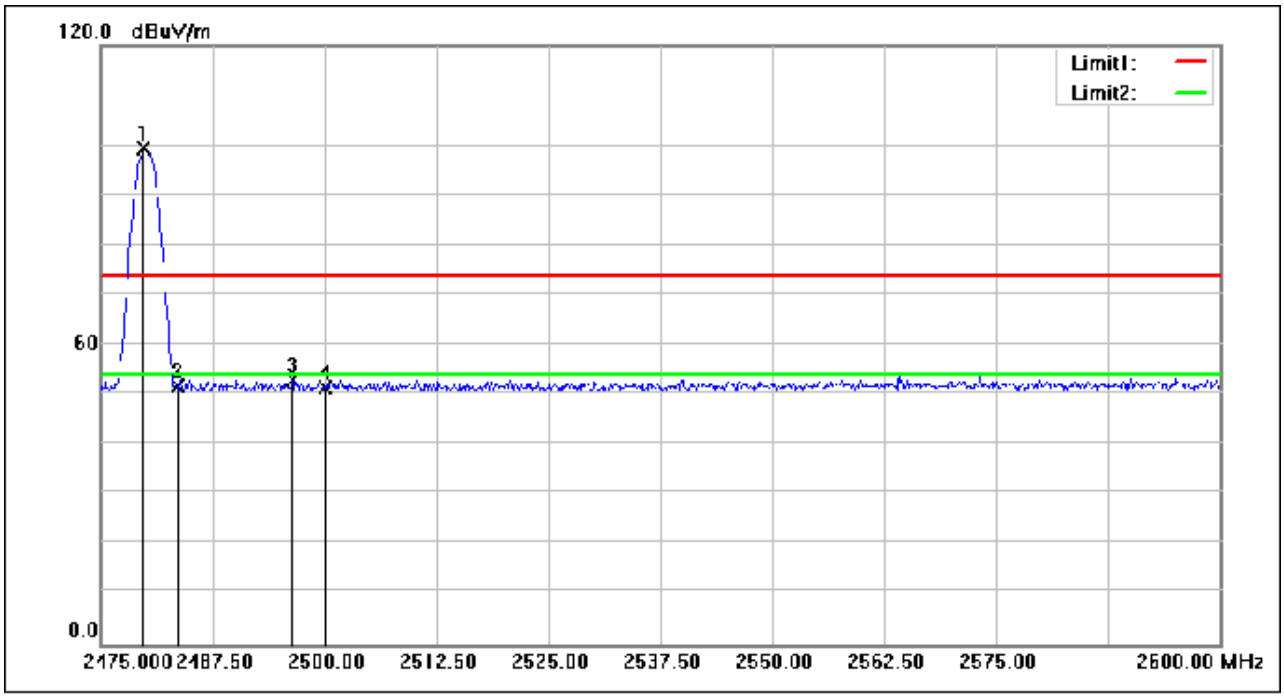
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2316.270	78.92	-25.03	53.89	74.00	-20.11	peak
2	2390.000	75.84	-24.71	51.13	74.00	-22.87	peak
3	2401.865	125.68	-24.65	101.03	74.00	27.03	peak

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



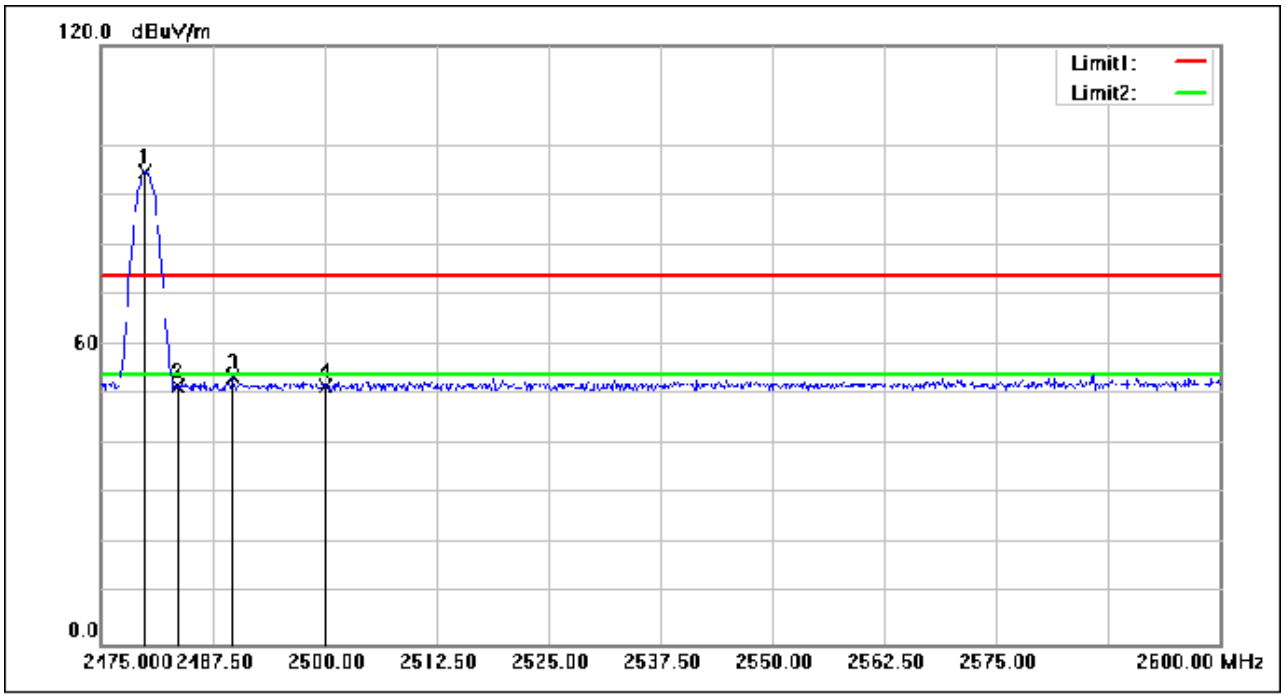
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2377.070	77.09	-24.77	52.32	74.00	-21.68	peak
2	2390.000	75.13	-24.71	50.42	74.00	-23.58	peak
3	2402.245	118.55	-24.65	93.90	74.00	19.90	peak

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



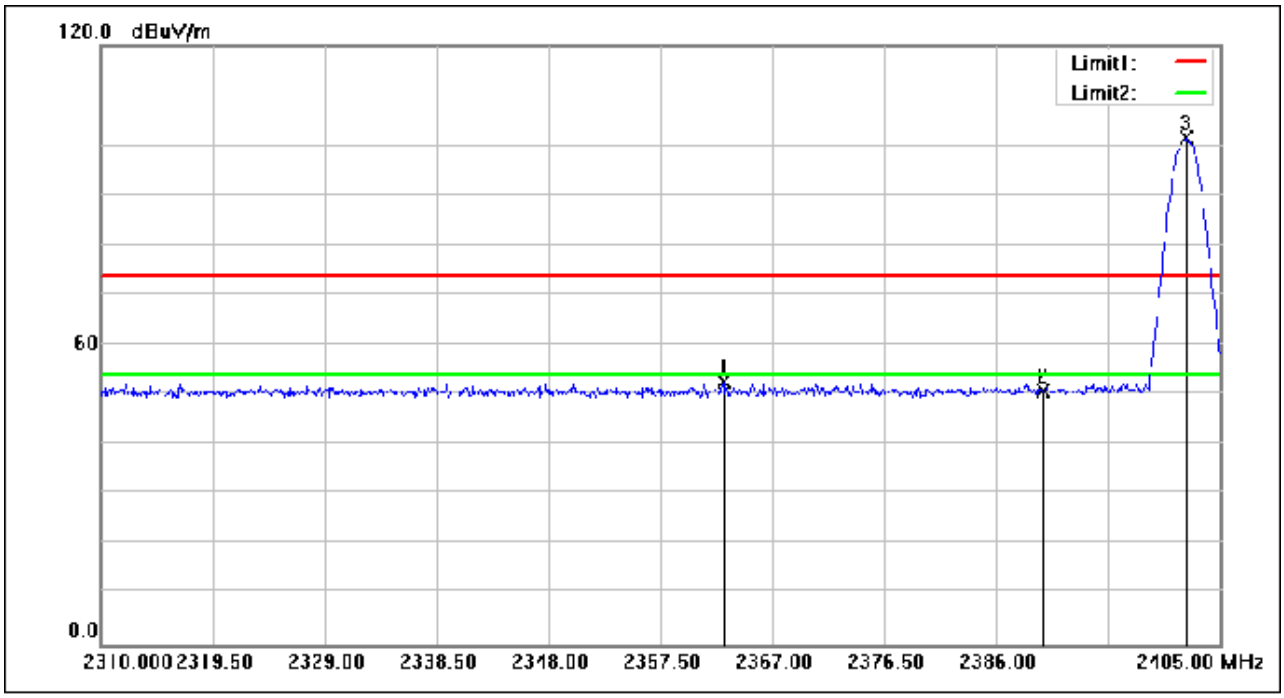
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2479.750	123.81	-24.28	99.53	74.00	25.53	peak
2	2483.500	75.90	-24.27	51.63	74.00	-22.37	peak
3	2496.375	77.24	-24.20	53.04	74.00	-20.96	peak
4	2500.000	75.57	-24.19	51.38	74.00	-22.62	peak

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



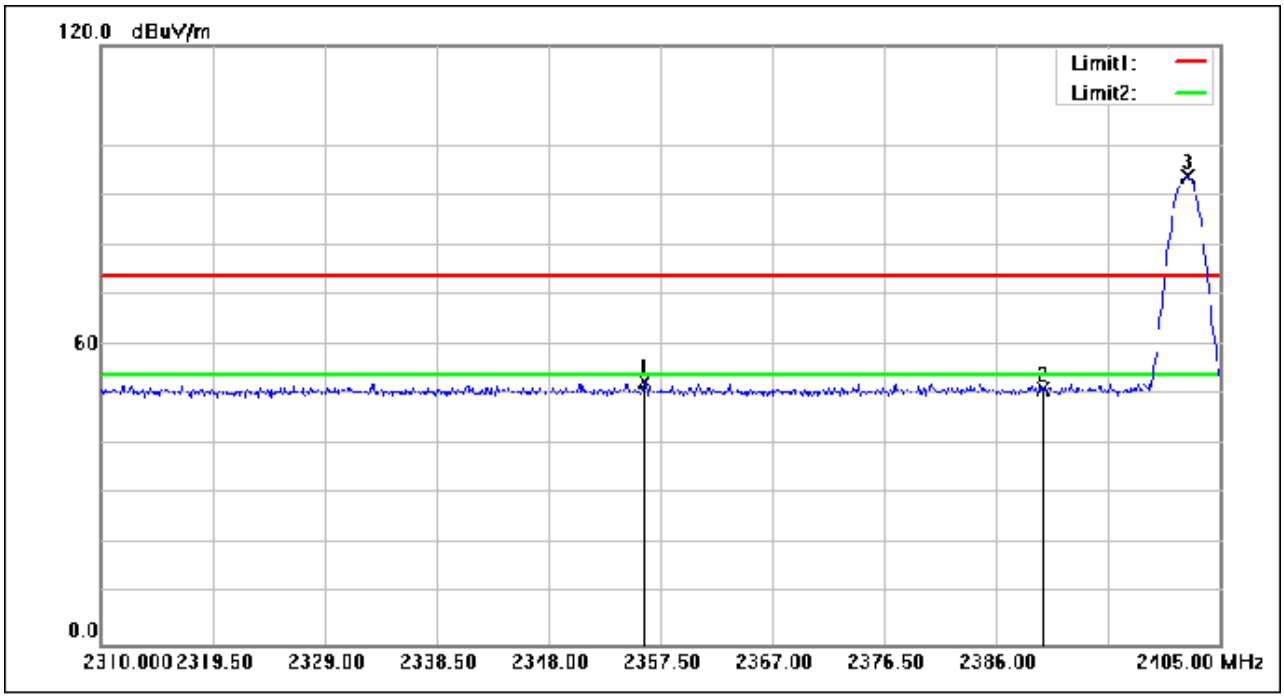
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2479.875	118.96	-24.28	94.68	74.00	20.68	peak
2	2483.500	76.03	-24.27	51.76	74.00	-22.24	peak
3	2489.750	77.72	-24.24	53.48	74.00	-20.52	peak
4	2500.000	75.90	-24.19	51.71	74.00	-22.29	peak

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



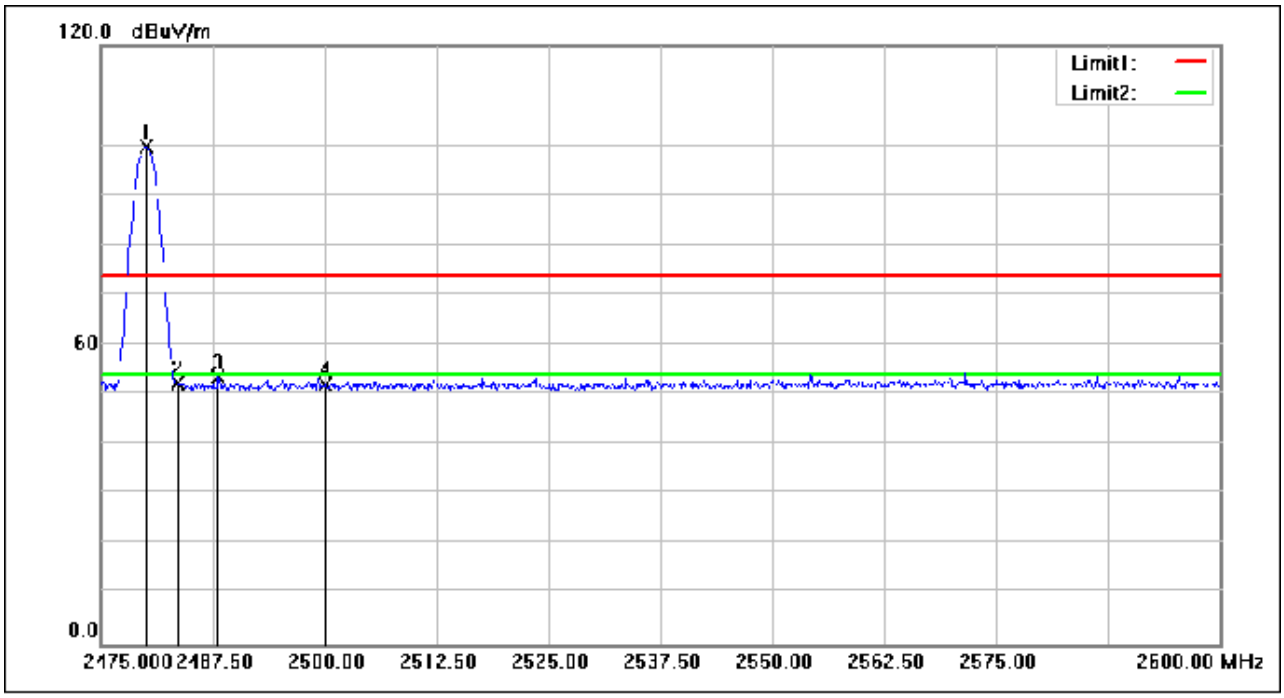
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2362.820	77.43	-24.84	52.59	74.00	-21.41	peak
2	2390.000	75.67	-24.71	50.96	74.00	-23.04	peak
3	2402.150	126.06	-24.65	101.41	74.00	27.41	peak

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



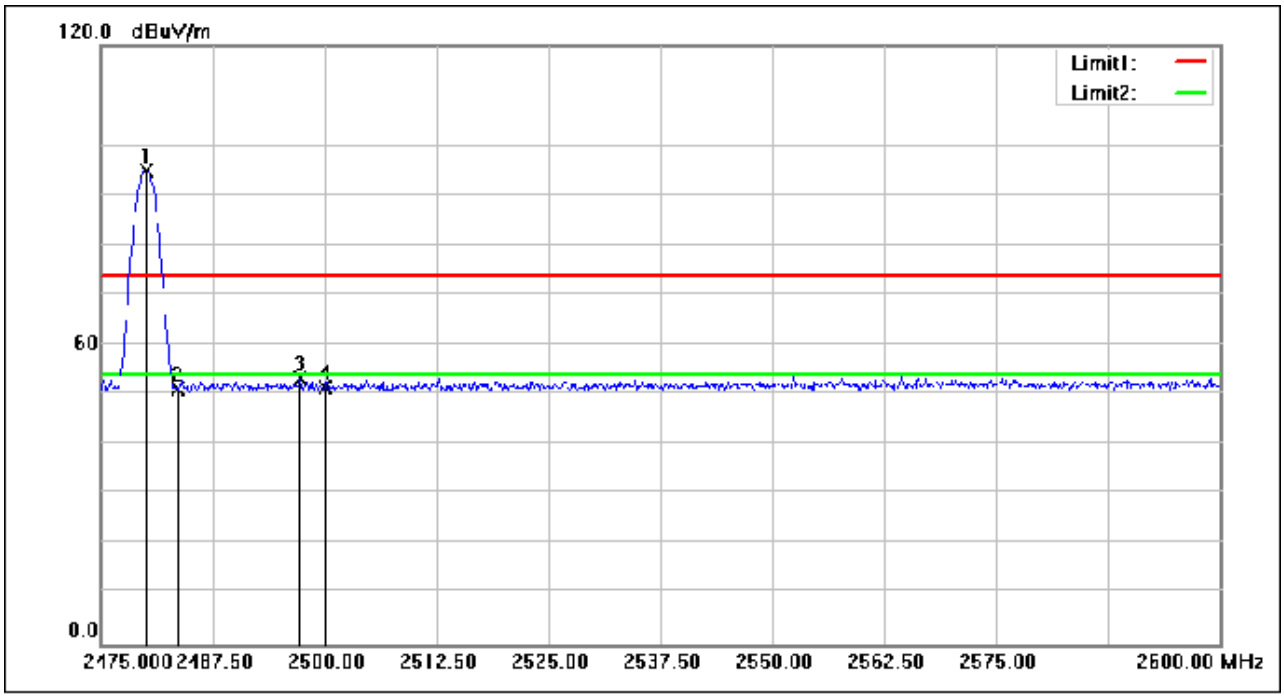
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2356.170	77.52	-24.86	52.66	74.00	-21.34	peak
2	2390.000	75.90	-24.71	51.19	74.00	-22.81	peak
3	2402.245	118.49	-24.65	93.84	74.00	19.84	peak

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



No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2480.000	123.99	-24.28	99.71	74.00	25.71	peak
2	2483.500	76.51	-24.27	52.24	74.00	-21.76	peak
3	2488.125	77.73	-24.25	53.48	74.00	-20.52	peak
4	2500.000	76.35	-24.19	52.16	74.00	-21.84	peak

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



No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2480.000	119.21	-24.28	94.93	74.00	20.93	peak
2	2483.500	75.51	-24.27	51.24	74.00	-22.76	peak
3	2497.250	77.55	-24.20	53.35	74.00	-20.65	peak
4	2500.000	75.65	-24.19	51.46	74.00	-22.54	peak

7.3 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
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
960-1000	500	3

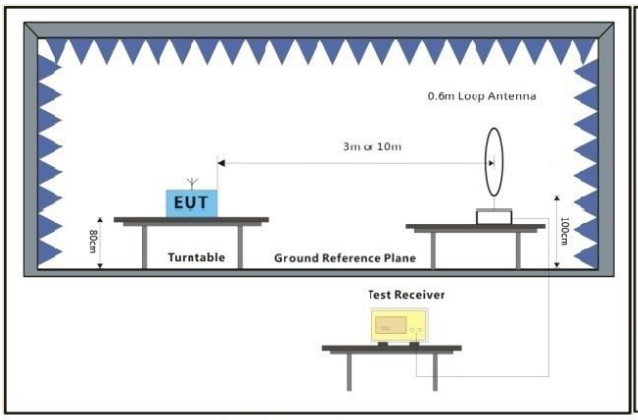
7.3.1 E.U.T. Operation

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

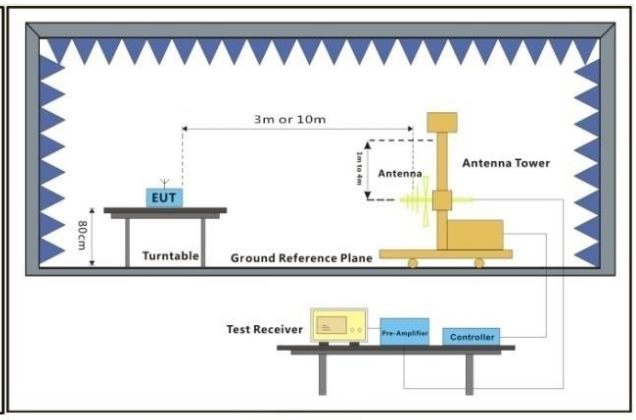
7.3.2 Test Mode Description

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



Below 30MHz



30MHz-1GHz

7.3.4 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.

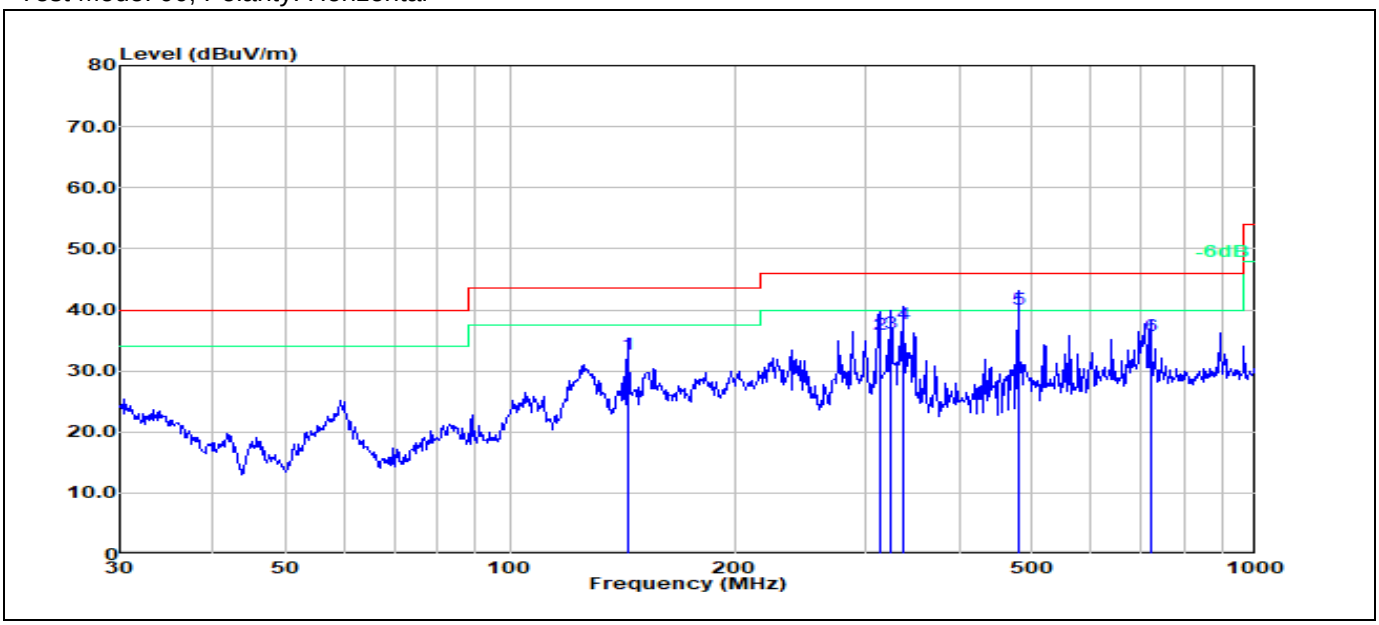
i. Repeat above procedures until all frequencies measured was complete.

Remark:

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

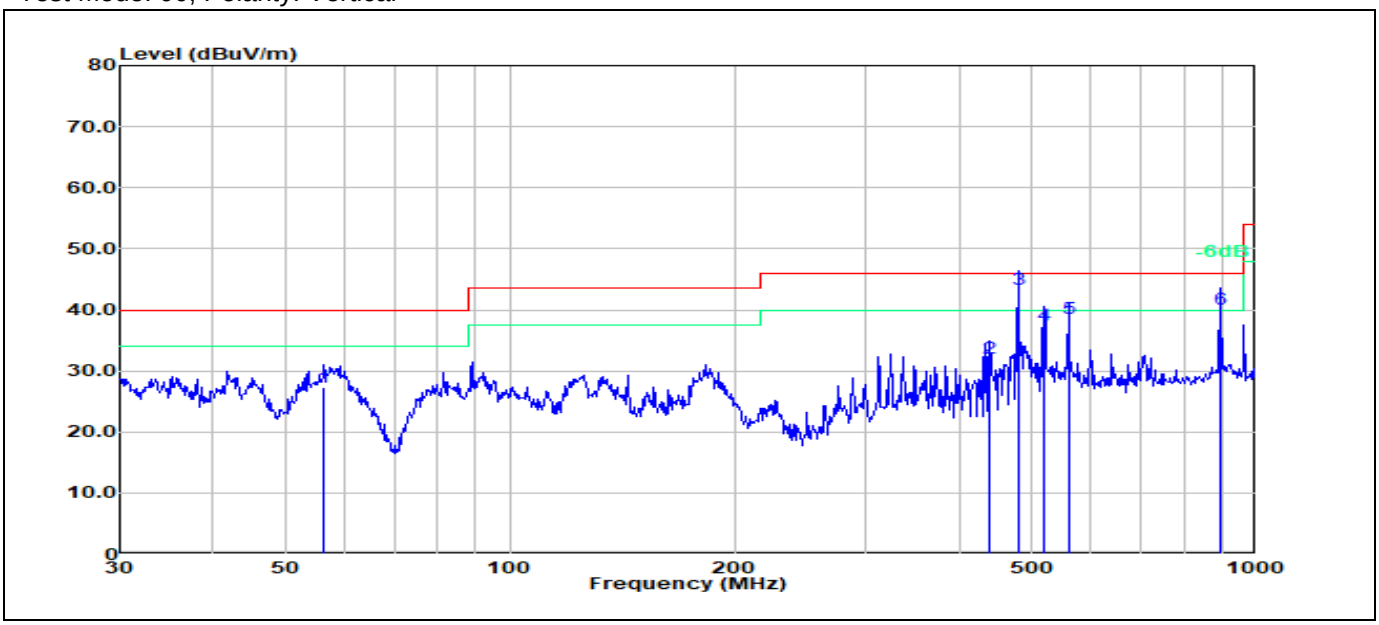
2. Scan from 9kHz to 30MHz, the disturbance below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

Test Mode: 00; Polarity: Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Height	Degree	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(deg.)	
1	143.8295	19.29	13.55	32.84	43.50	-10.66	100	104	QP
2	313.2760	20.07	15.98	36.05	46.00	-9.95	100	223	QP
3	324.4561	19.93	16.21	36.14	46.00	-9.86	100	37	QP
4	336.0352	21.41	16.22	37.63	46.00	-8.37	200	58	QP
5	480.5276	19.88	20.18	40.06	46.00	-5.94	100	230	QP
6	721.7259	11.68	24.16	35.84	46.00	-10.16	100	356	QP

Test Mode: 00; Polarity: Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Height	Degree	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(deg.)	
1	56.3949	20.97	6.44	27.41	40.00	-12.59	100	147	QP
2	438.6554	13.03	19.16	32.19	46.00	-13.81	100	80	QP
3	480.5280	23.12	20.18	43.30	46.00	-2.70	100	290	QP
4	519.0650	16.05	21.47	37.52	46.00	-8.48	200	290	QP
5	560.6930	16.21	22.40	38.61	46.00	-7.39	100	296	QP
6	893.8567	14.51	25.67	40.18	46.00	-5.82	100	296	QP

7.4 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
Measurement Distance: 3M

Limit:

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

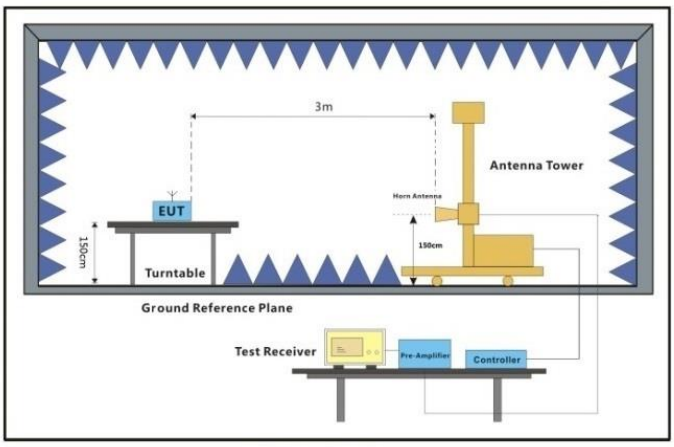
7.4.1 E.U.T. Operation

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

7.4.2 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.

7.4.3 Test Setup Diagram



Above 1GHz

7.4.4 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.

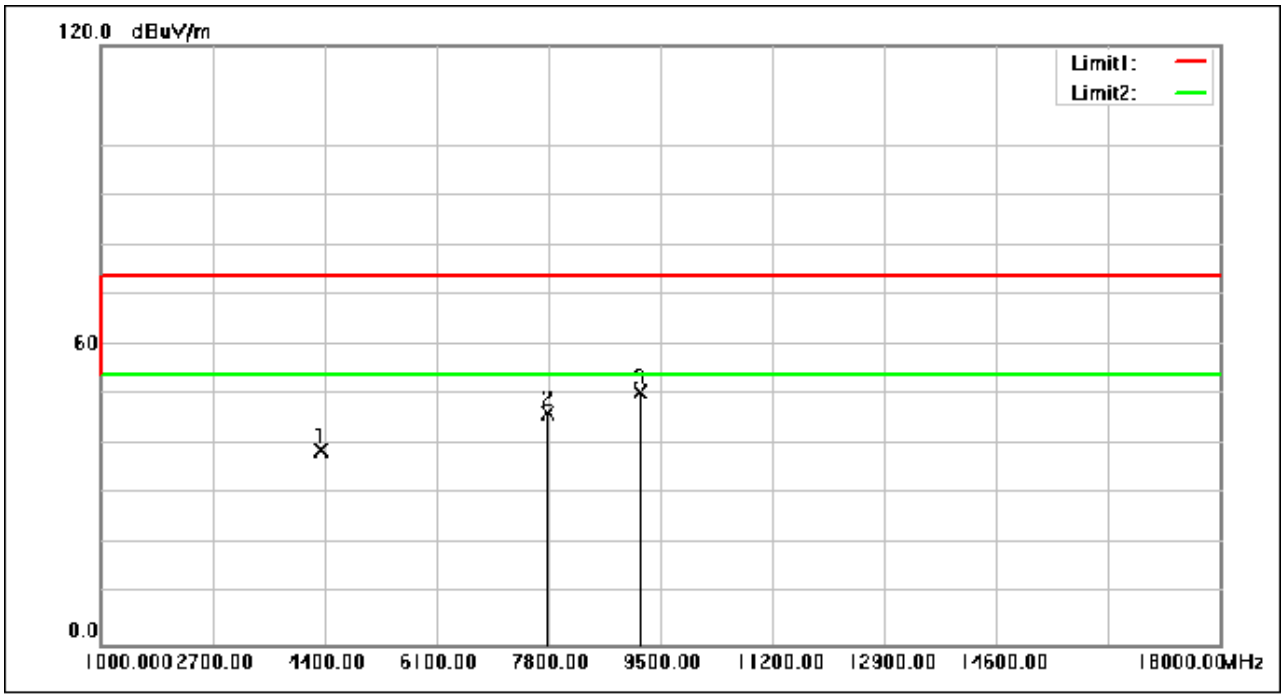
Remark:

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.

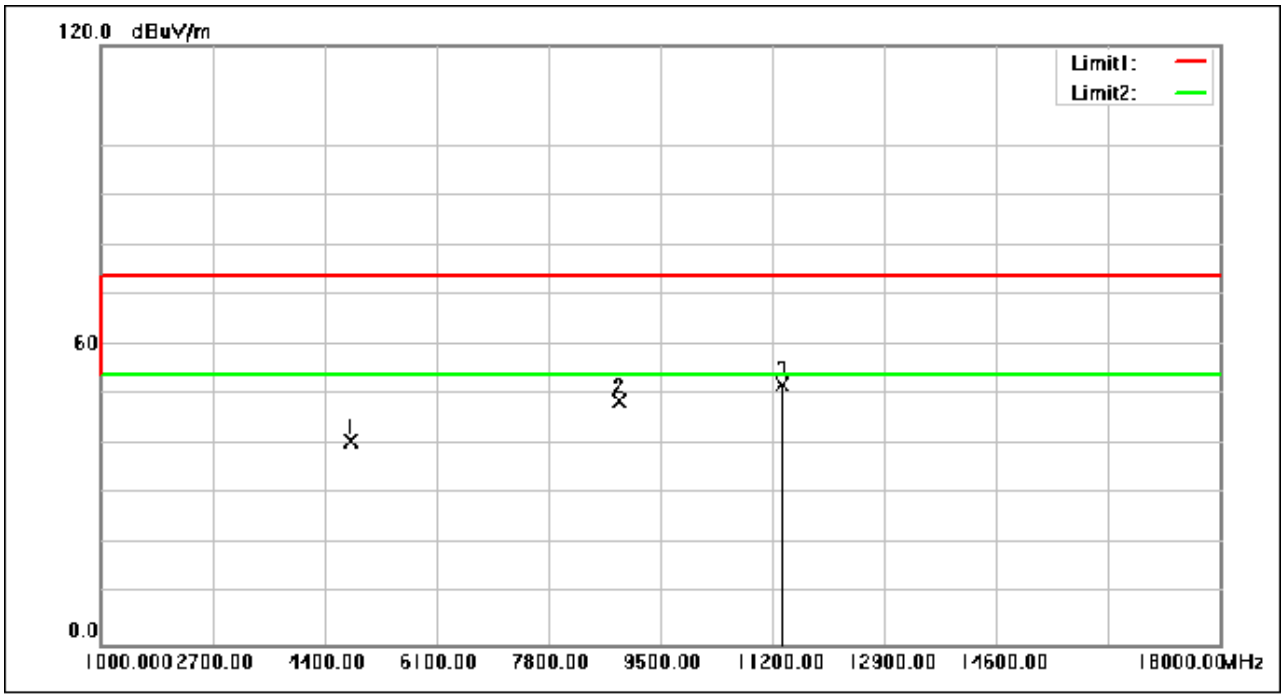
3. As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

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



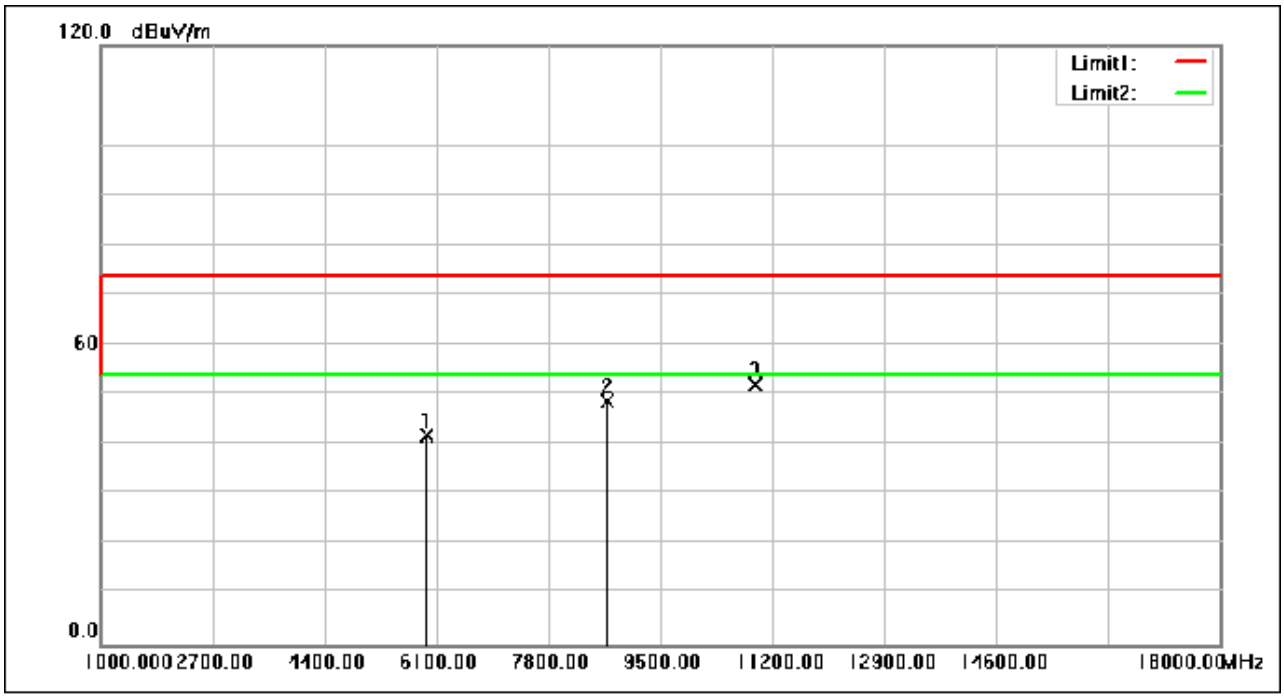
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4359.200	58.37	-19.38	38.99	74.00	-35.01	peak
2	7799.320	57.35	-10.87	46.48	74.00	-27.52	peak
3	9210.320	58.99	-8.50	50.49	74.00	-23.51	peak

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



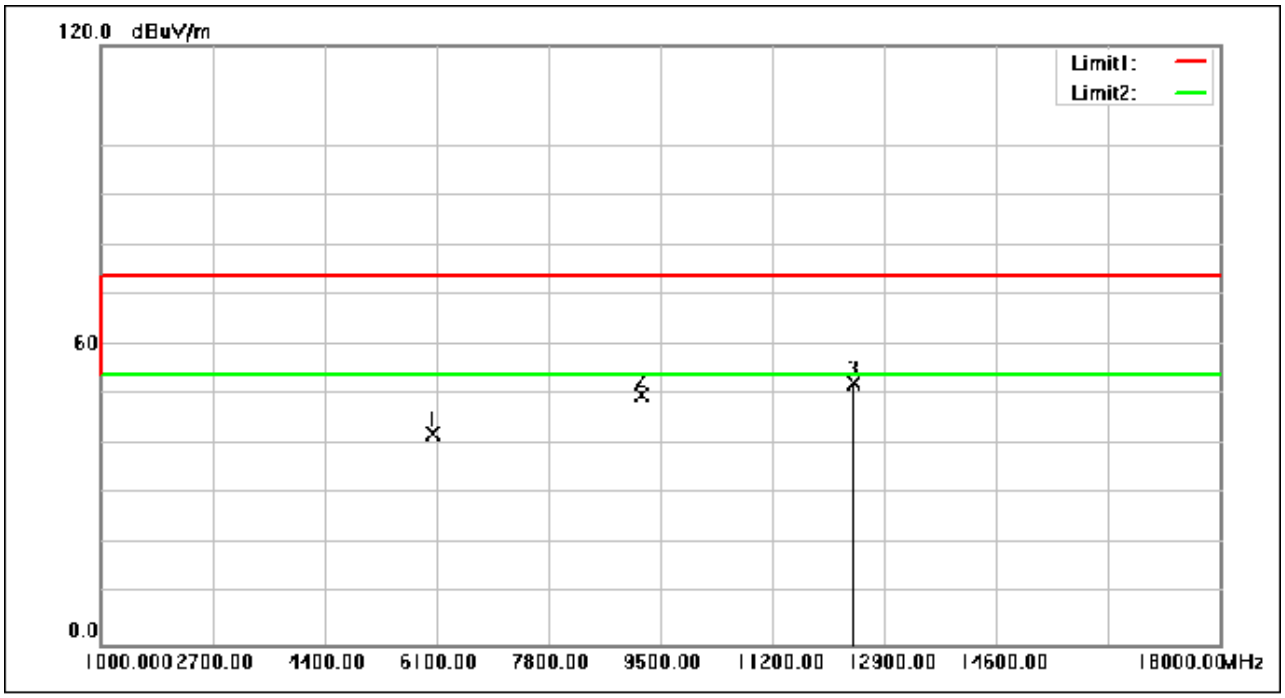
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4798.480	59.15	-18.57	40.58	74.00	-33.42	peak
2	8880.520	58.02	-9.13	48.89	74.00	-25.11	peak
3	11357.760	58.54	-6.47	52.07	74.00	-21.93	peak

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



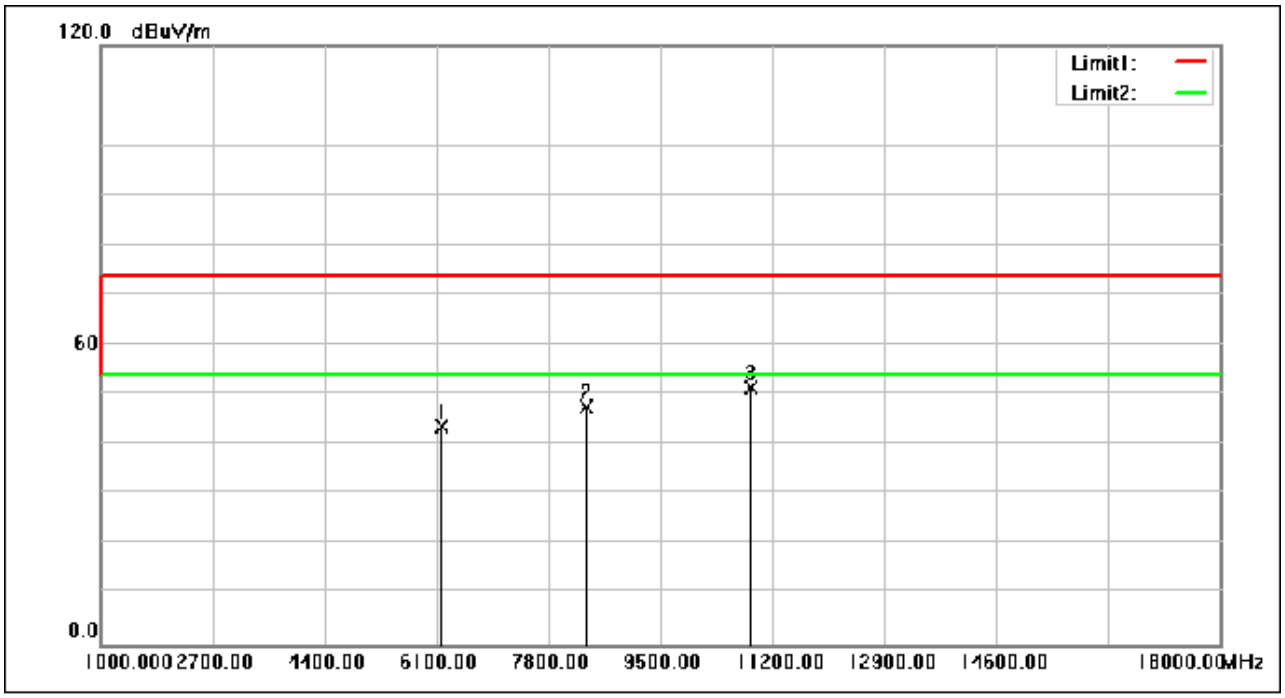
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	5954.480	57.95	-15.97	41.98	74.00	-32.02	peak
2	8712.560	58.31	-9.41	48.90	74.00	-25.10	peak
3	10938.880	58.89	-6.79	52.10	74.00	-21.90	peak

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



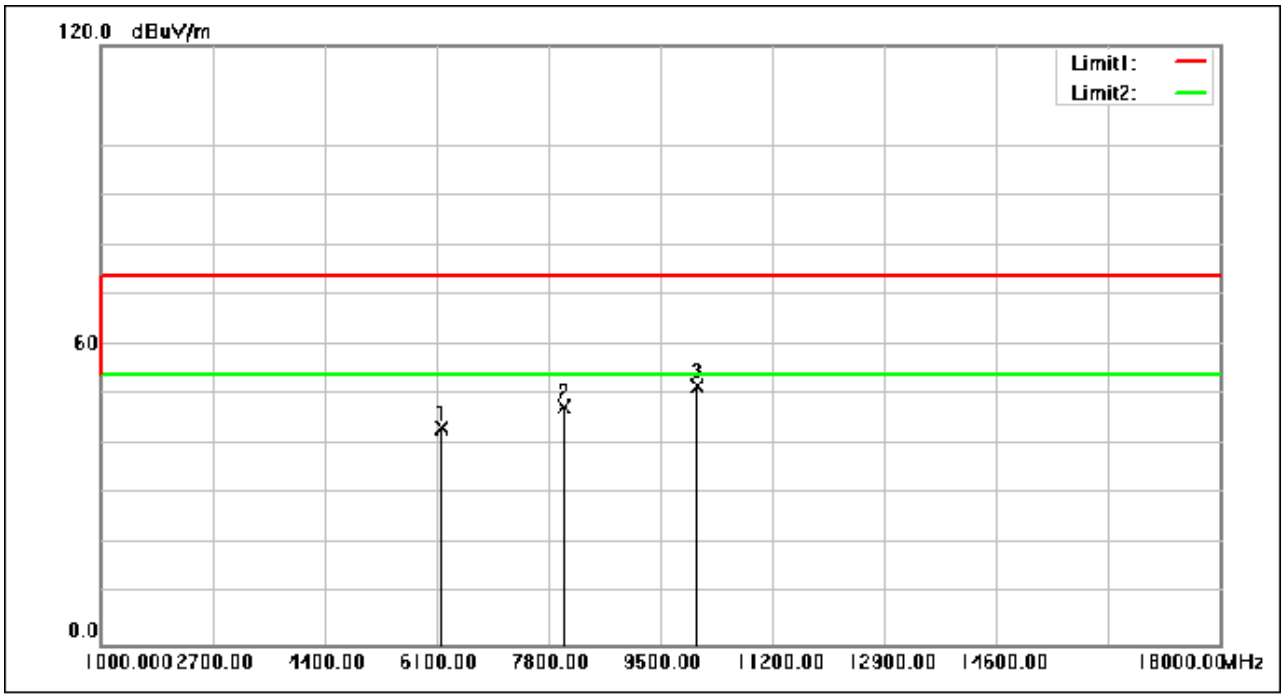
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	6044.920	57.85	-15.57	42.28	74.00	-31.72	peak
2	9215.080	58.36	-8.49	49.87	74.00	-24.13	peak
3	12430.120	58.38	-6.08	52.30	74.00	-21.70	peak

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



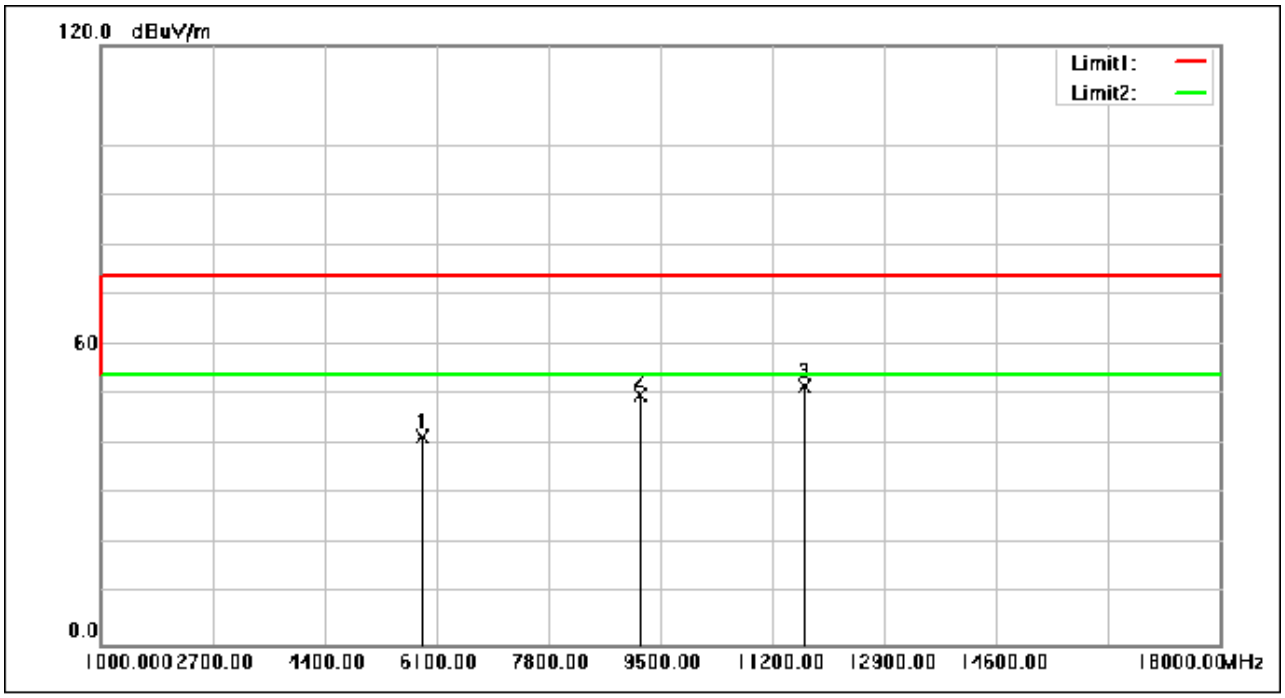
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	6183.640	58.41	-14.88	43.53	74.00	-30.47	peak
2	8387.520	57.48	-9.94	47.54	74.00	-26.46	peak
3	10864.080	58.33	-6.84	51.49	74.00	-22.51	peak

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



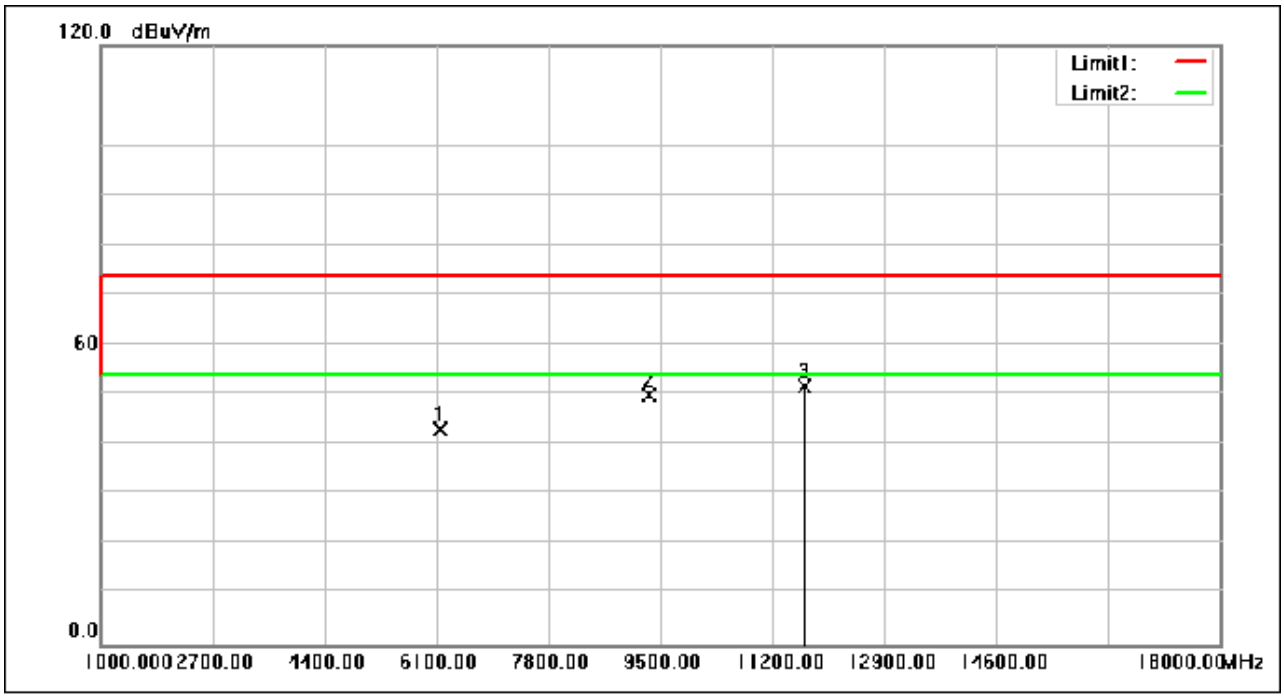
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	6179.560	58.19	-14.89	43.30	74.00	-30.70	peak
2	8053.640	57.92	-10.50	47.42	74.00	-26.58	peak
3	10056.920	58.94	-7.30	51.64	74.00	-22.36	peak

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



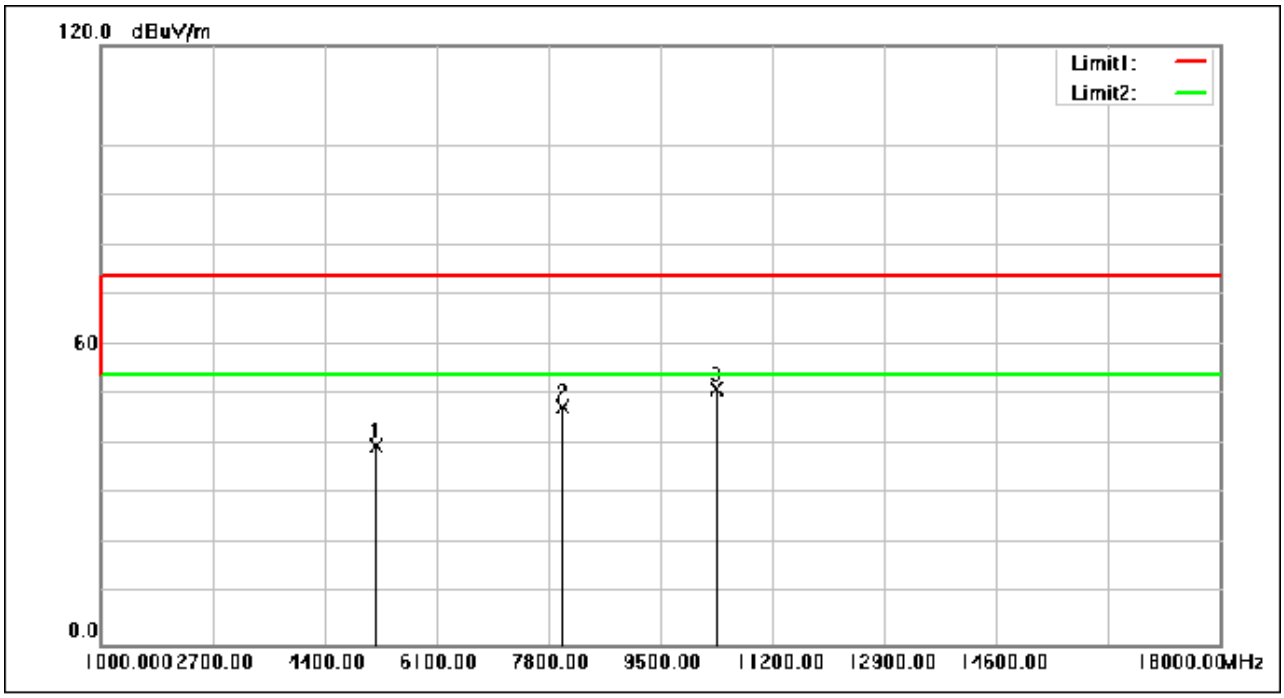
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	5888.520	57.87	-16.25	41.62	74.00	-32.38	peak
2	9208.960	58.50	-8.50	50.00	74.00	-24.00	peak
3	11686.200	57.96	-6.21	51.75	74.00	-22.25	peak

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



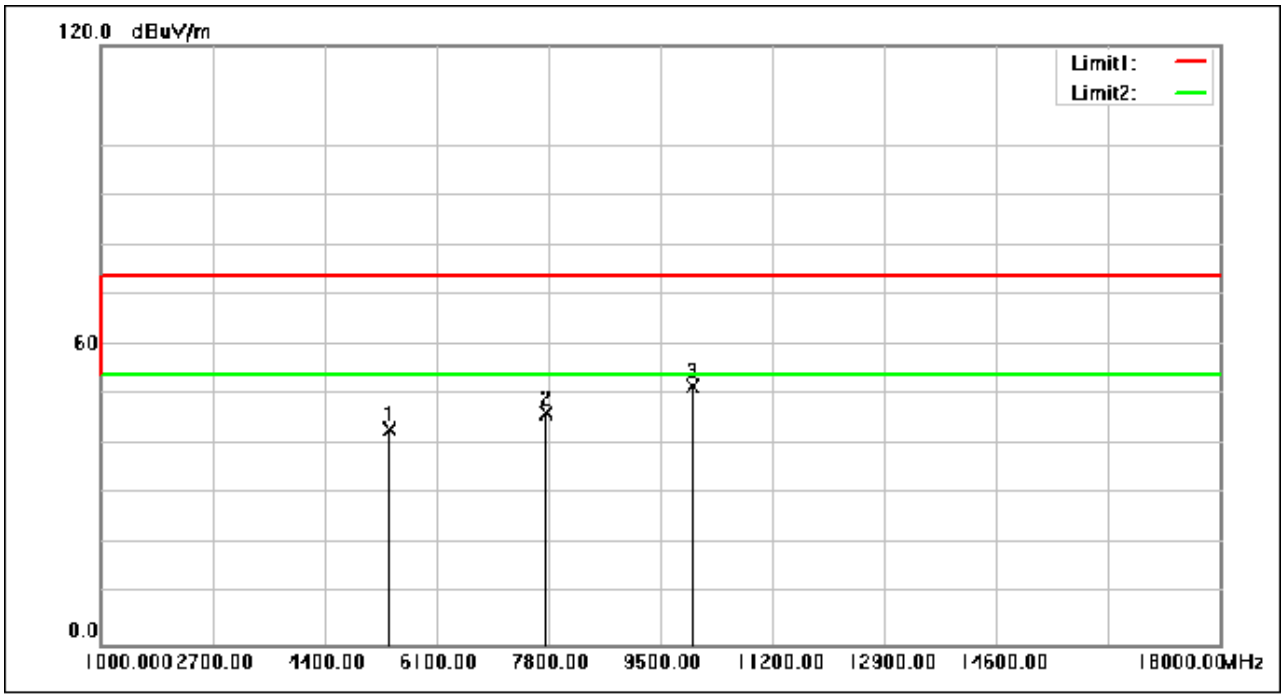
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	6157.120	58.09	-15.02	43.07	74.00	-30.93	peak
2	9343.600	58.26	-8.25	50.01	74.00	-23.99	peak
3	11706.600	57.83	-6.19	51.64	74.00	-22.36	peak

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



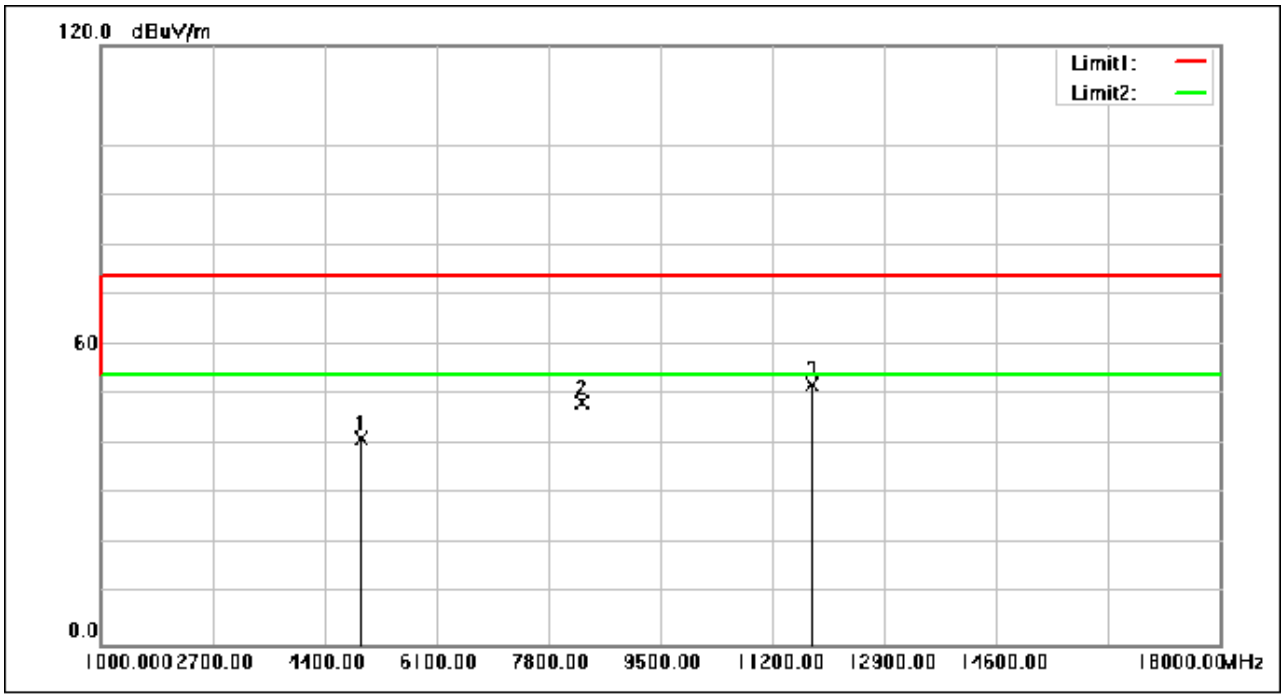
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	5191.520	57.98	-18.15	39.83	74.00	-34.17	peak
2	8029.160	58.15	-10.55	47.60	74.00	-26.40	peak
3	10354.760	58.35	-7.12	51.23	74.00	-22.77	peak

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



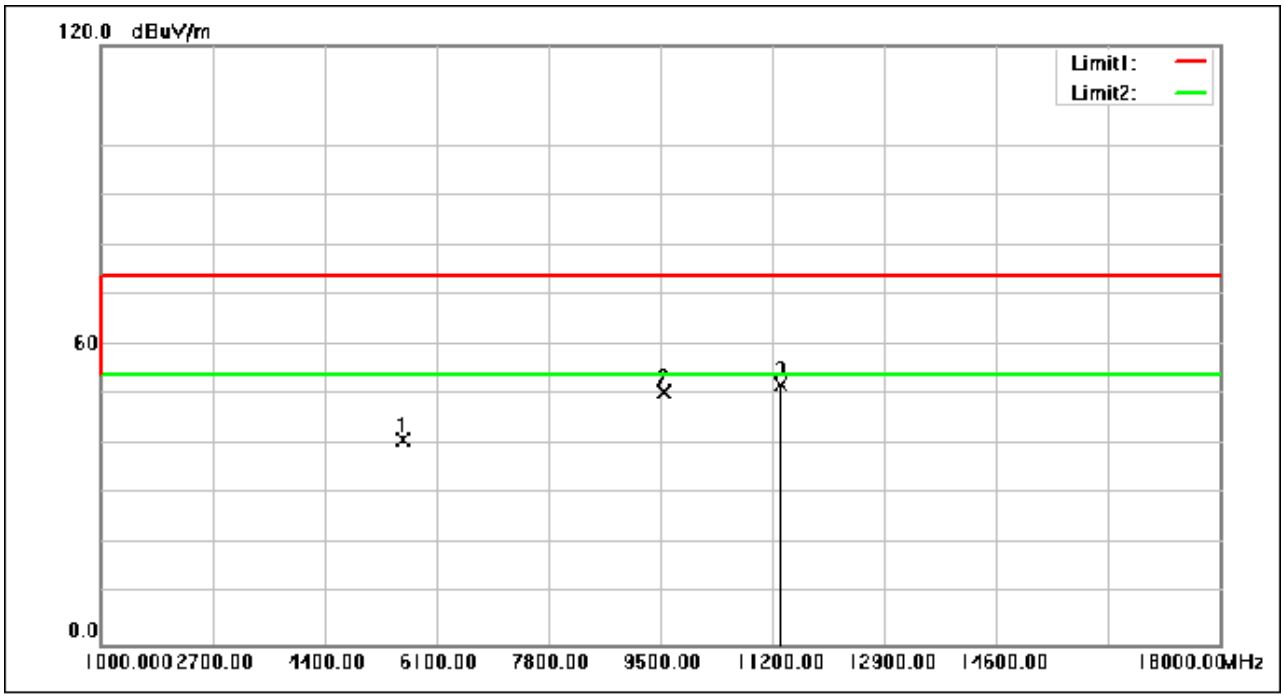
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	5395.520	60.90	-17.85	43.05	74.00	-30.95	peak
2	7770.080	57.20	-10.90	46.30	74.00	-27.70	peak
3	10007.960	59.12	-7.32	51.80	74.00	-22.20	peak

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



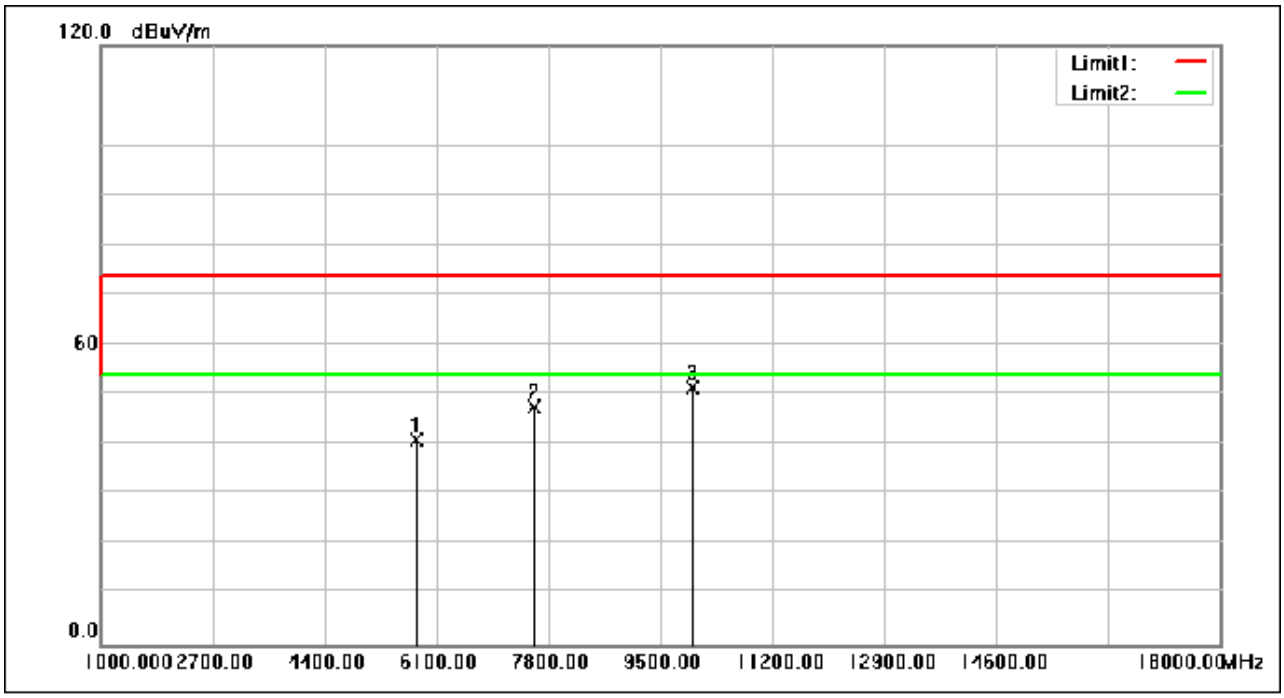
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4972.560	59.59	-18.46	41.13	74.00	-32.87	peak
2	8313.400	58.52	-10.07	48.45	74.00	-25.55	peak
3	11799.760	58.03	-6.12	51.91	74.00	-22.09	peak

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



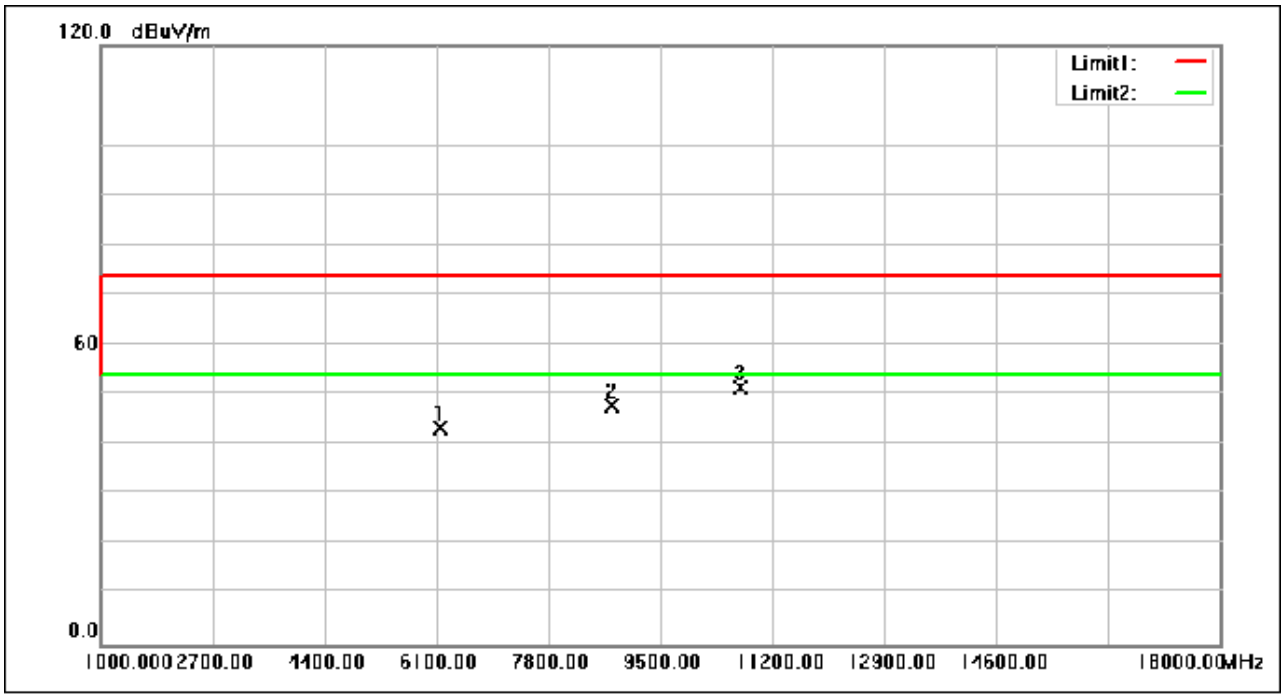
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	5593.400	58.36	-17.46	40.90	74.00	-33.10	peak
2	9555.080	58.43	-7.85	50.58	74.00	-23.42	peak
3	11323.760	58.63	-6.50	52.13	74.00	-21.87	peak

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



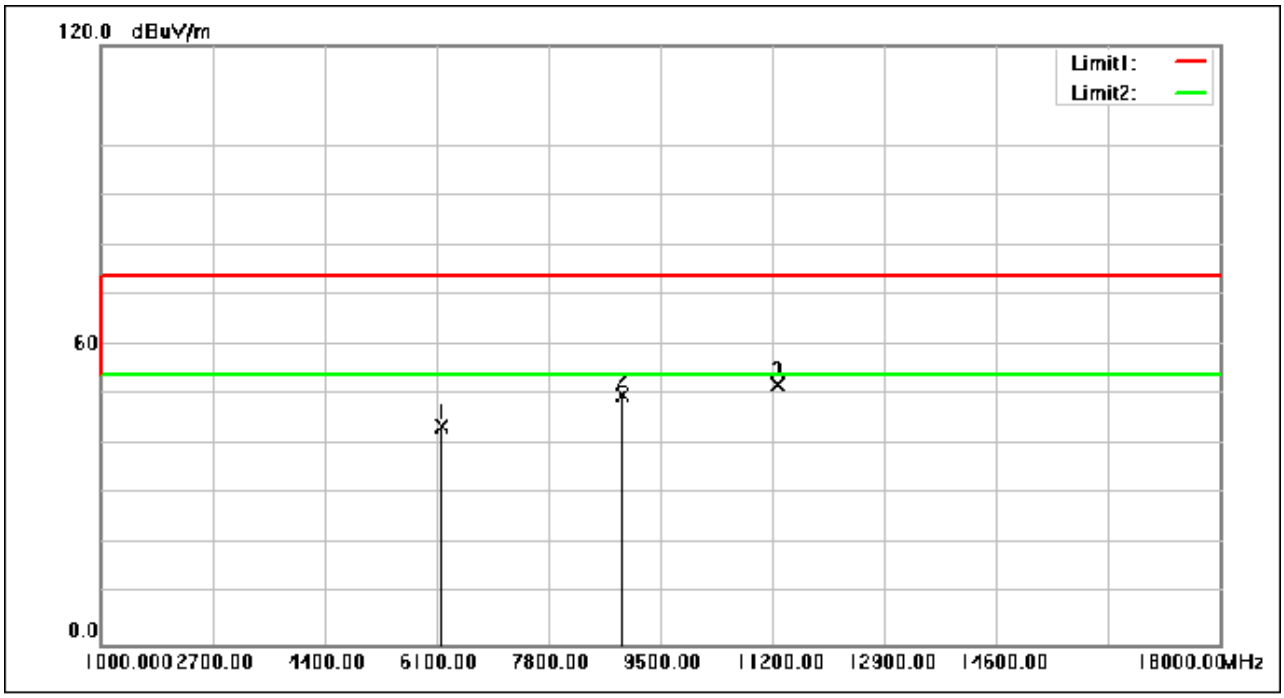
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	5802.840	57.63	-16.60	41.03	74.00	-32.97	peak
2	7579.000	58.81	-11.16	47.65	74.00	-26.35	peak
3	10002.520	58.84	-7.33	51.51	74.00	-22.49	peak

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



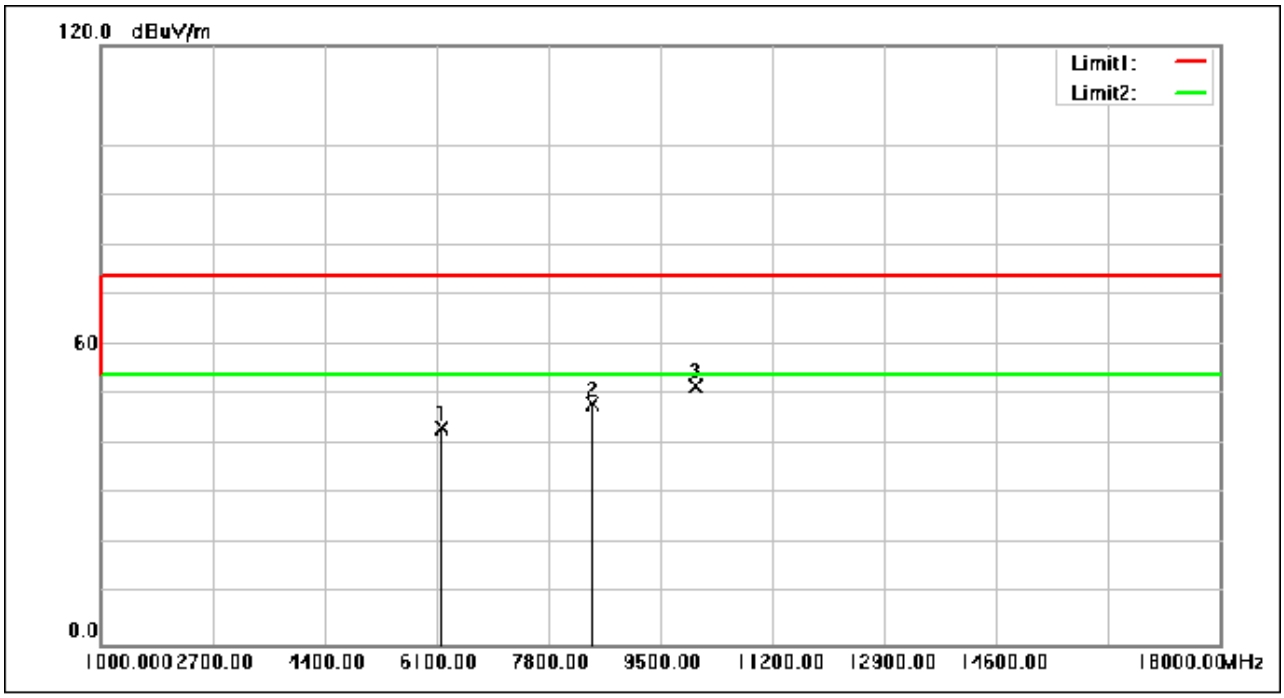
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	6159.840	58.35	-15.00	43.35	74.00	-30.65	peak
2	8766.960	57.22	-9.31	47.91	74.00	-26.09	peak
3	10717.200	58.30	-6.92	51.38	74.00	-22.62	peak

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



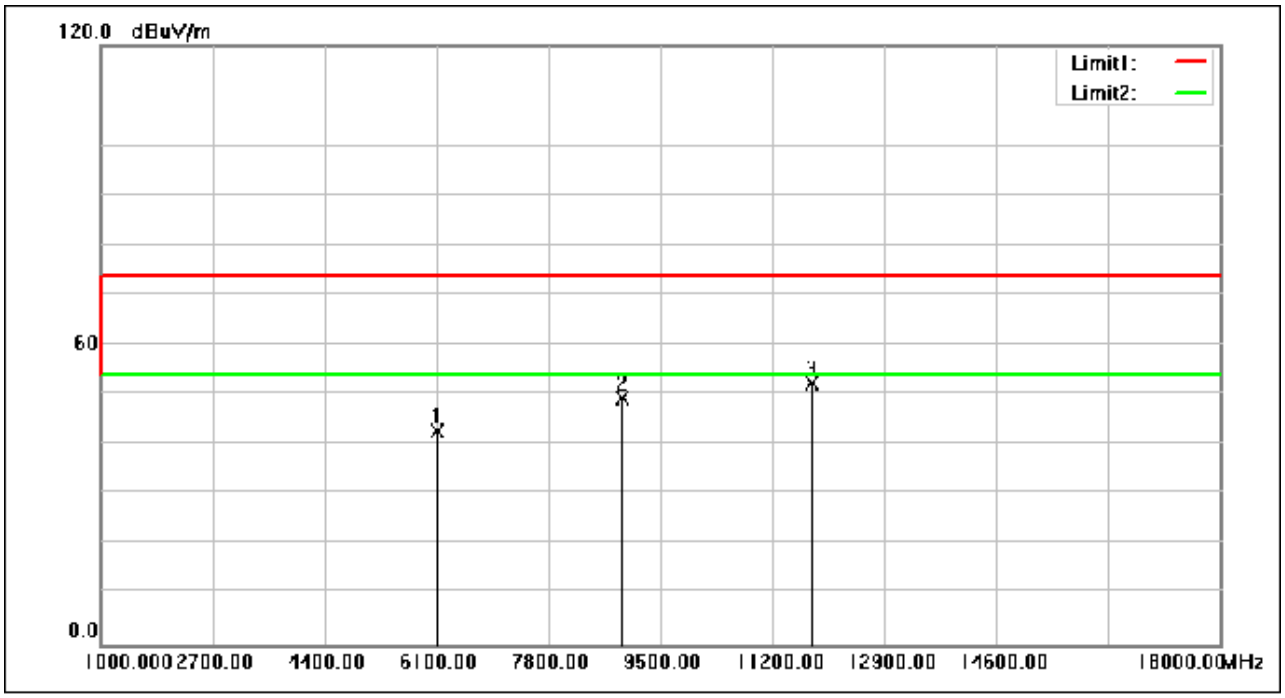
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	6174.120	58.58	-14.93	43.65	74.00	-30.35	peak
2	8925.400	58.96	-9.05	49.91	74.00	-24.09	peak
3	11271.400	58.52	-6.54	51.98	74.00	-22.02	peak

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



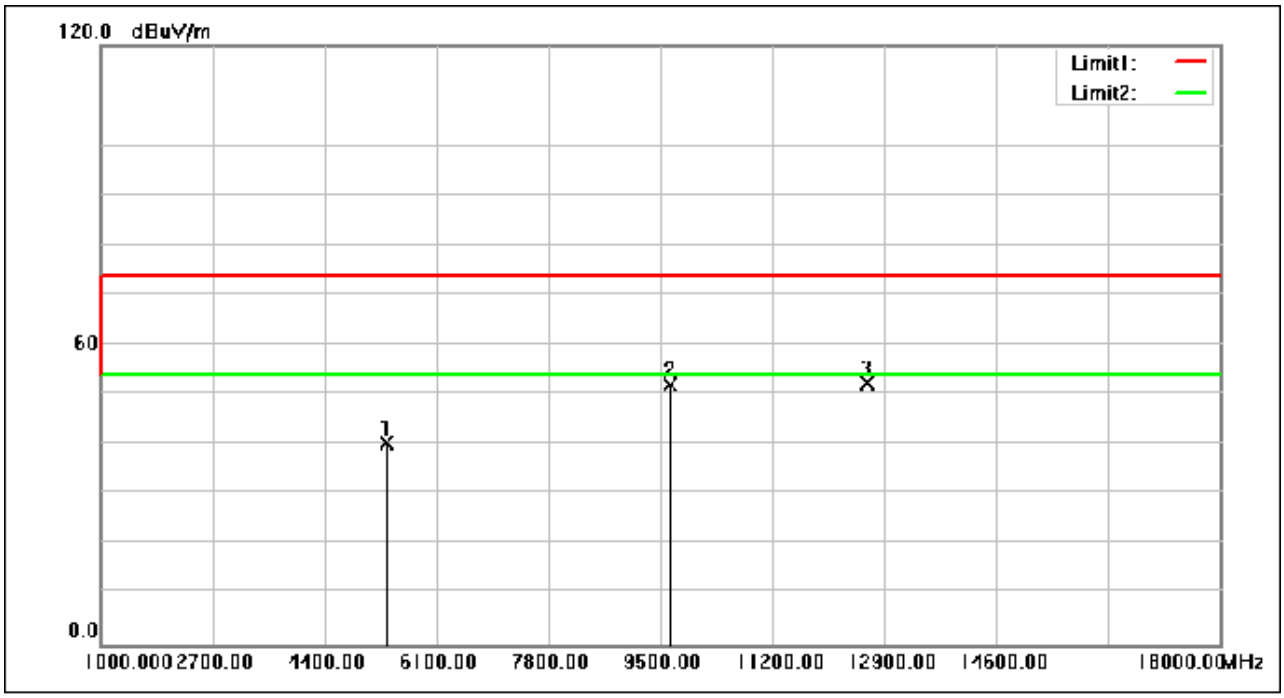
No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	6177.520	58.29	-14.90	43.39	74.00	-30.61	peak
2	8464.360	58.10	-9.81	48.29	74.00	-25.71	peak
3	10030.400	59.11	-7.31	51.80	74.00	-22.20	peak

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



No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	6132.640	57.87	-15.14	42.73	74.00	-31.27	peak
2	8928.120	58.33	-9.04	49.29	74.00	-24.71	peak
3	11798.400	58.55	-6.12	52.43	74.00	-21.57	peak

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



No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	5346.560	58.16	-17.93	40.23	74.00	-33.77	peak
2	9646.200	59.78	-7.67	52.11	74.00	-21.89	peak
3	12661.320	58.47	-6.19	52.28	74.00	-21.72	peak

7.5 Conducted Average 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

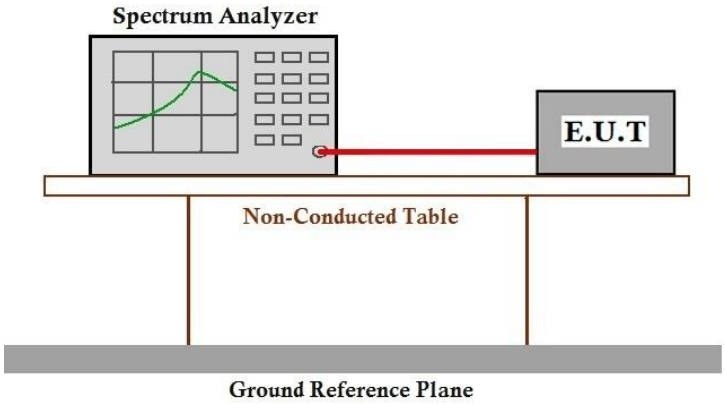
7.5.1 E.U.T. Operation

Operating Environment:
Temperature: 25.4 °C Humidity: 44.1 % RH Atmospheric Pressure: 1010 mbar

7.5.2 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.

7.5.3 Test Setup Diagram



7.5.4 Measurement Procedure and Data

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

Please Refer to Appendix for Details

7.6 20dB Bandwidth

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

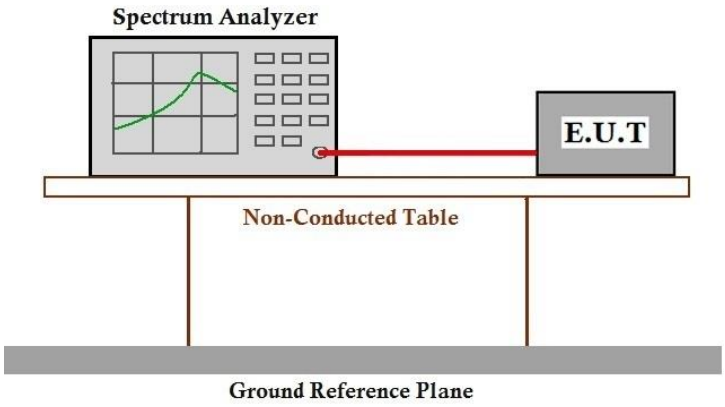
7.6.1 E.U.T. Operation

Operating Environment:
Temperature: 25.4 °C Humidity: 44.1 % RH Atmospheric Pressure: 1010 mbar

7.6.2 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.

7.6.3 Test Setup Diagram



7.6.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.7 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.

7.7.1 E.U.T. Operation

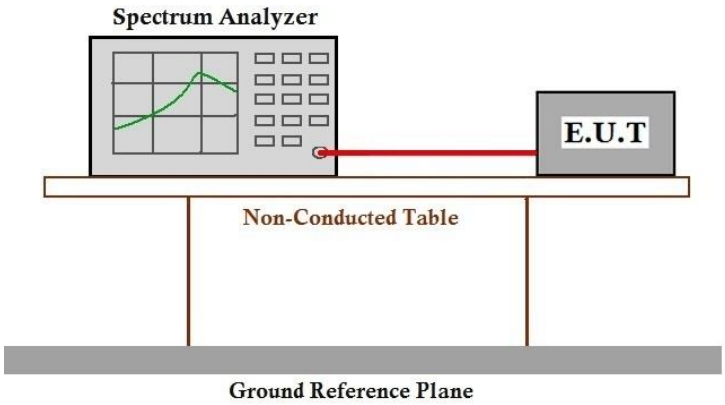
Operating Environment:

Temperature: 25.4 °C Humidity: 44.1 % RH Atmospheric Pressure: 1010 mbar

7.7.2 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.

7.7.3 Test Setup Diagram



7.7.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.8 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

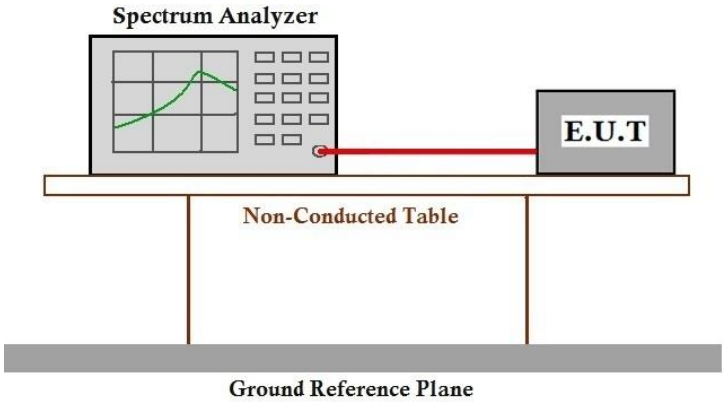
7.8.1 E.U.T. Operation

Operating Environment:
Temperature: 25.4 °C Humidity: 44.1 % RH Atmospheric Pressure: 1010 mbar

7.8.2 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.

7.8.3 Test Setup Diagram



7.8.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.9 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

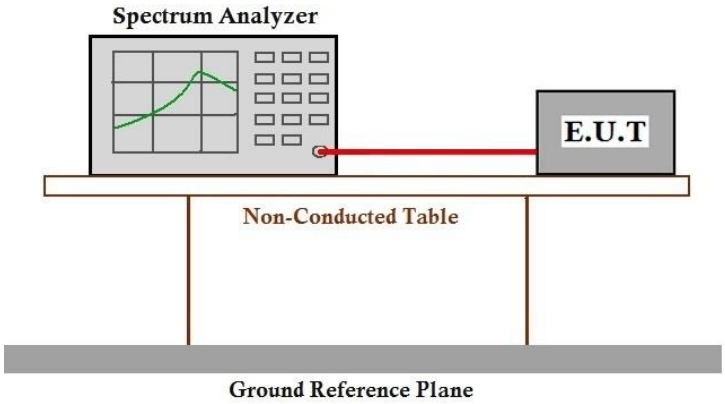
7.9.1 E.U.T. Operation

Operating Environment:
Temperature: 25.4 °C Humidity: 44.1 % RH Atmospheric Pressure: 1010 mbar

7.9.2 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.

7.9.3 Test Setup Diagram



7.9.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.10 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).

7.10.1 E.U.T. Operation

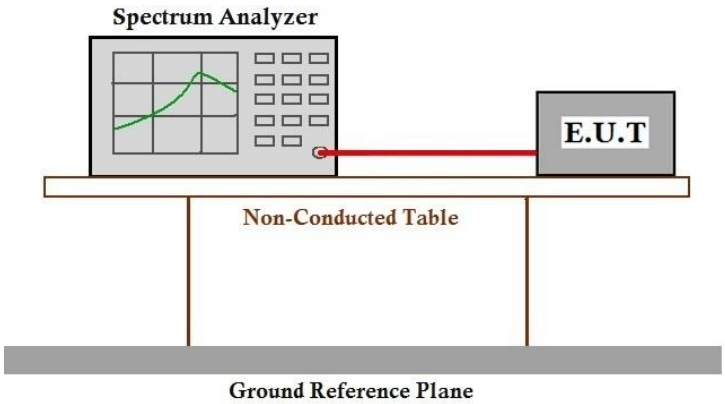
Operating Environment:

Temperature: 25.4 °C Humidity: 44.1 % 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.
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.

7.10.3 Test Setup Diagram



7.10.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.11 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).

7.11.1 E.U.T. Operation

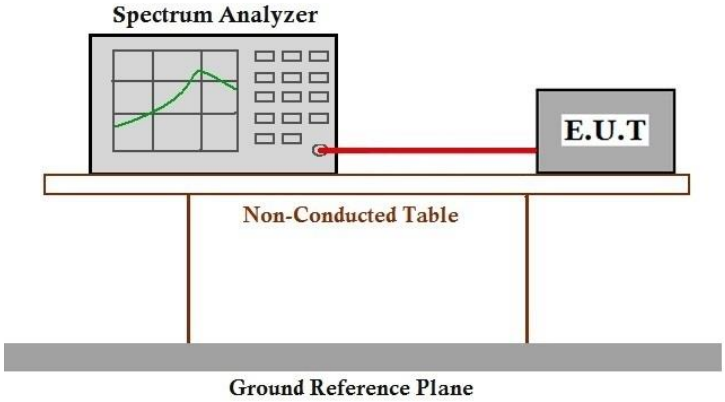
Operating Environment:

Temperature: 25.4 °C Humidity: 44.1 % 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



7.11.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.12 99% Bandwidth

Test Requirement RSS-Gen Section 6.7
Test Method: ANSI C63.10 (2013) Section 6.9.3

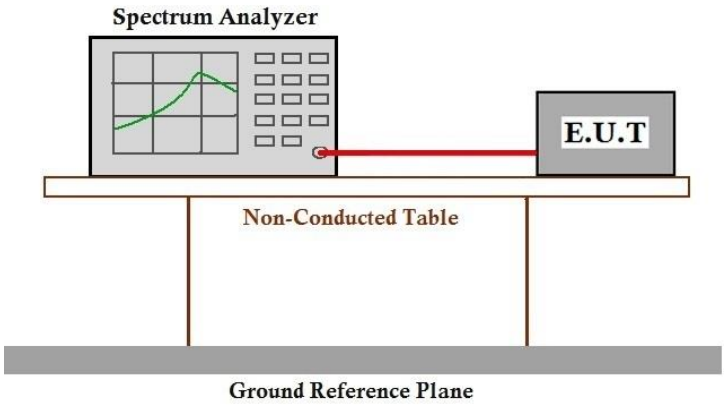
7.12.1 E.U.T. Operation

Operating Environment:
Temperature: 25.4 °C Humidity: 44.1 % 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

8 Test Setup Photo

Refer to Appendix - Test Setup Photo for KSCR2407001236AT

9 EUT Constructional Details (EUT Photos)

Refer to Appendix - Photographs of EUT Constructional Details for KSCR2407001236AT

10 Appendix

1. Bandwidth

1.1 Test Result

1.1.1 OBW

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	99% Occupied Bandwidth (MHz)		Verdict
					Result	Limit	
GFSK	SISO	2402	DH5	1	0.836	/	Pass
		2441	DH5	1	0.828	/	Pass
		2480	DH5	1	0.827	/	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.195	/	Pass
		2441	2DH5	1	1.193	/	Pass
		2480	2DH5	1	1.178	/	Pass
8DPSK	SISO	2402	3DH5	1	1.199	/	Pass
		2441	3DH5	1	1.195	/	Pass
		2480	3DH5	1	1.186	/	Pass

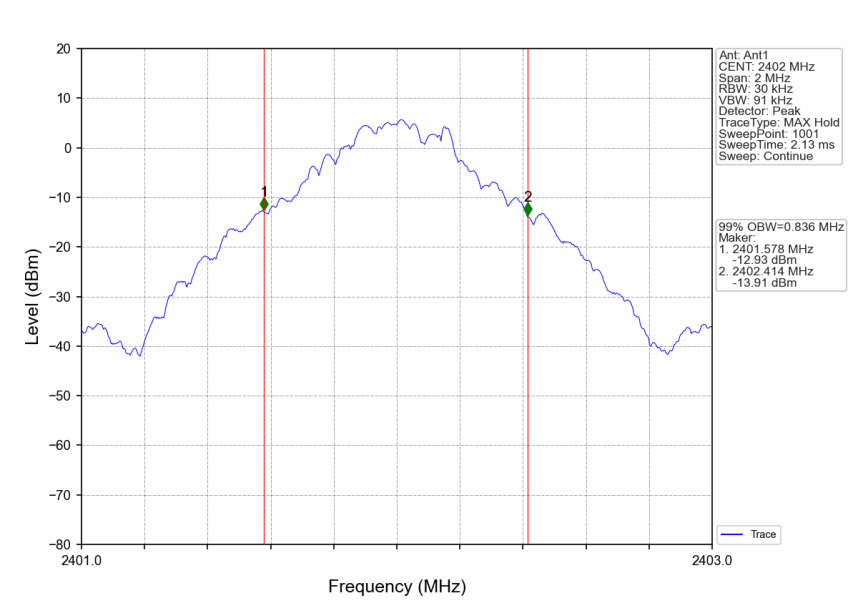
1.1.2 20dB BW

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	20dB Bandwidth (MHz)		Verdict
					Result	Limit	
GFSK	SISO	2402	DH5	1	0.935	/	Pass
		2441	DH5	1	0.933	/	Pass
		2480	DH5	1	0.933	/	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.333	/	Pass
		2441	2DH5	1	1.331	/	Pass
		2480	2DH5	1	1.332	/	Pass
8DPSK	SISO	2402	3DH5	1	1.321	/	Pass
		2441	3DH5	1	1.318	/	Pass
		2480	3DH5	1	1.318	/	Pass

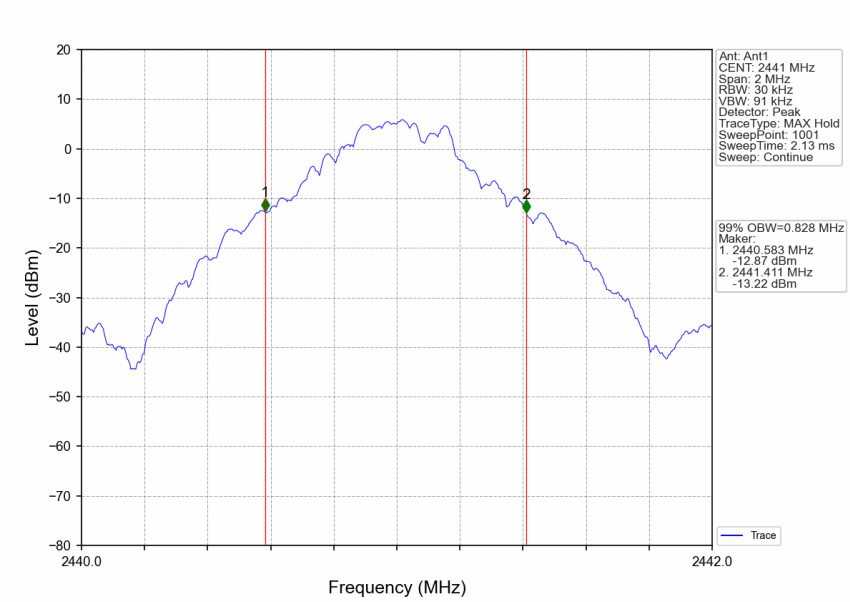
1.2 Test Graph

1.2.1 OBW

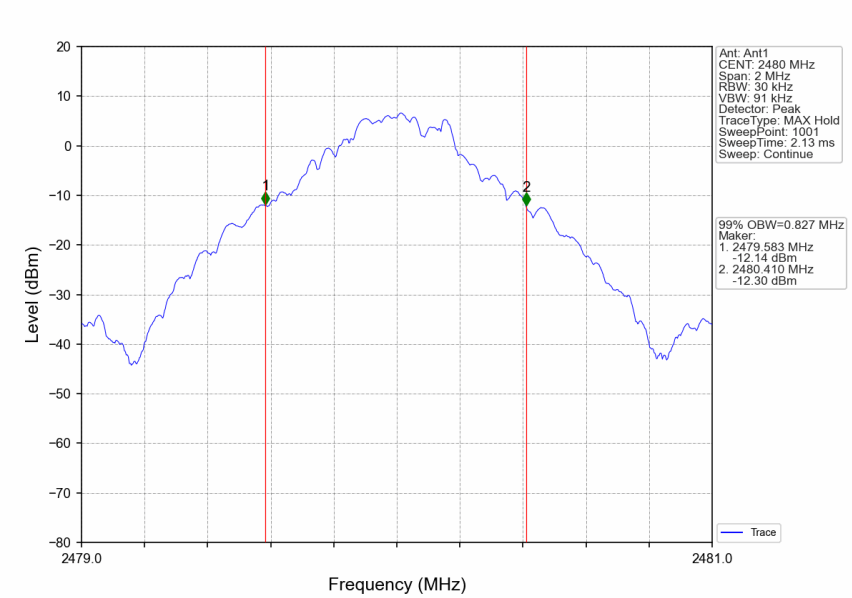
GFSK_DH5_LCH_2402MHz_Ant1_NTNV



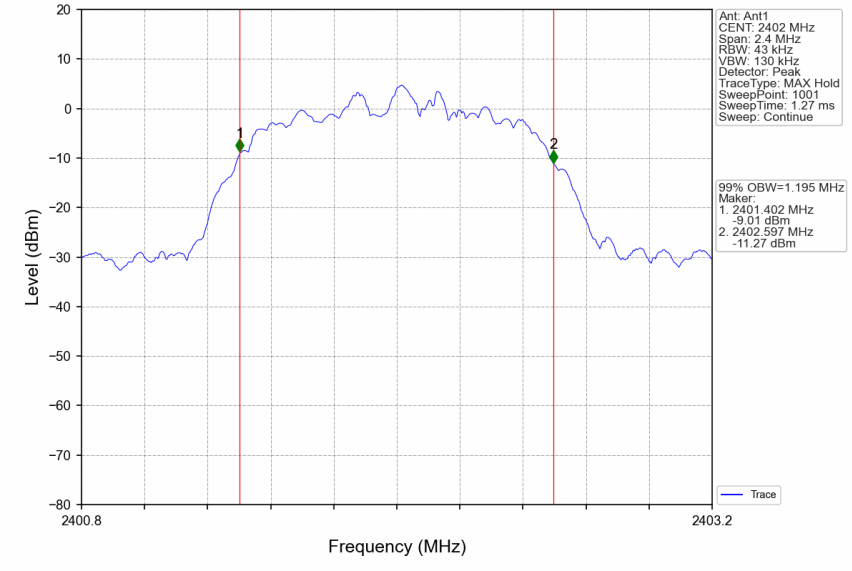
GFSK_DH5_MCH_2441MHz_Ant1_NTNV

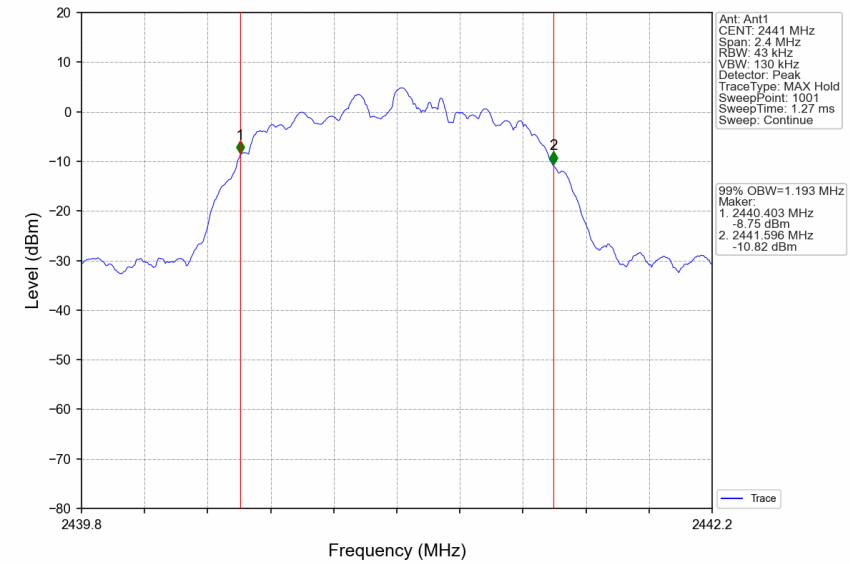


GFSK_DH5_HCH_2480MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_MCH_2441MHz_Ant1_NTNV

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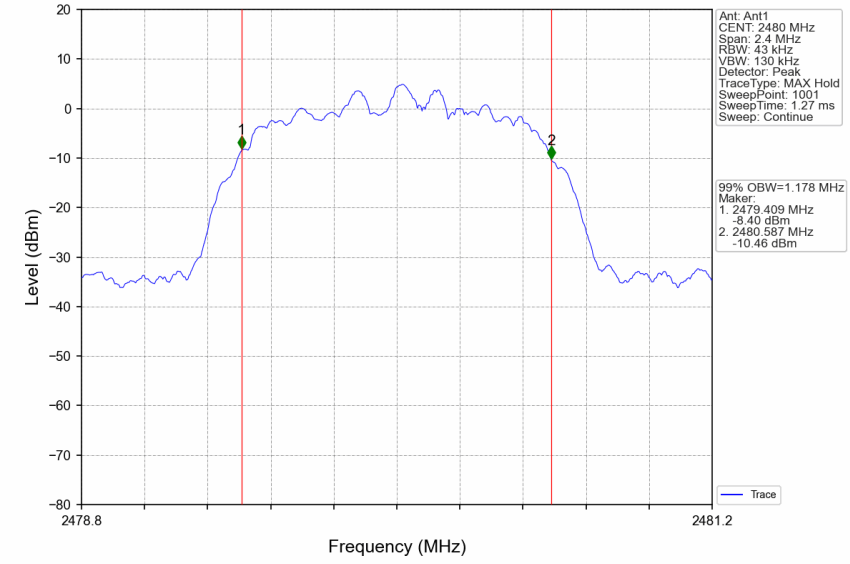
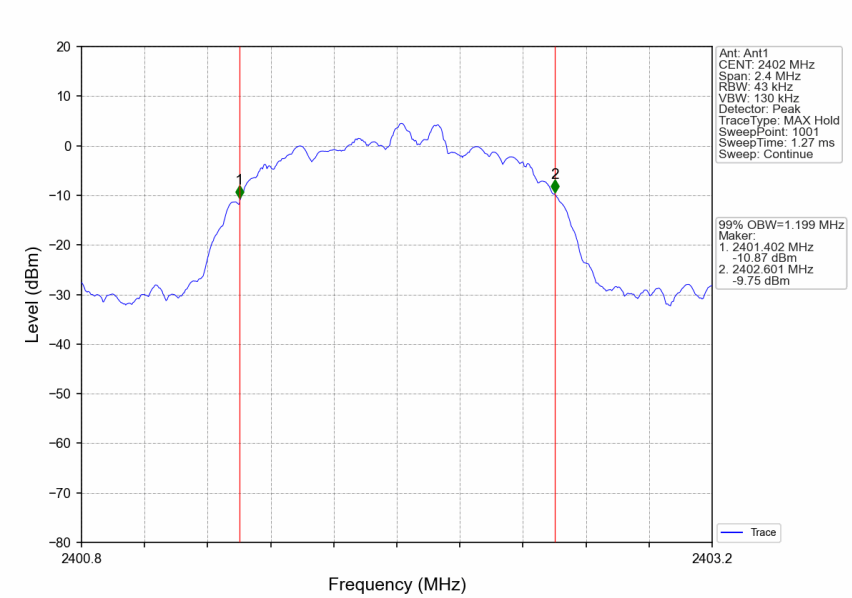


8DPSK_3DH5_LCH_2402MHz_Ant1_NTNV

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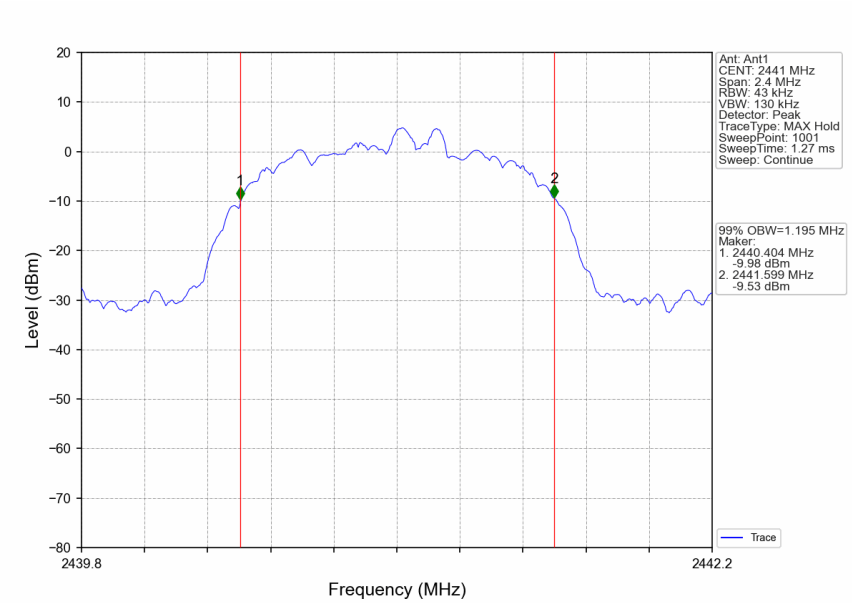
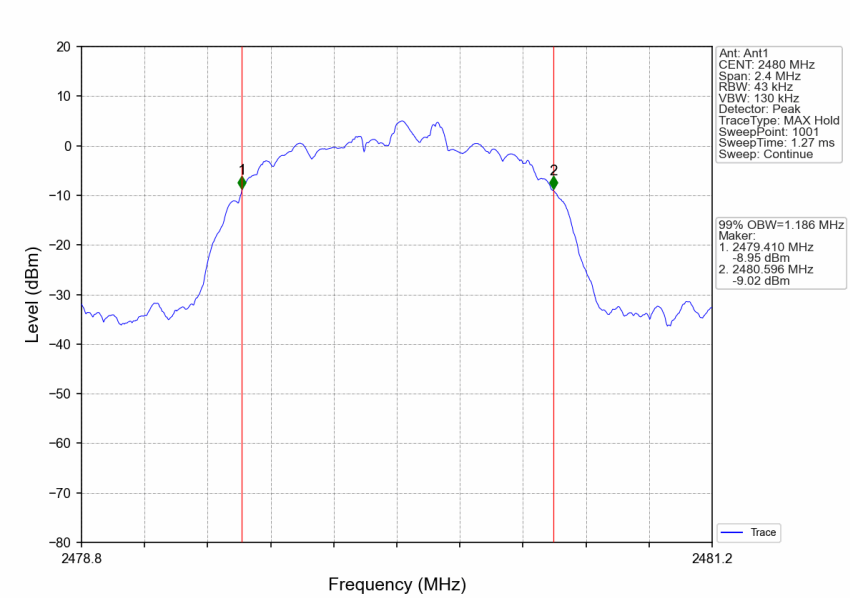
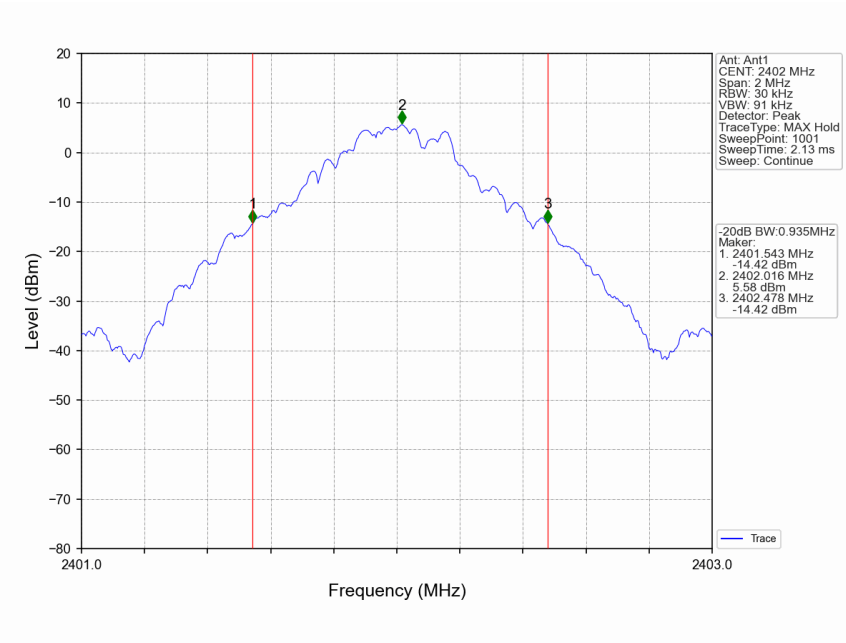
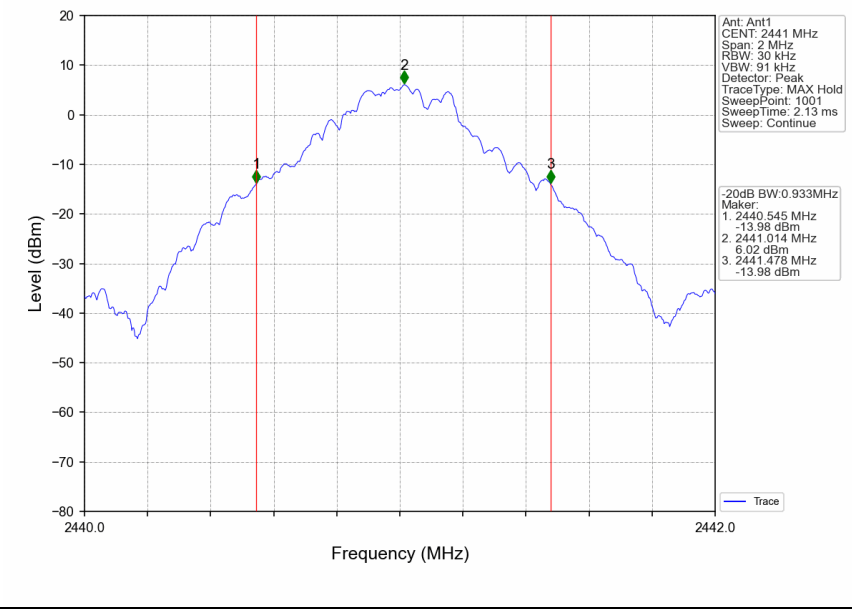


8DPSK_3DH5_HCH_2480MHz_Ant1_NTNV



1.2.2 20dB BW

GFSK_DH5_LCH_2402MHz_Ant1_NTNV

GFSK_DH5_MCH_2441MHz_Ant1_NTNV


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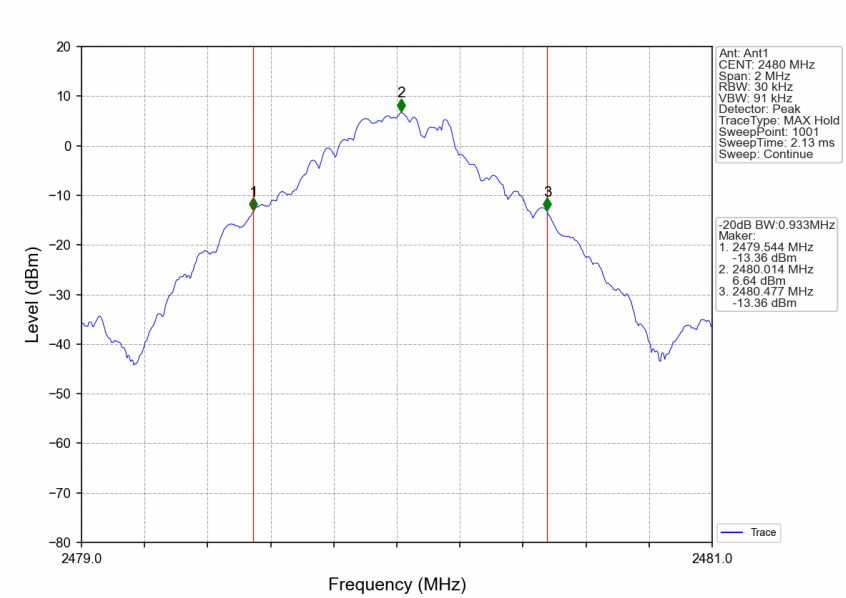
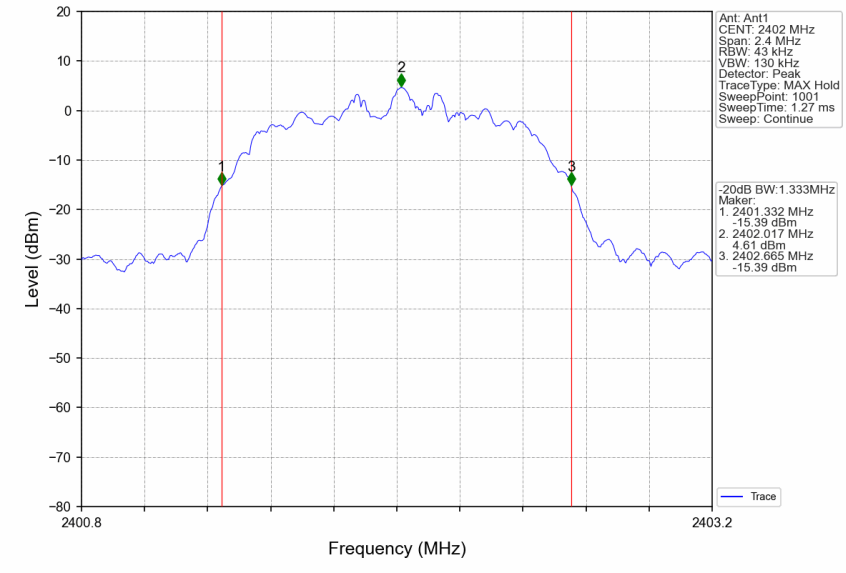
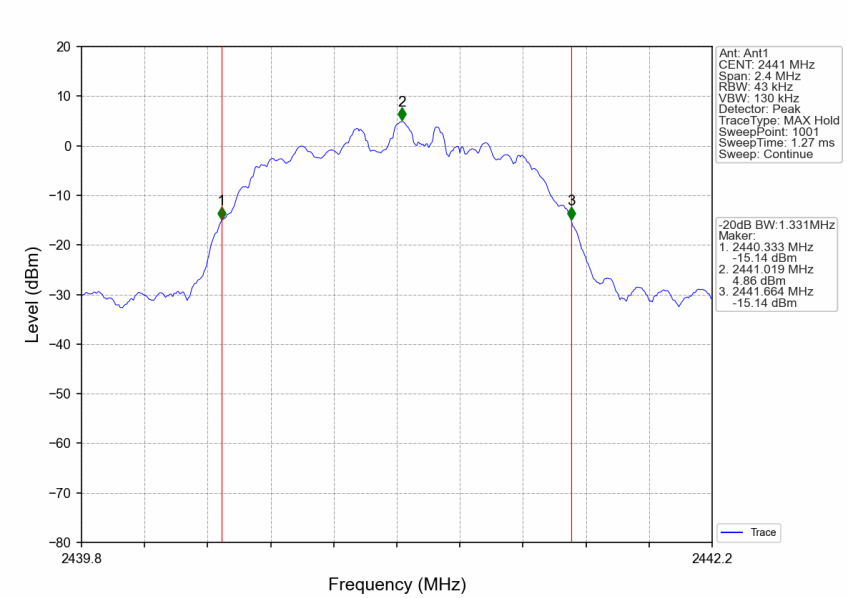
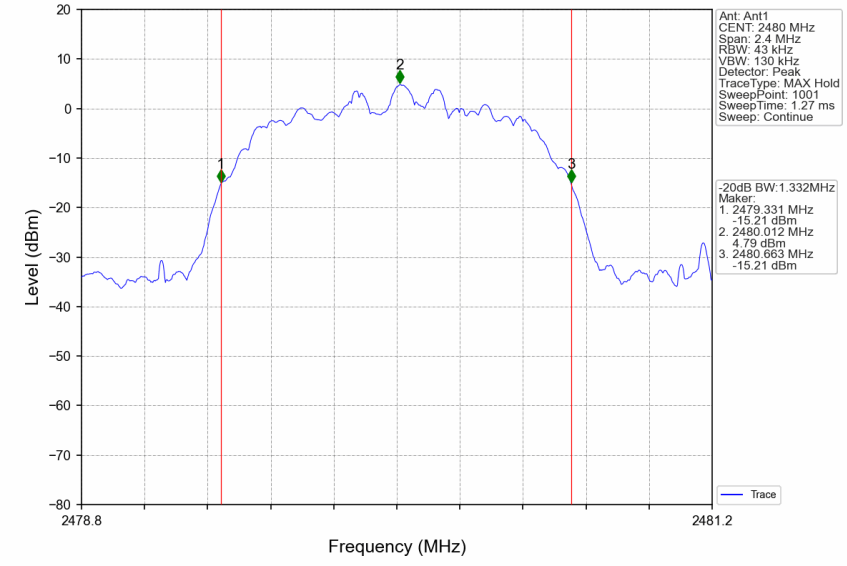

Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV


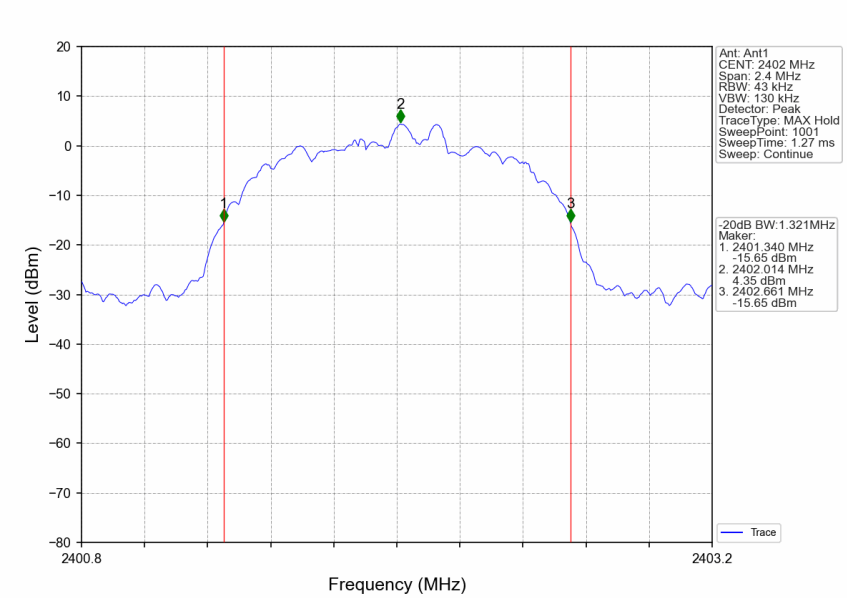
Pi/4DQPSK_2DH5_MCH_2441MHz_Ant1_NTNV



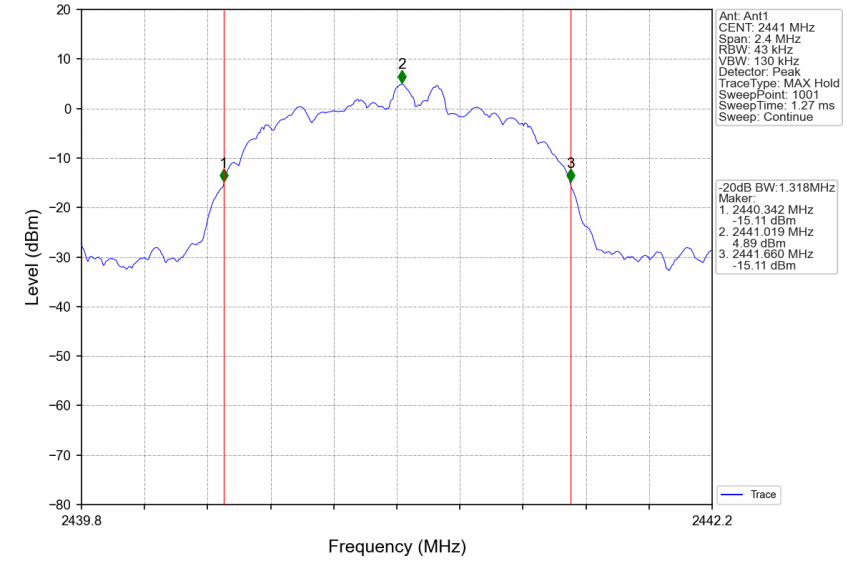
Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV

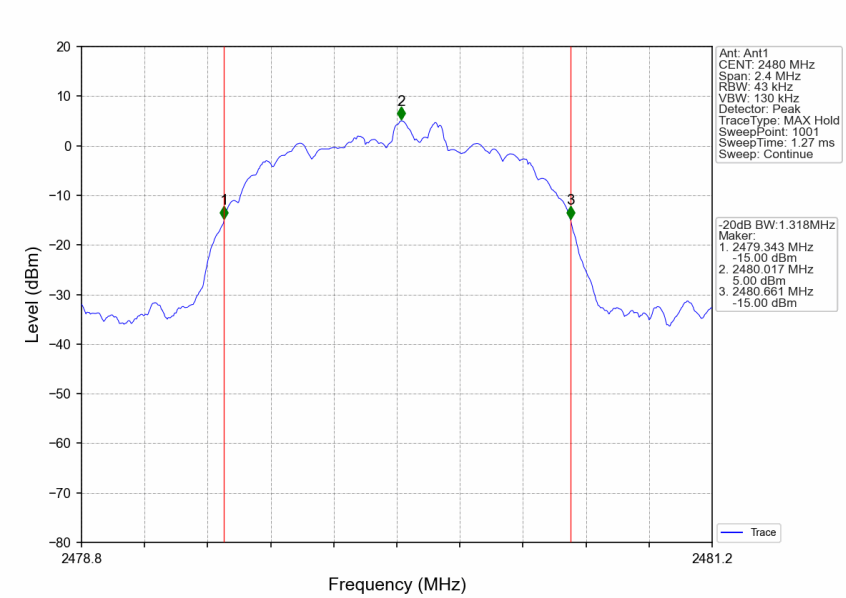


8DPSK_3DH5_LCH_2402MHz_Ant1_NTNV



8DPSK_3DH5_MCH_2441MHz_Ant1_NTNV



8DPSK_3DH5_HCH_2480MHz_Ant1_NTNV


2. Maximum Conducted Output Power

2.1 Test Result

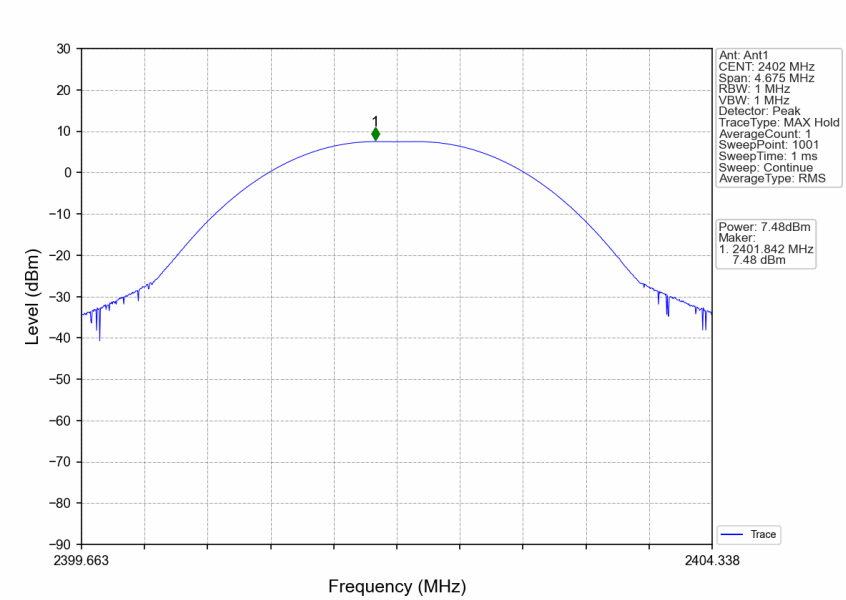
2.1.1 Power

Mode	TX Type	Frequency (MHz)	Packet Type	Maximum Average Conducted Output Power (dBm)		Verdict
				ANT1	Limit	
GFSK	SISO	2402	DH5	7.48	<=30	Pass
		2441	DH5	7.85	<=30	Pass
		2480	DH5	8.50	<=30	Pass
Pi/4DQPSK	SISO	2402	2DH5	7.13	<=20.97	Pass
		2441	2DH5	7.47	<=20.97	Pass
		2480	2DH5	7.86	<=20.97	Pass
8DPSK	SISO	2402	3DH5	7.40	<=30	Pass
		2441	3DH5	7.70	<=30	Pass
		2480	3DH5	8.25	<=30	Pass
Note1: Antenna Gain: Ant1: 2.10dBi;						

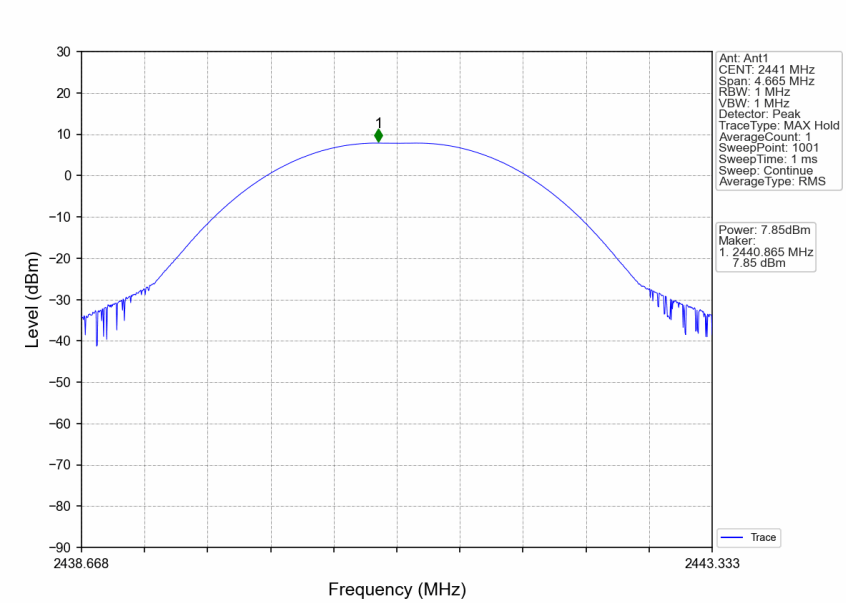
2.2 Test Graph

2.2.1 Power

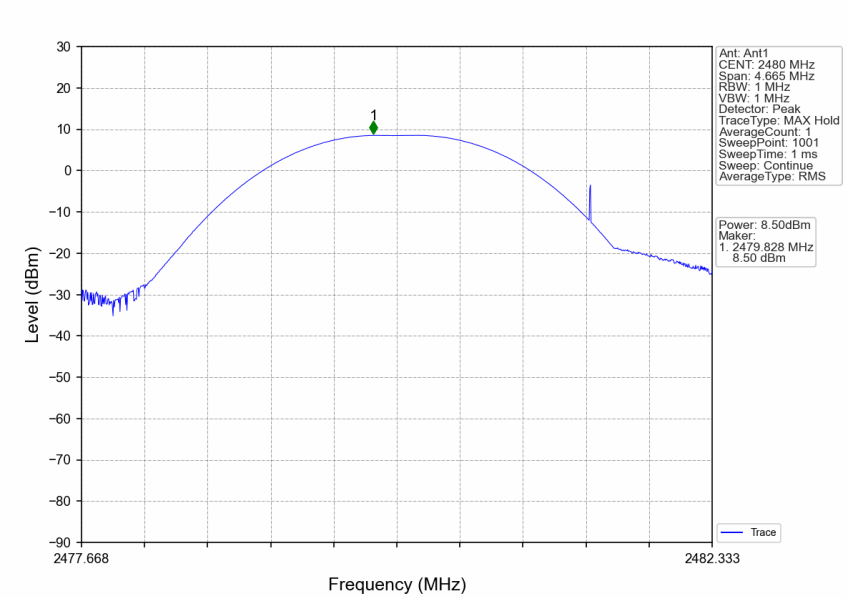
GFSK_DH5_LCH_2402MHz_Ant1_NTNV



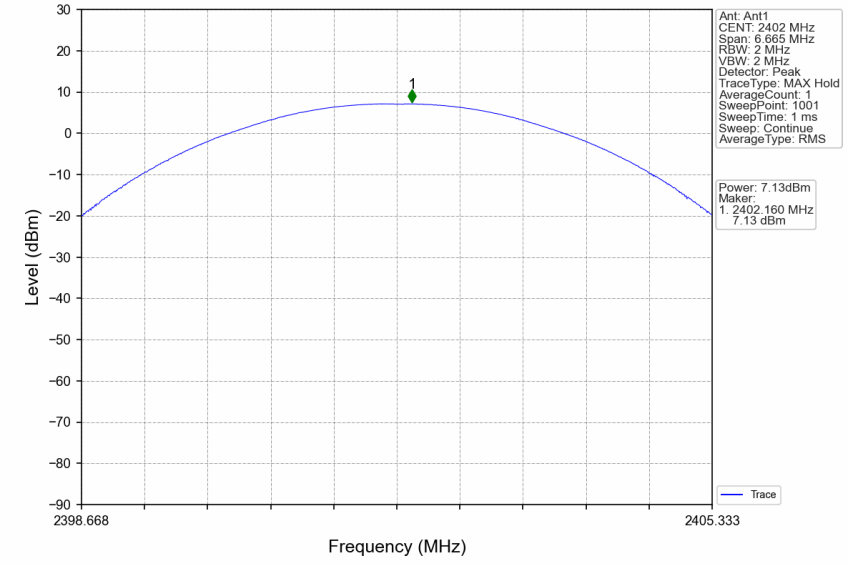
GFSK_DH5_MCH_2441MHz_Ant1_NTNV



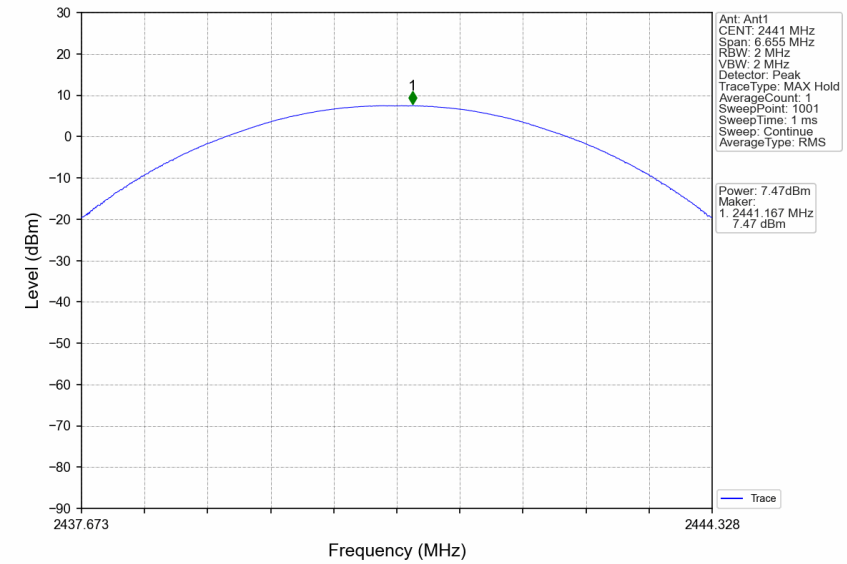
GFSK_DH5_HCH_2480MHz_Ant1_NTNV



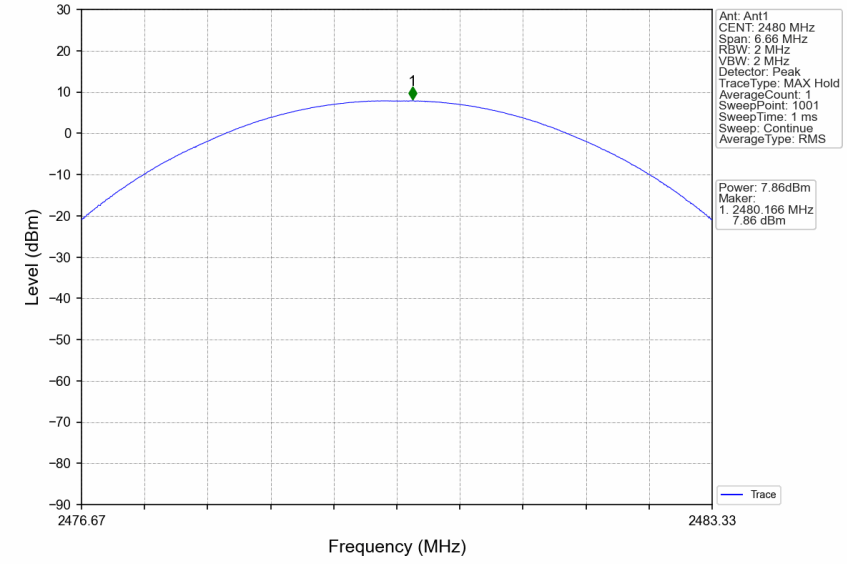
Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



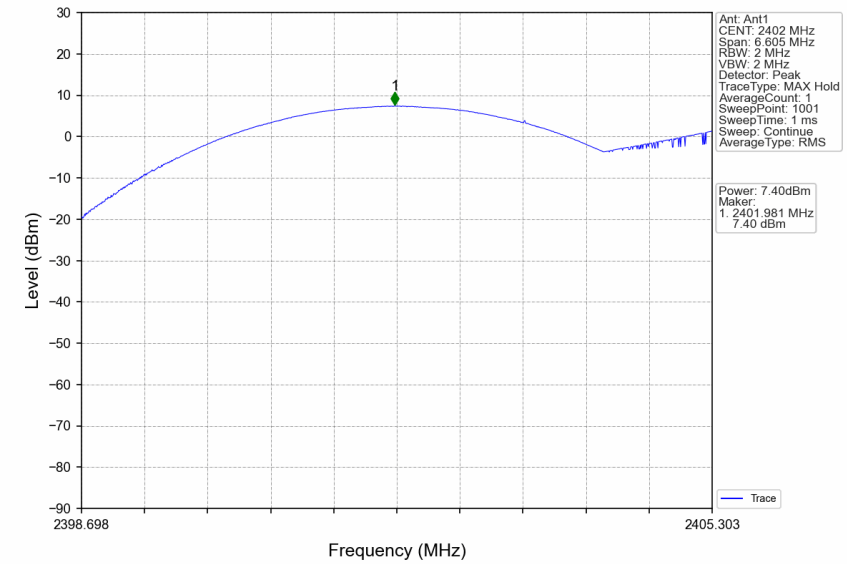
Pi/4DQPSK_2DH5_MCH_2441MHz_Ant1_NTNV



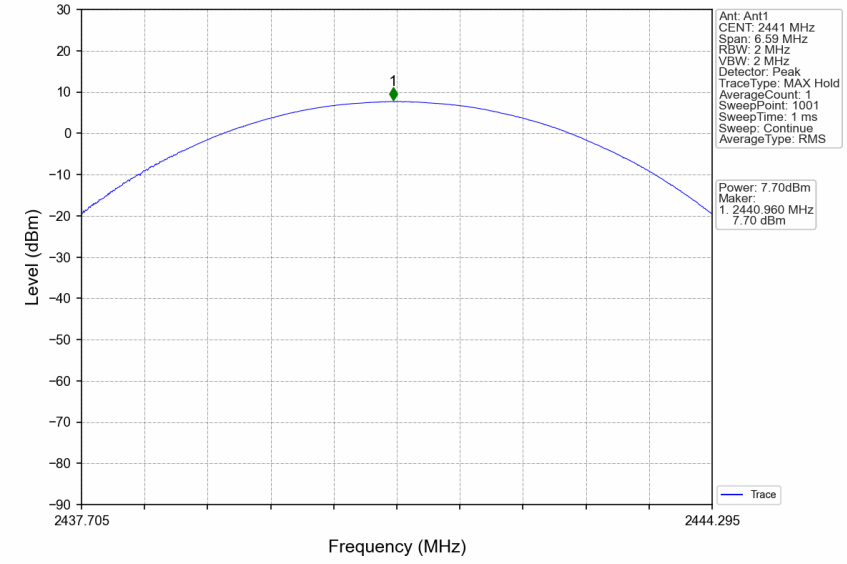
Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV



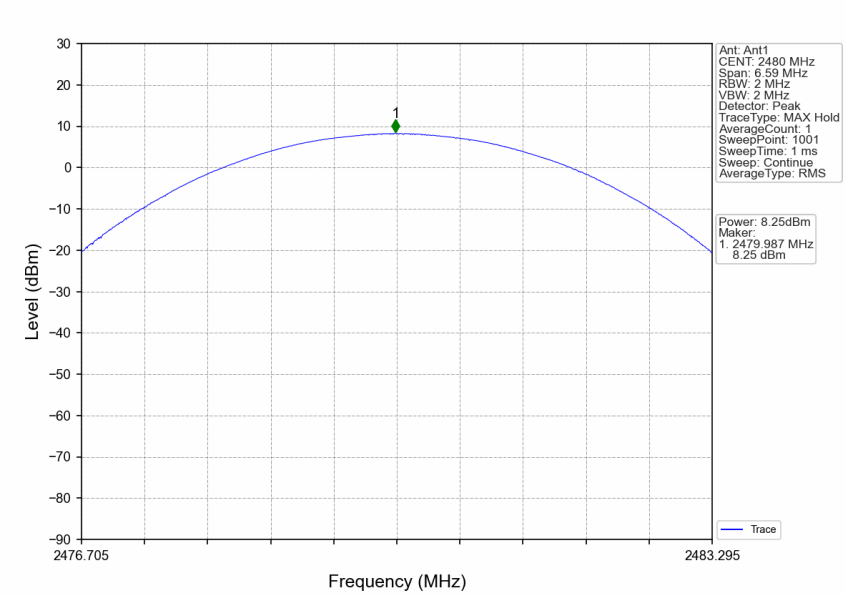
8DPSK_3DH5_LCH_2402MHz_Ant1_NTNV



8DPSK_3DH5_MCH_2441MHz_Ant1_NTNV



8DPSK_3DH5_HCH_2480MHz_Ant1_NTNV



3. Carrier Frequency Separation

3.1 Test Result

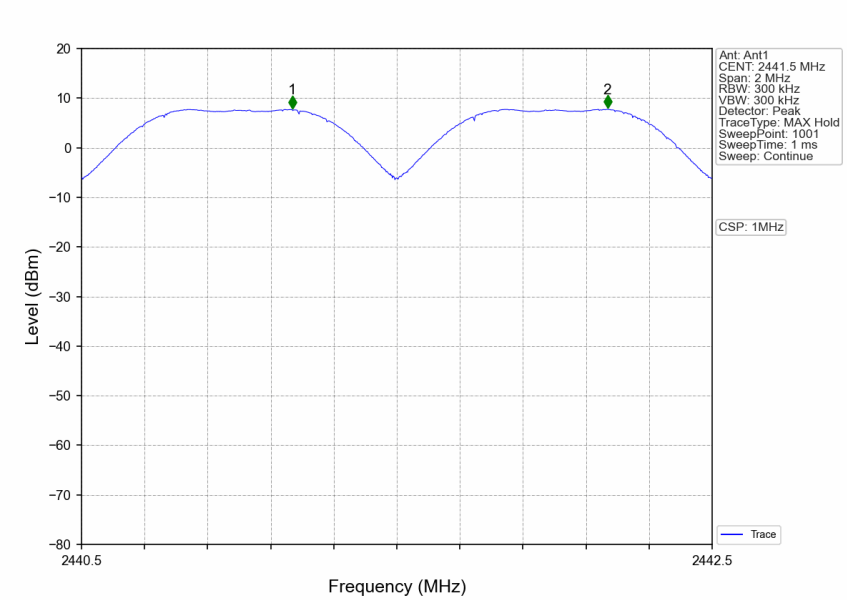
3.1.1 Ant1

Ant1							
Mode	TX Type	Frequency (MHz)	Packet Type	Channel Separation (MHz)	20dB Bandwidth (MHz)	Limit (MHz)	Verdict
GFSK	SISO	HOPP	DH5	1.000	0.935	>=0.935	Pass
Pi/4DQPSK	SISO	HOPP	2DH5	1.001	1.333	>=0.889	Pass
8DPSK	SISO	HOPP	3DH5	1.373	1.321	>=1.321	Pass

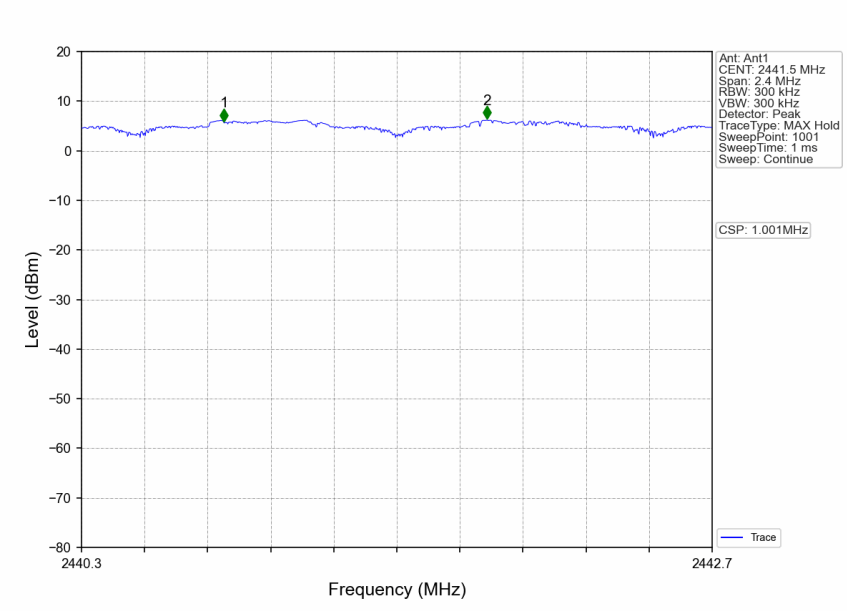
3.2 Test Graph

3.2.1 Ant1

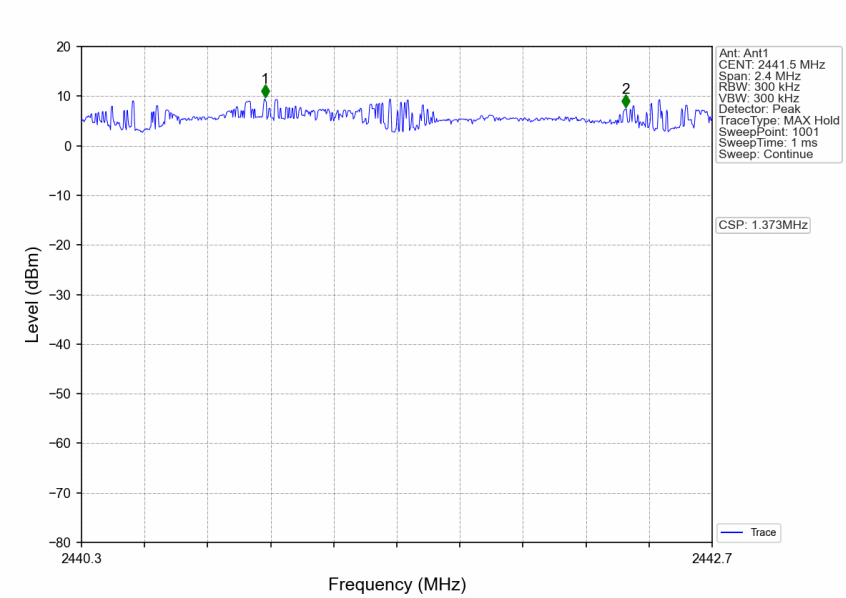
GFSK_DH5_HOPP_Ant1_NTNV



Pi/4DQPSK_2DH5_HOPP_Ant1_NTNV



8DPSK_3DH5_HOPP_Ant1_NTNV



4. Number of Hopping Frequencies

4.1 Test Result

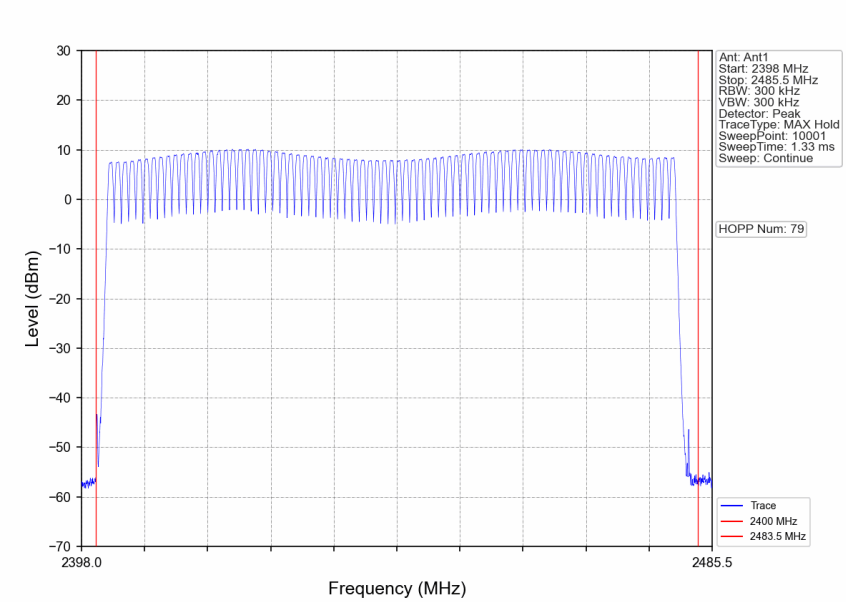
4.1.1 HoppNum

Mode	TX Type	Frequency (MHz)	Packet Type	Num of Hopping Frequencies		Verdict
				ANT1	Limit	
GFSK	SISO	HOPP	DH5	79	>=15	Pass
Pi/4DQPSK	SISO	HOPP	2DH5	79	>=15	Pass
8DPSK	SISO	HOPP	3DH5	79	>=15	Pass

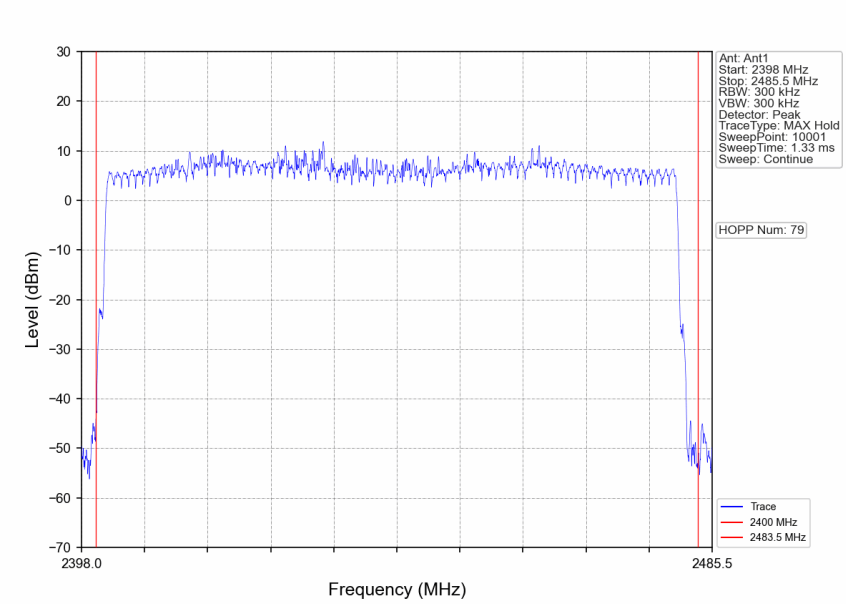
4.2 Test Graph

4.2.1 HoppNum

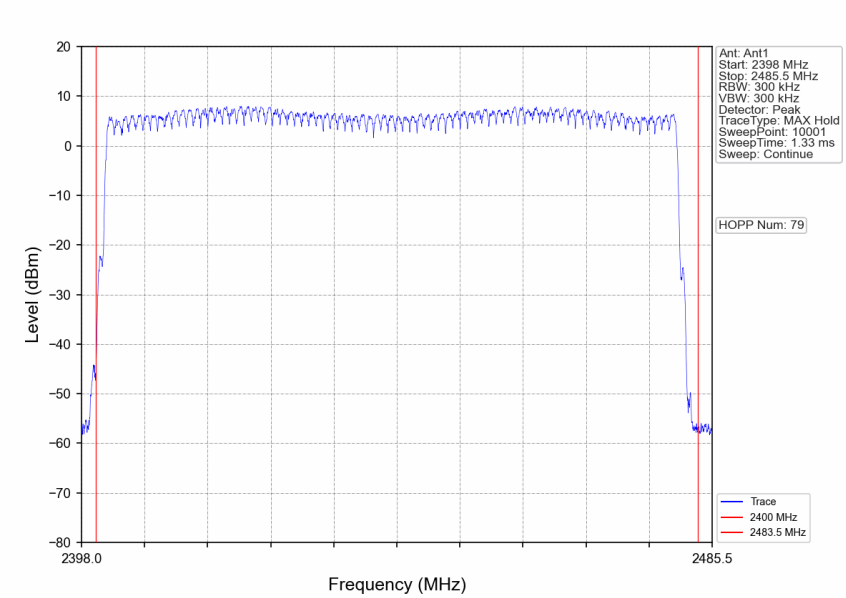
GFSK_DH5_HOPP_Ant1_NTNV



Pi/4DQPSK_2DH5_HOPP_Ant1_NTNV



8DPSK_3DH5_HOPP_Ant1_NTNV



5. Time of Occupancy (Dwell Time)

5.1 Test Result

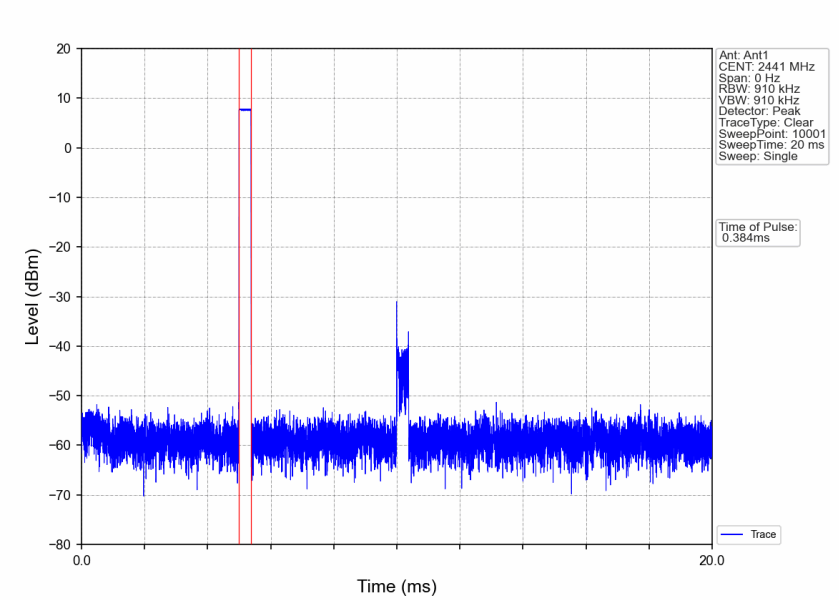
5.1.1 Ant1

Ant1									
Mode	TX Type	Frequency (MHz)	Packet Type	Duration of Single Pulse (ms)	Observation Period (s)	Num of Pulse in Observation Period	Dwell Time (ms)	Limit (ms)	Verdict
GFSK	SISO	HOPP	DH1	0.384	31.600	322	123.648	<=400	Pass
			DH3	1.648	31.600	157	258.736	<=400	Pass
			DH5	2.896	31.600	99	286.704	<=400	Pass
Pi/4DQPSK	SISO	HOPP	2DH1	0.390	31.600	320	124.800	<=400	Pass
			2DH3	1.642	31.600	149	244.658	<=400	Pass
			2DH5	2.904	31.600	94	272.976	<=400	Pass
8DPSK	SISO	HOPP	3DH1	0.388	31.600	322	124.936	<=400	Pass
			3DH3	1.652	31.600	166	274.232	<=400	Pass
			3DH5	2.900	31.600	112	324.800	<=400	Pass

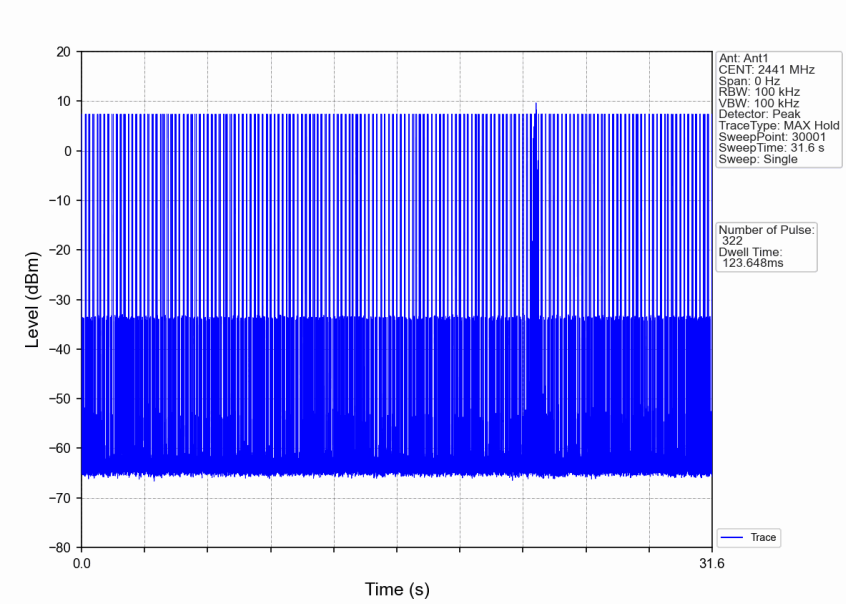
5.2 Test Graph

5.2.1 Ant1

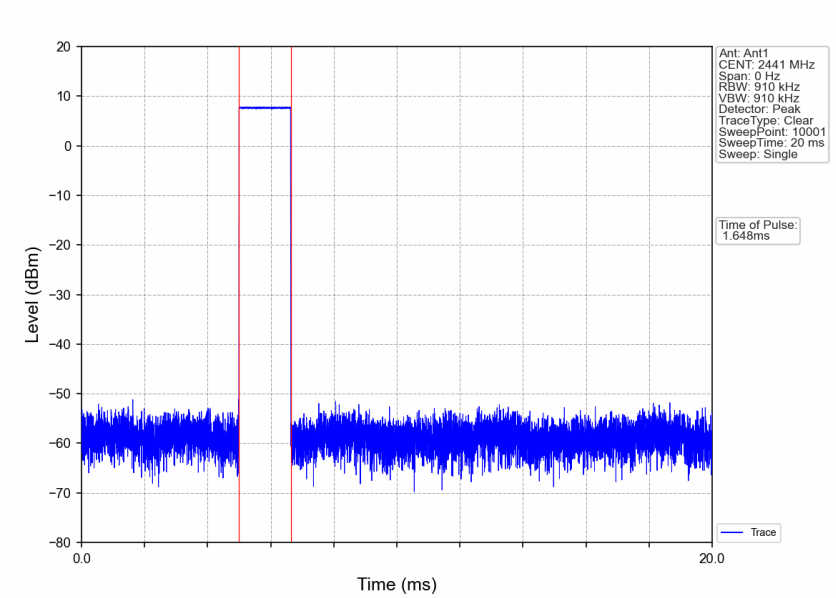
GFSK_DH1_HOPP_Ant1_NTNV



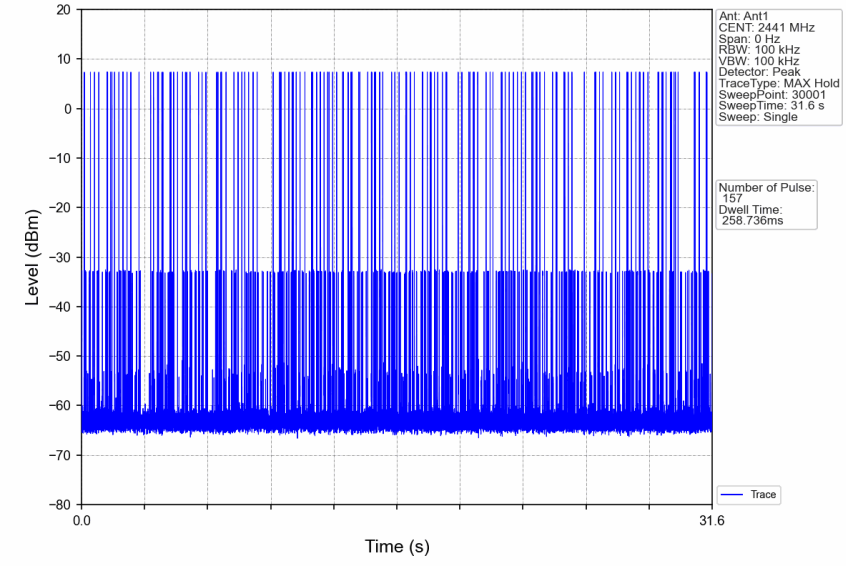
GFSK_DH1_HOPP_Ant1_NTNV



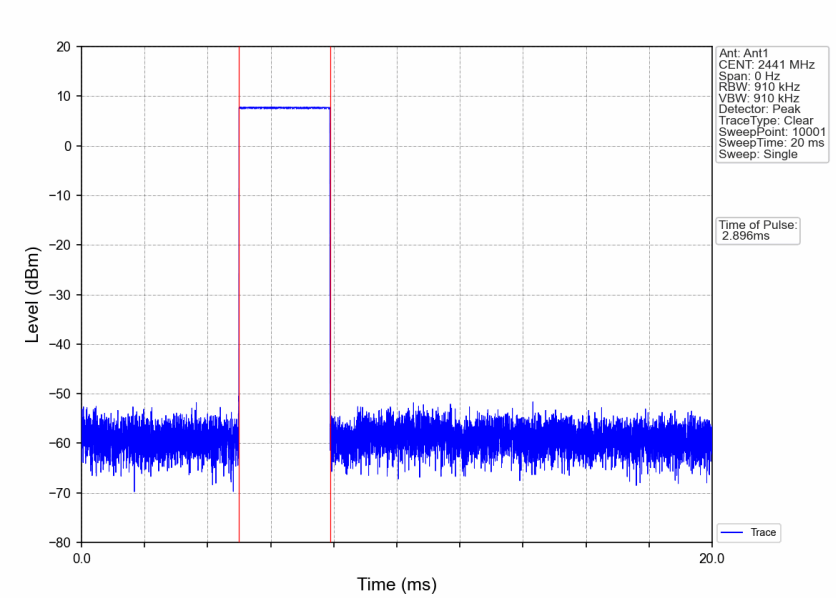
GFSK_DH3_HOPP_Ant1_NTNV



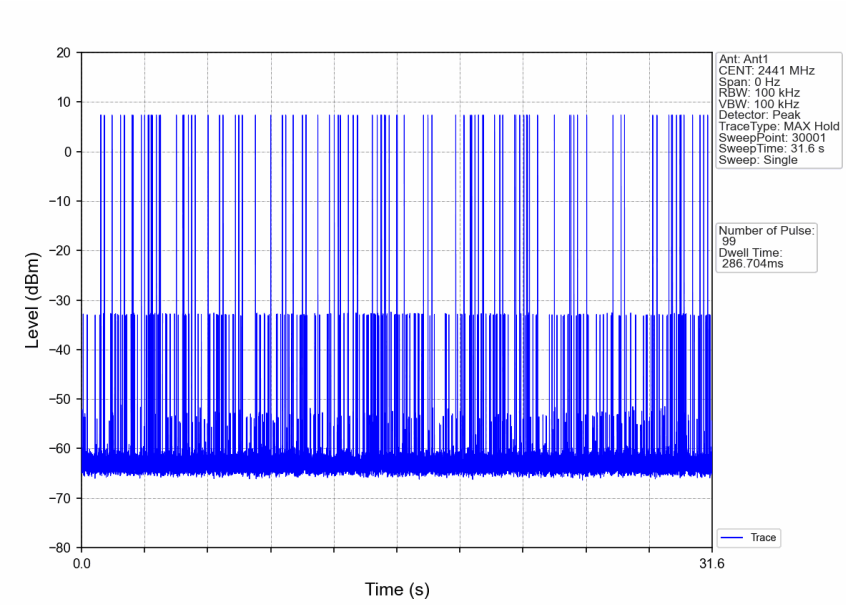
GFSK_DH3_HOPP_Ant1_NTNV

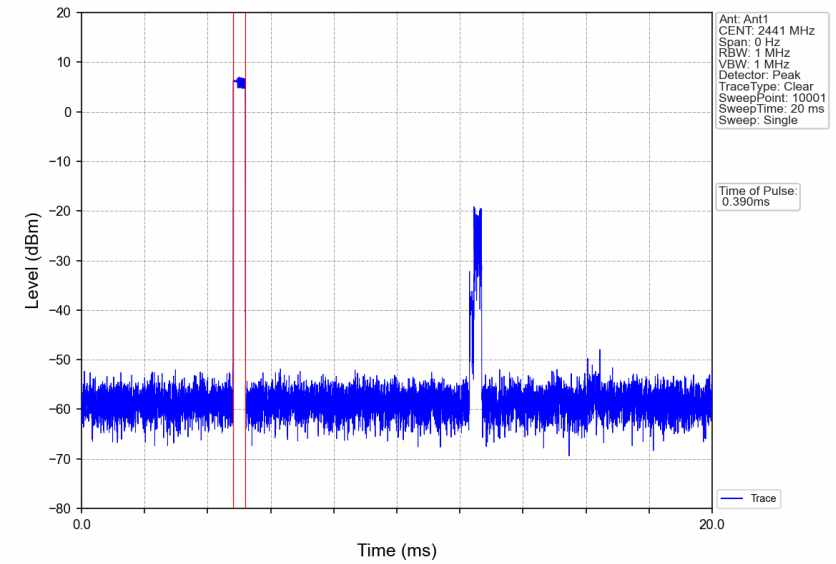


GFSK_DH5_HOPP_Ant1_NTNV



GFSK_DH5_HOPP_Ant1_NTNV



Pi/4DQPSK_2DH1_HOPP_Ant1_NTNV


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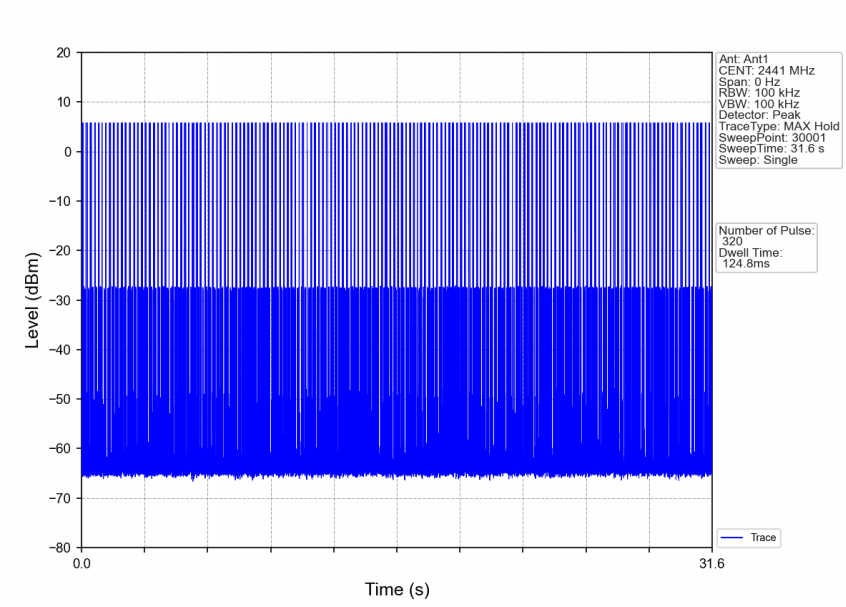

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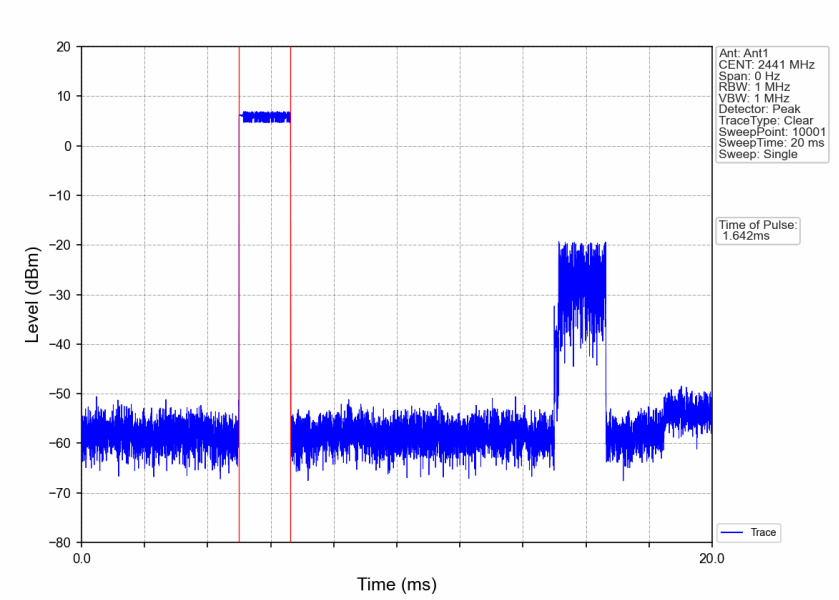

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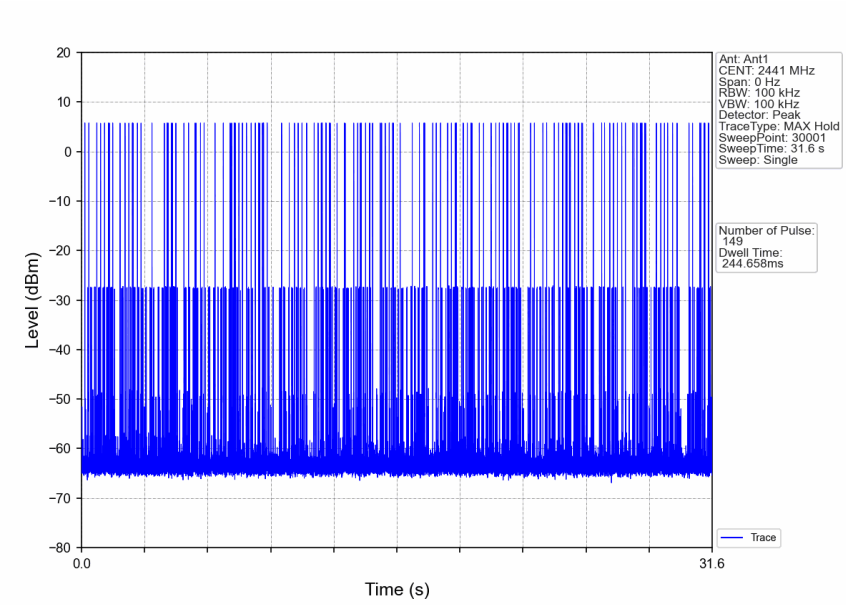

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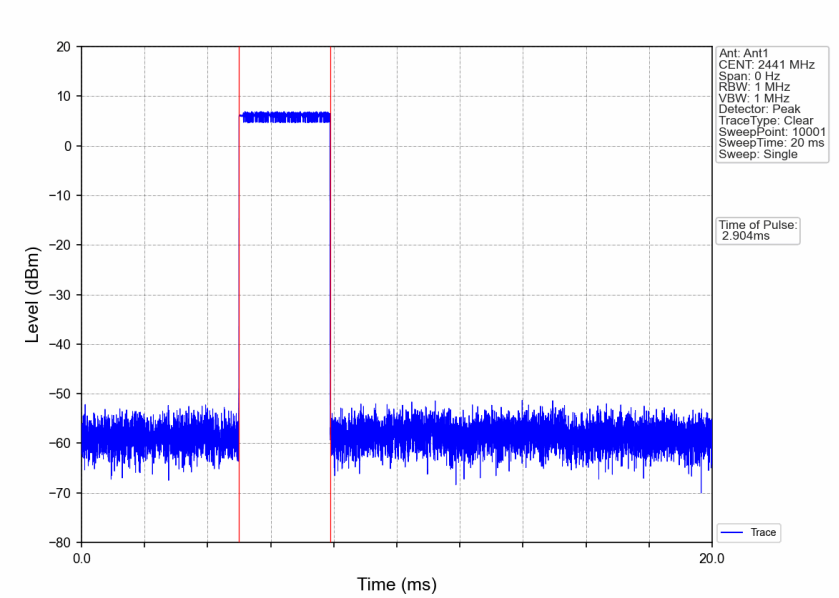
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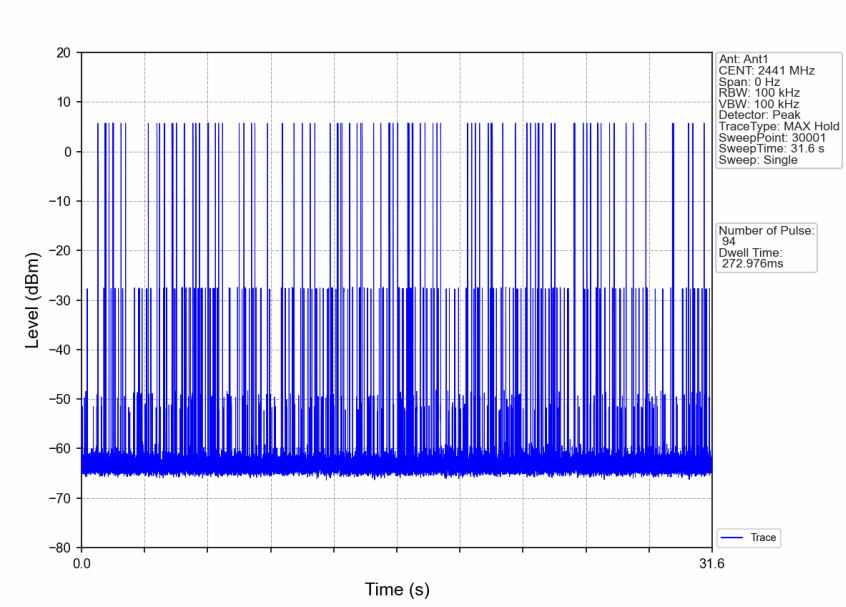
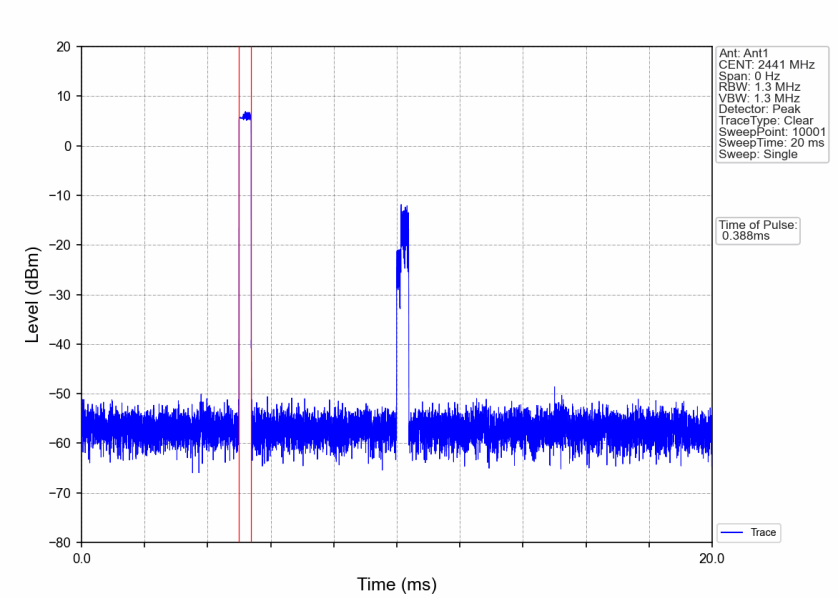


8DPSK_3DH1_HOPP_Ant1_NTNV


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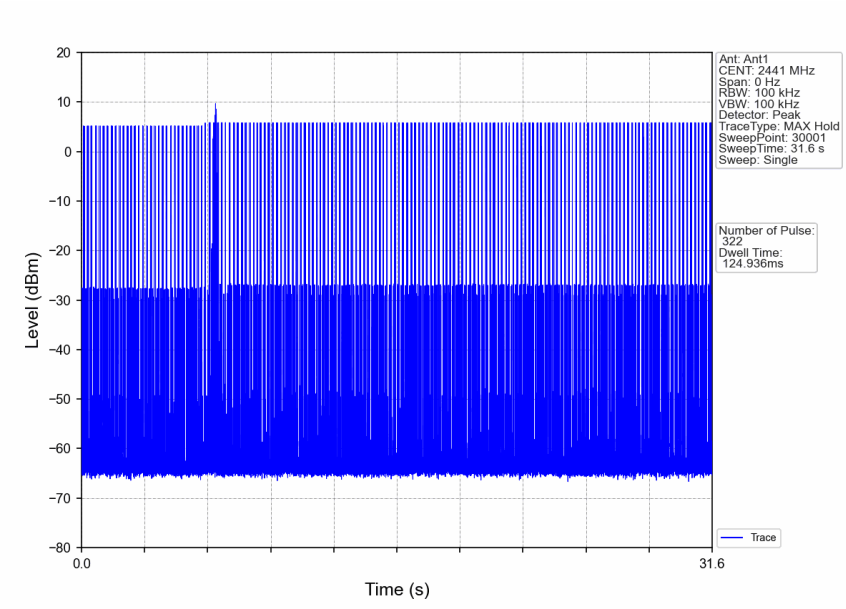

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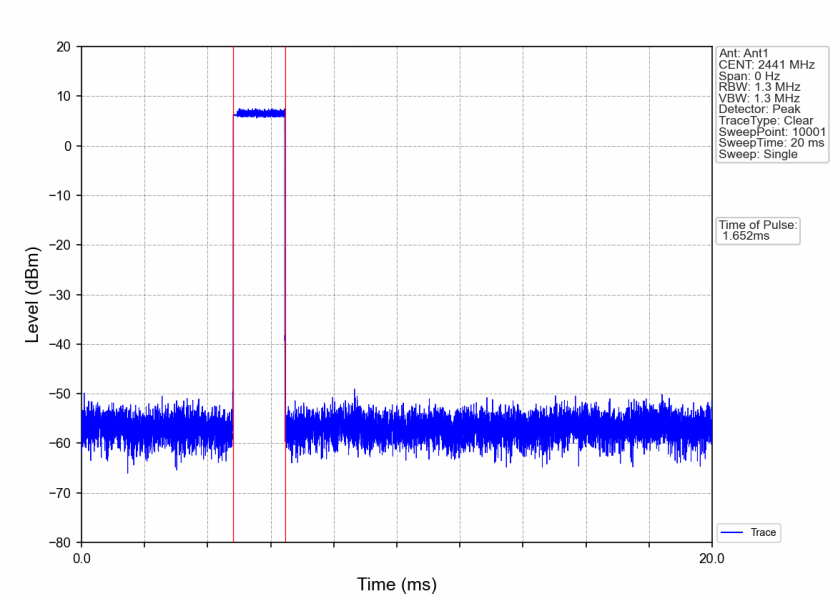
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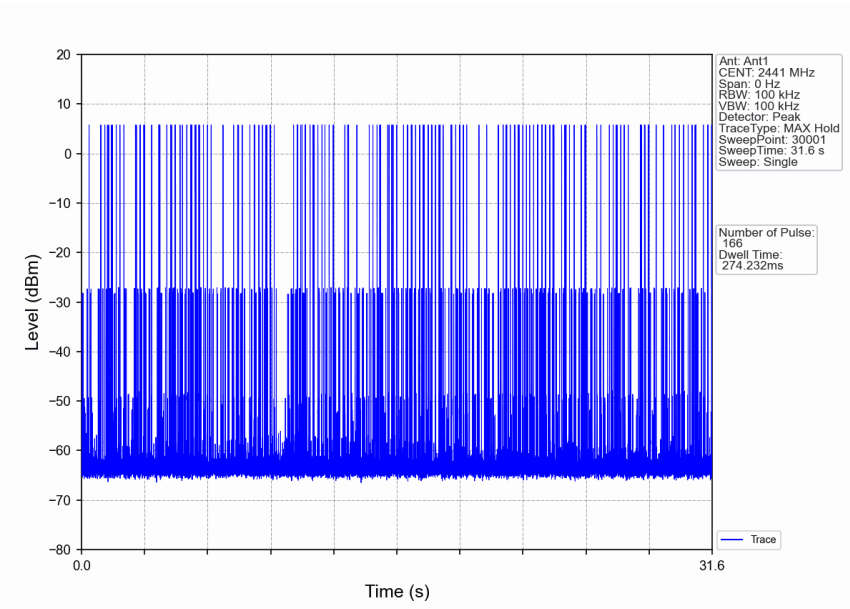

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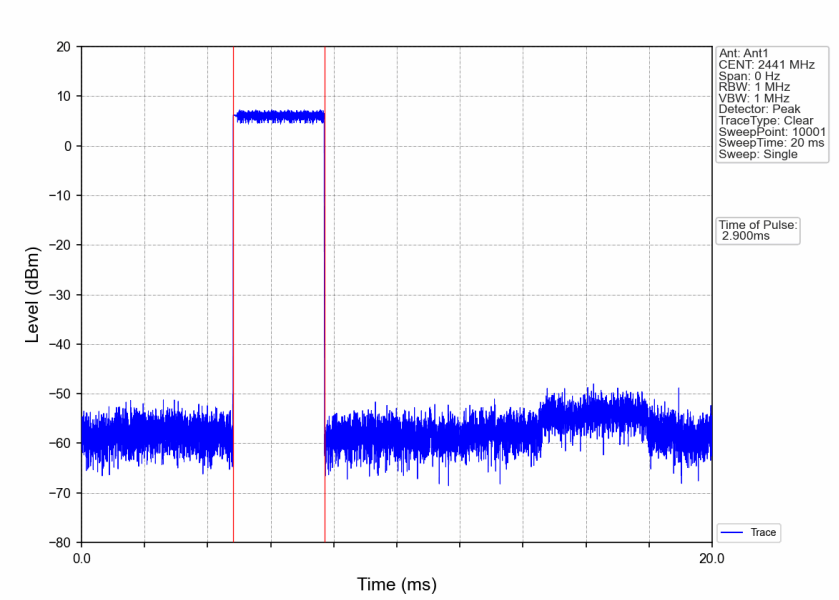

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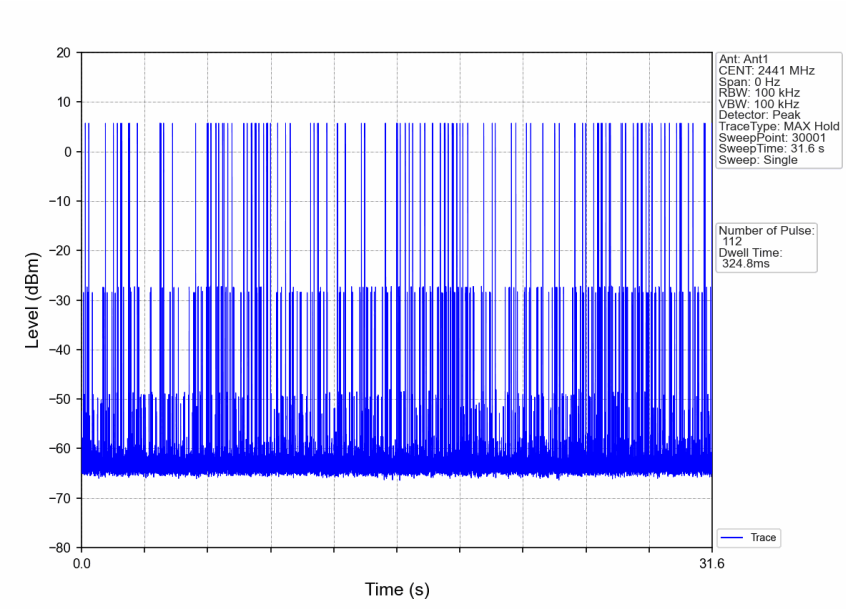


6. Unwanted Emissions In Non-restricted Frequency Bands

6.1 Test Result

6.1.1 Ref

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	Level of Reference (dBm)
GFSK	SISO	2402	DH5	1	7.36
		2441	DH5	1	7.62
		2480	DH5	1	**8.34**
Pi/4DQPSK	SISO	2402	2DH5	1	5.80
		2441	2DH5	1	6.12
		2480	2DH5	1	**6.20**
8DPSK	SISO	2402	3DH5	1	5.81
		2441	3DH5	1	5.90
		2480	3DH5	1	**6.27**
Note1: Refer to FCC Part 15.247 (d) and ANSI C63.10-2013, the channel contains the maximum PSD level was used to establish the reference level.					

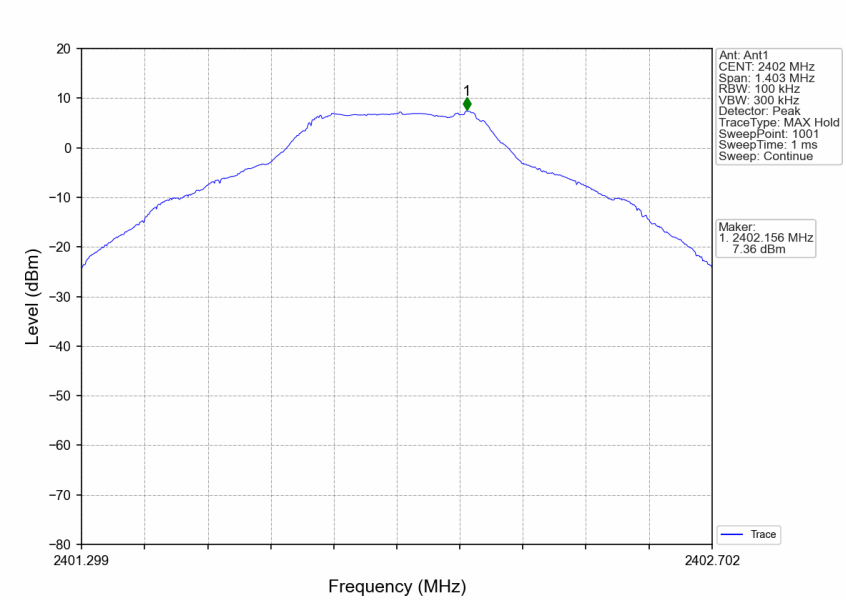
6.1.2 CSE

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	Level of Reference (dBm)	Limit (dBm)	Verdict
GFSK	SISO	2402	DH5	1	8.34	-11.66	Pass
		2441	DH5	1	8.34	-11.66	Pass
		2480	DH5	1	8.34	-11.66	Pass
		HOPP	DH5	1	8.34	-11.66	Pass
					8.34	-11.66	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	6.20	-13.80	Pass
		2441	2DH5	1	6.20	-13.80	Pass
		2480	2DH5	1	6.20	-13.80	Pass
		HOPP	2DH5	1	6.20	-13.80	Pass
					6.20	-13.80	Pass
8DPSK	SISO	2402	3DH5	1	6.27	-13.73	Pass
		2441	3DH5	1	6.27	-13.73	Pass
		2480	3DH5	1	6.27	-13.73	Pass
		HOPP	3DH5	1	6.27	-13.73	Pass
					6.27	-13.73	Pass
Note1: Refer to FCC Part 15.247 (d) and ANSI C63.10-2013, the channel contains the maximum PSD level was used to establish the reference level.							

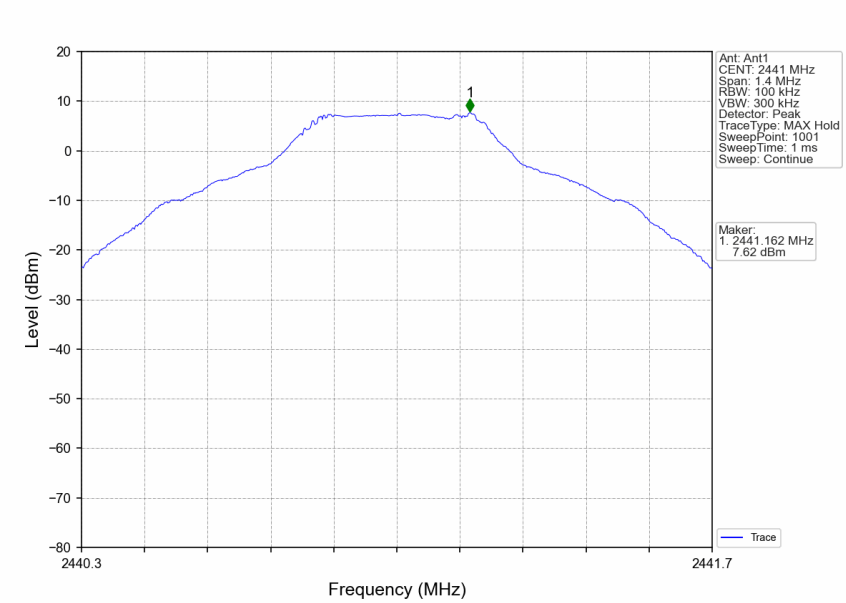
6.2 Test Graph

6.2.1 Ref

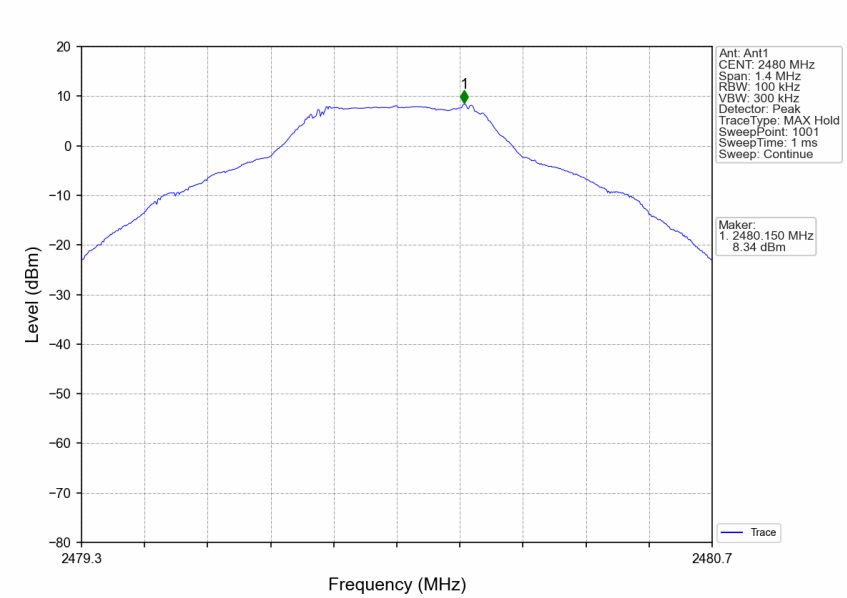
GFSK_DH5_LCH_2402MHz_Ant1_NTNV



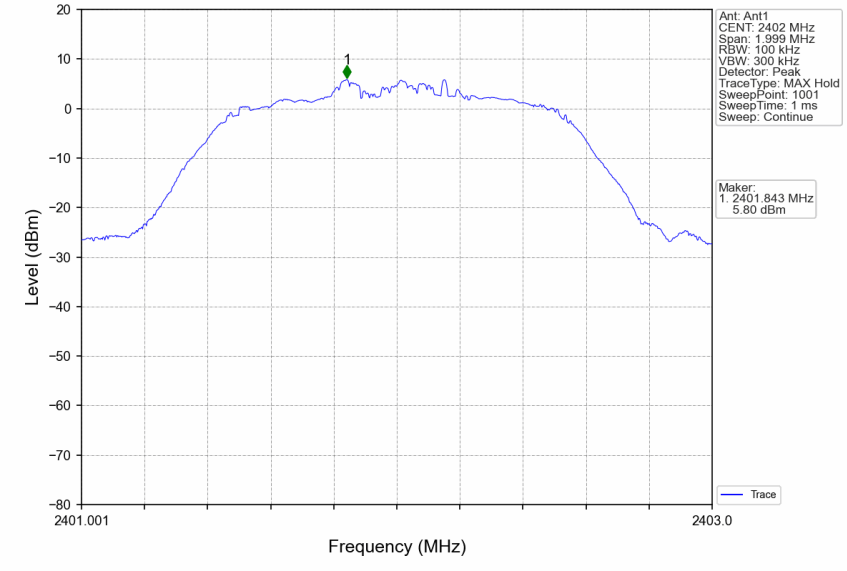
GFSK_DH5_MCH_2441MHz_Ant1_NTNV



GFSK_DH5_HCH_2480MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



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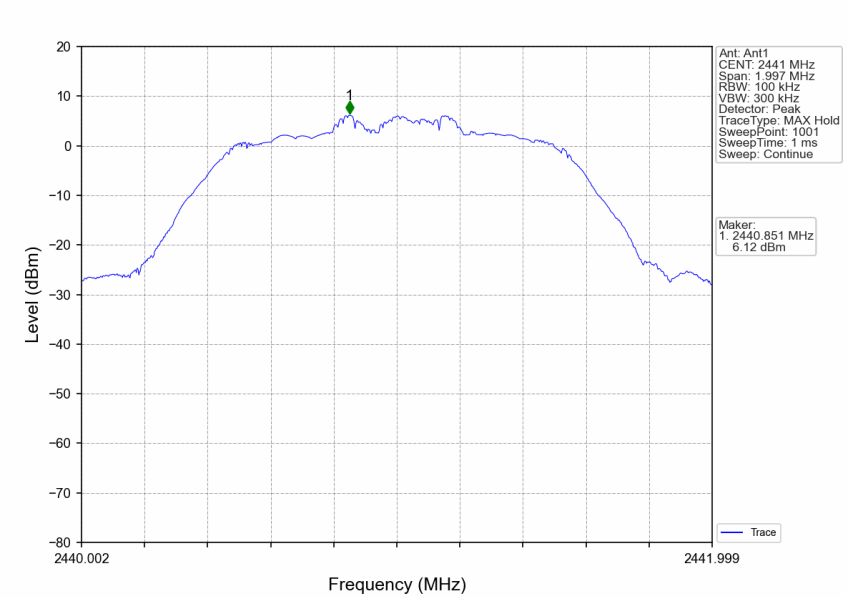
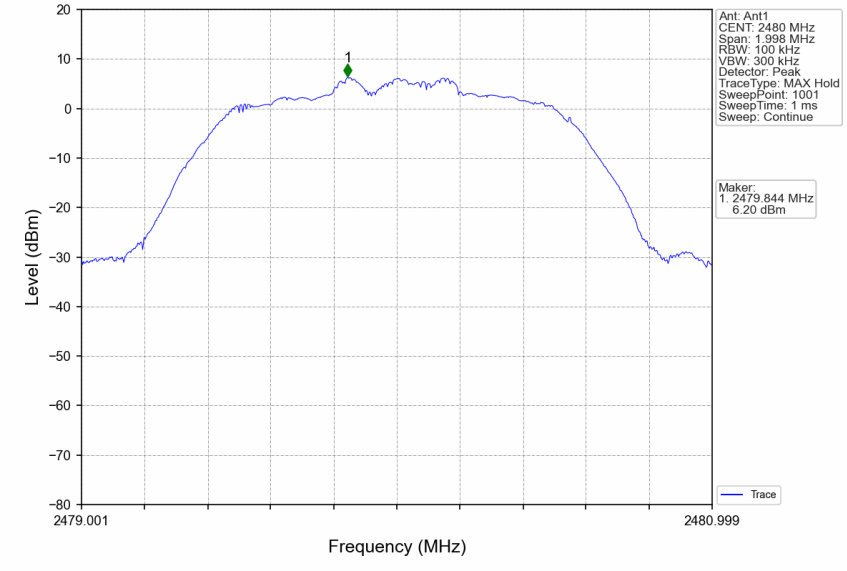
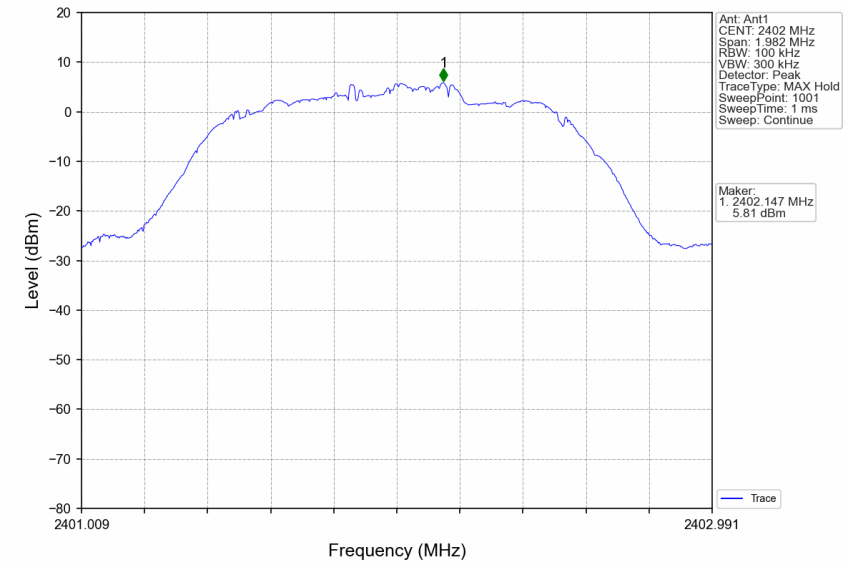
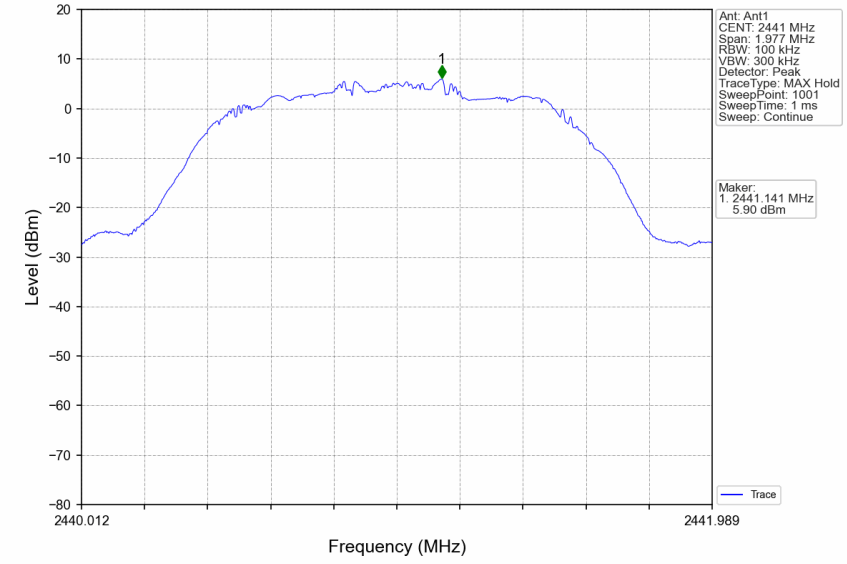
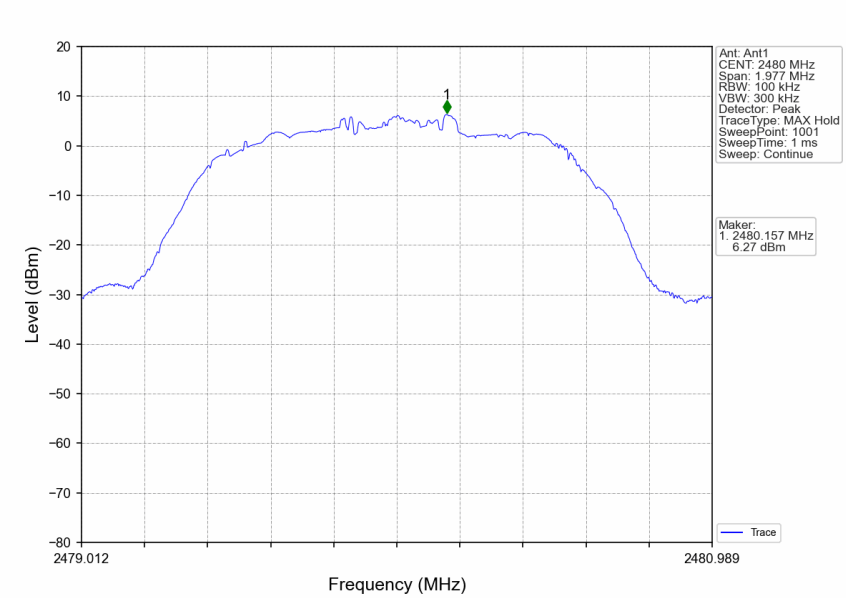


Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV



8DPSK_3DH5_LCH_2402MHz_Ant1_NTNV

8DPSK_3DH5_MCH_2441MHz_Ant1_NTNV


8DPSK_3DH5_HCH_2480MHz_Ant1_NTNV



6.2.2 CSE

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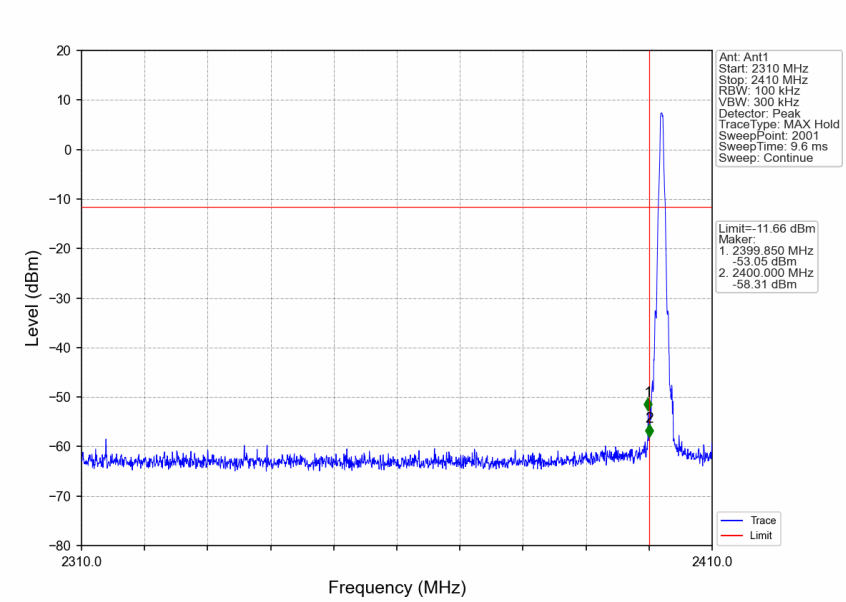
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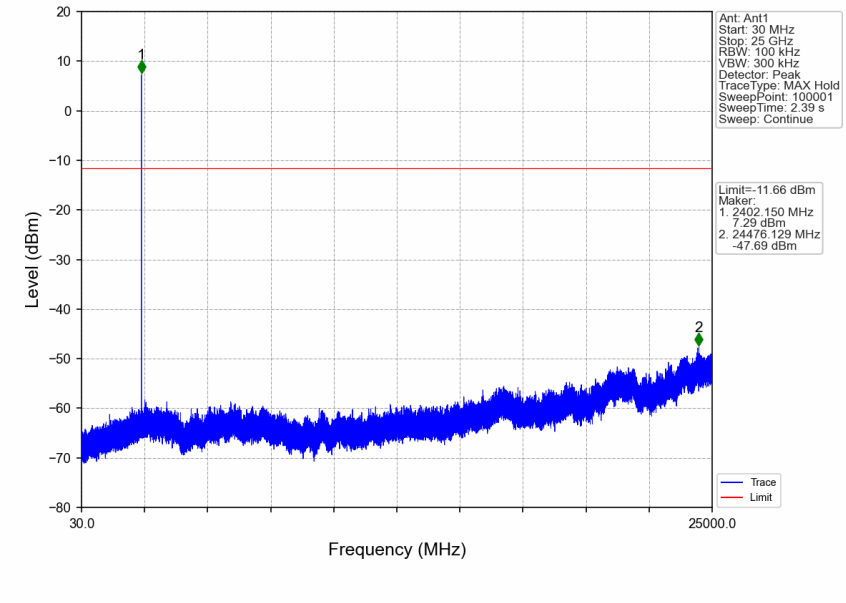
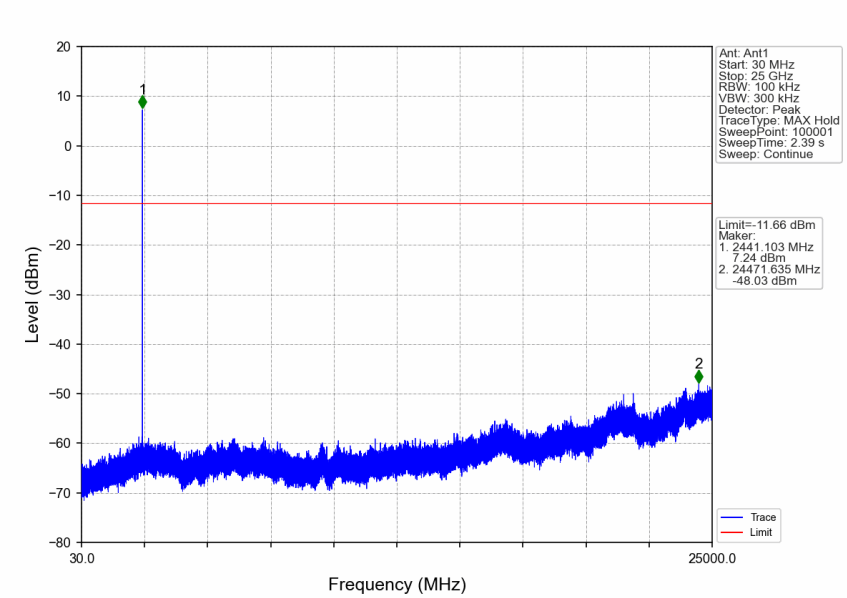
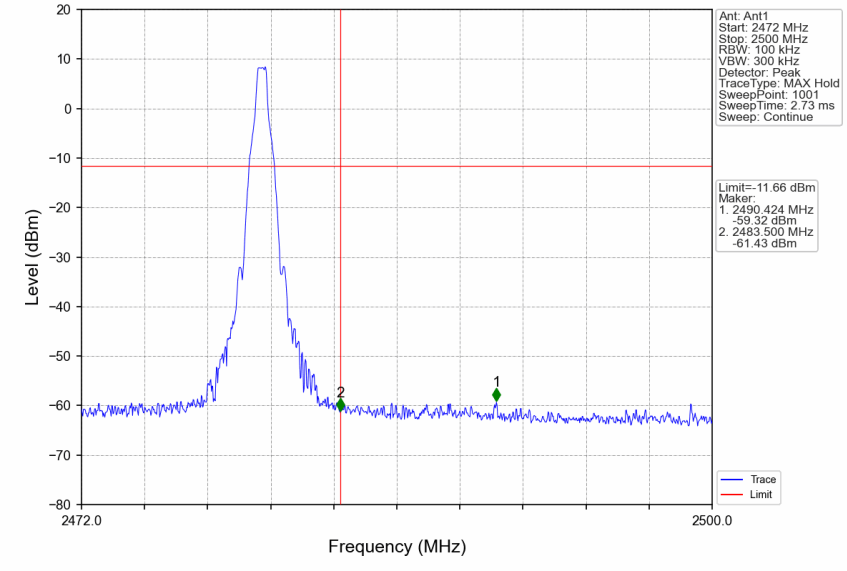


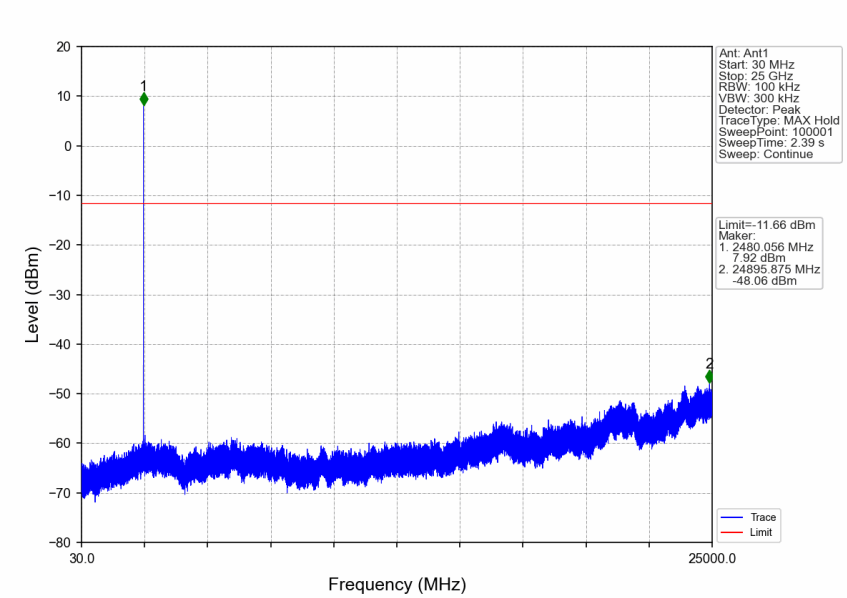
GFSK_DH5_MCH_2441MHz_Ant1_NTNV



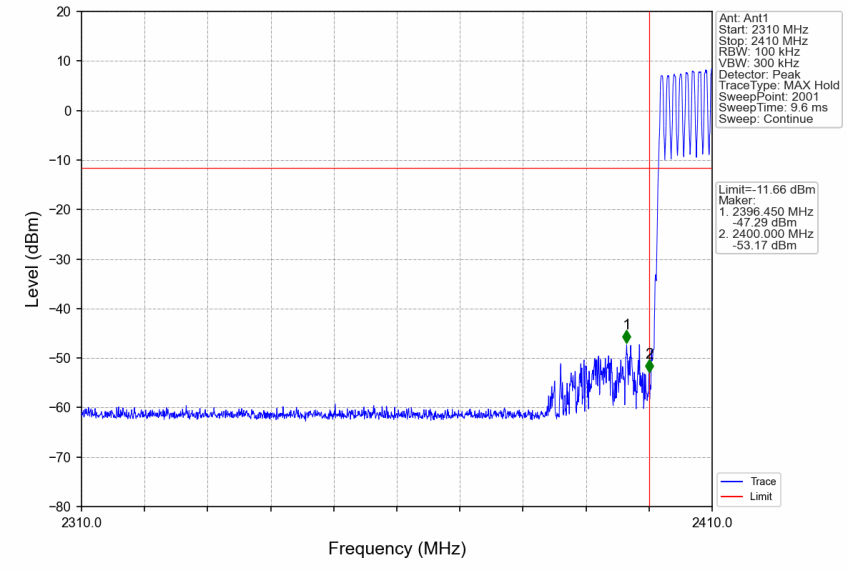
GFSK_DH5_HCH_2480MHz_Ant1_NTNV



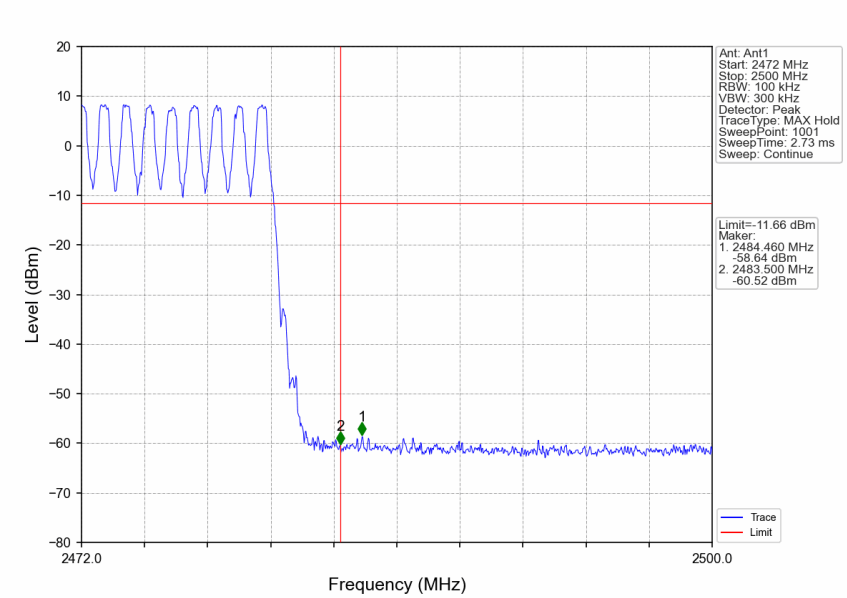
GFSK_DH5_HCH_2480MHz_Ant1_NTNV



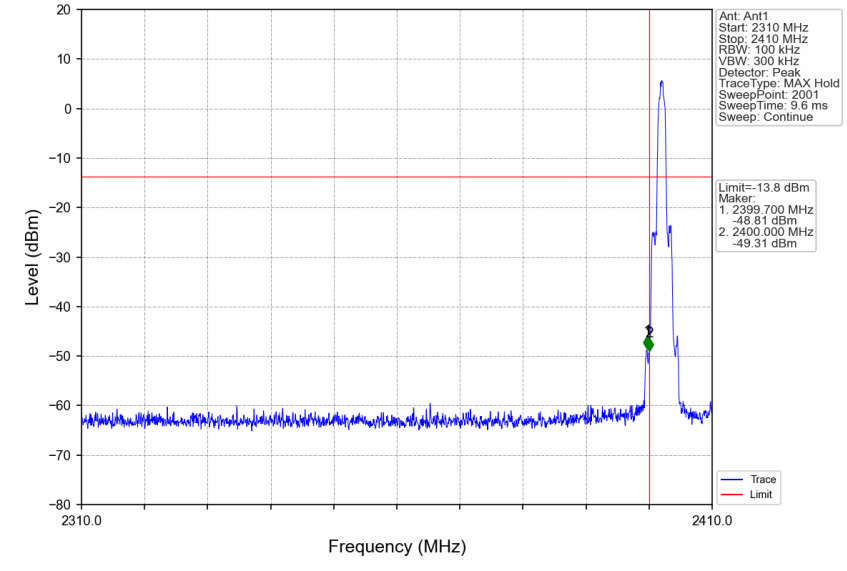
GFSK_DH5_HOPP_Ant1_NTNV



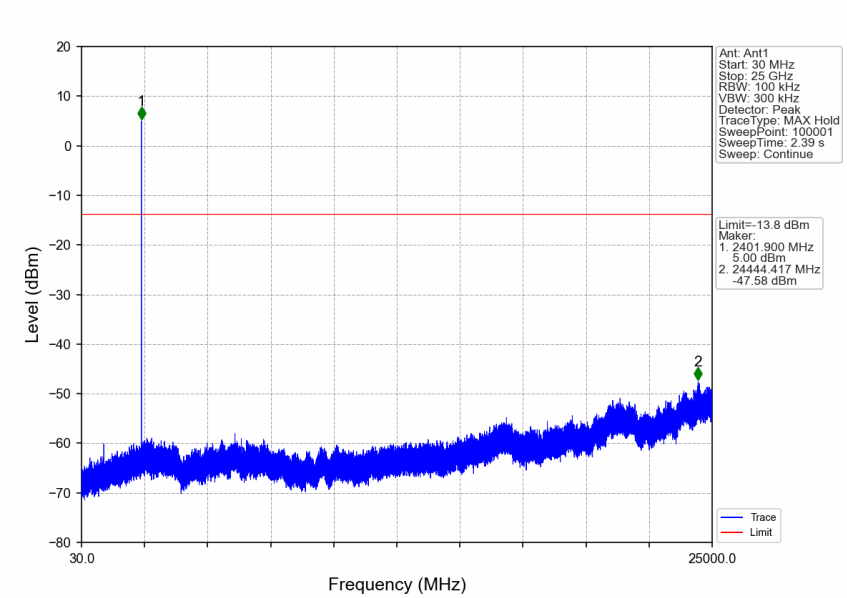
GFSK_DH5_HOPP_Ant1_NTNV



Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



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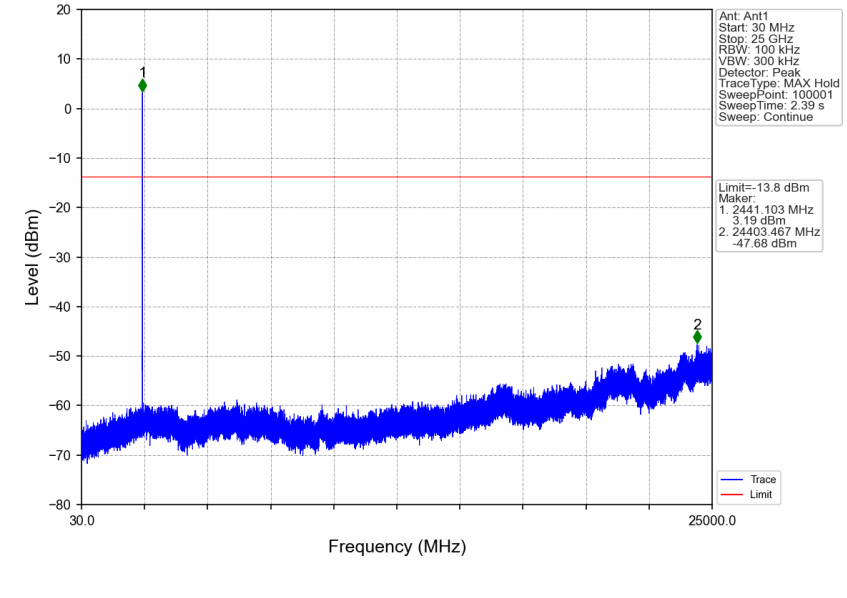

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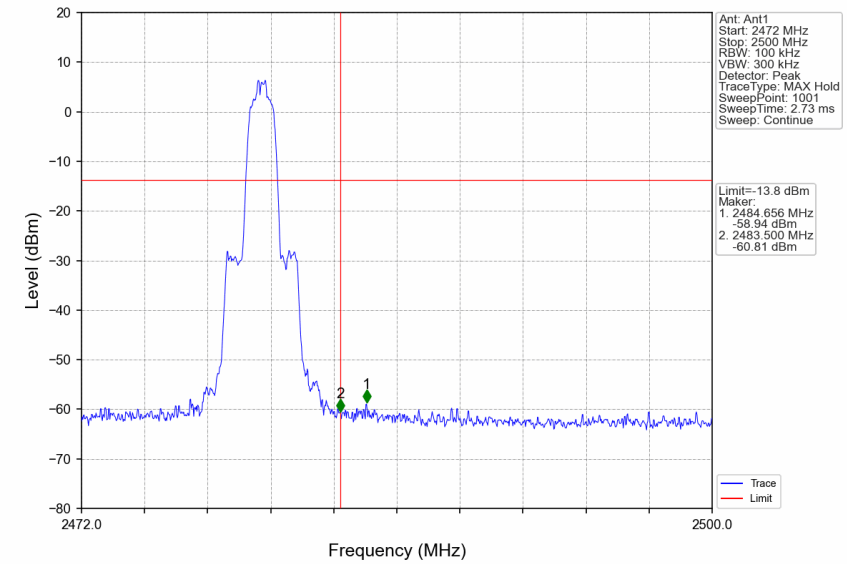
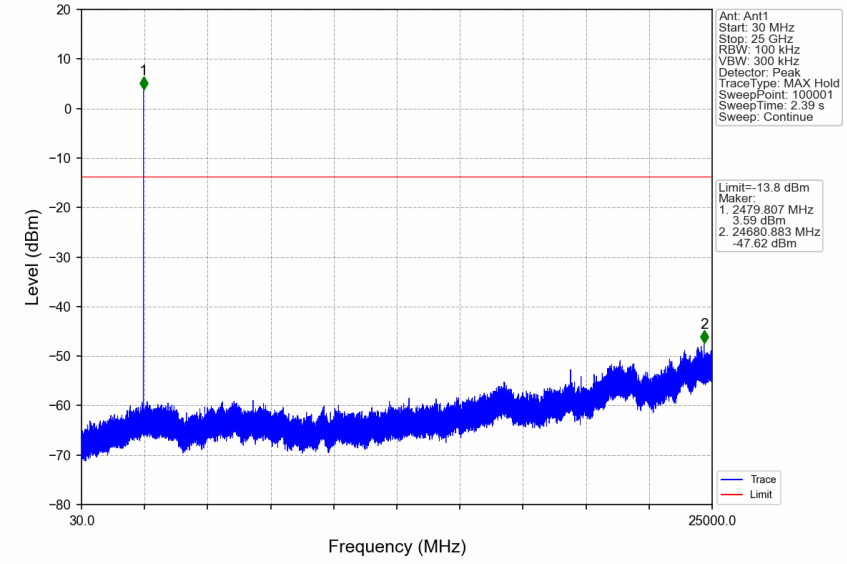


Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV



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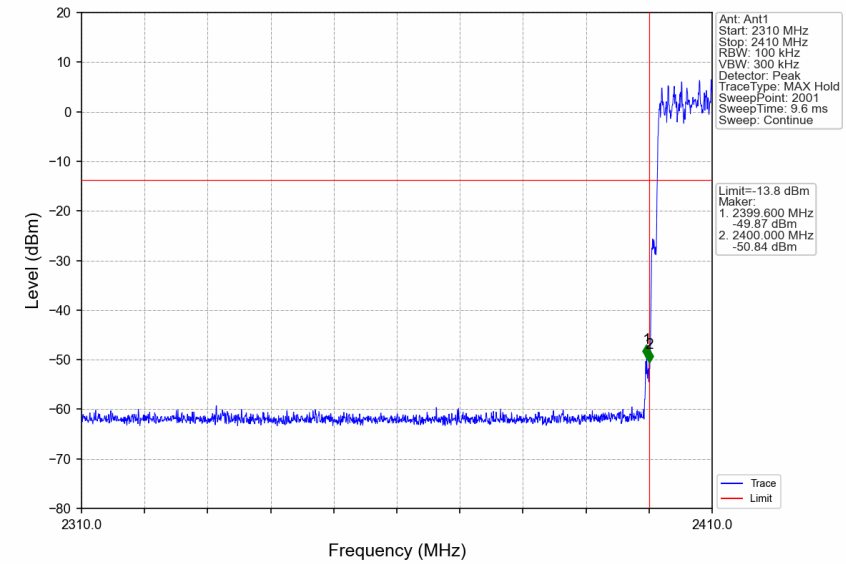

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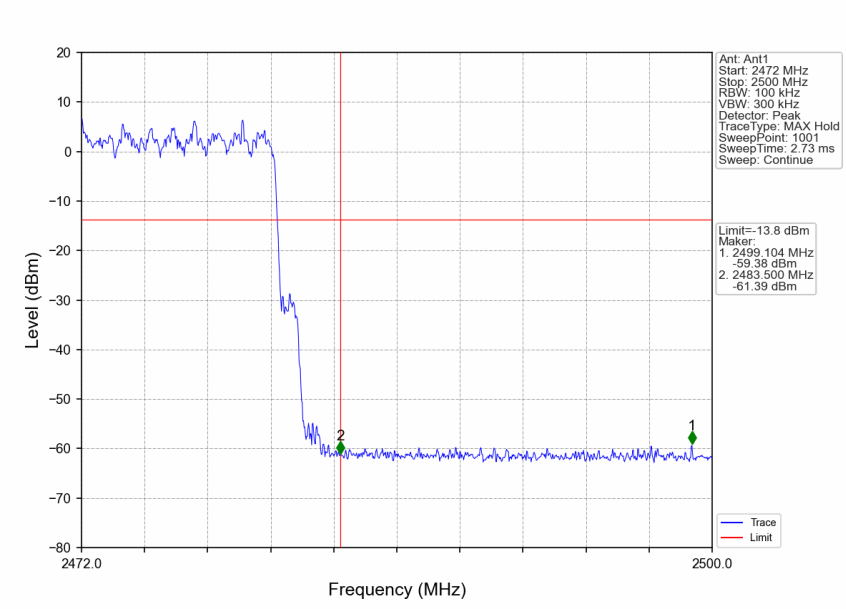

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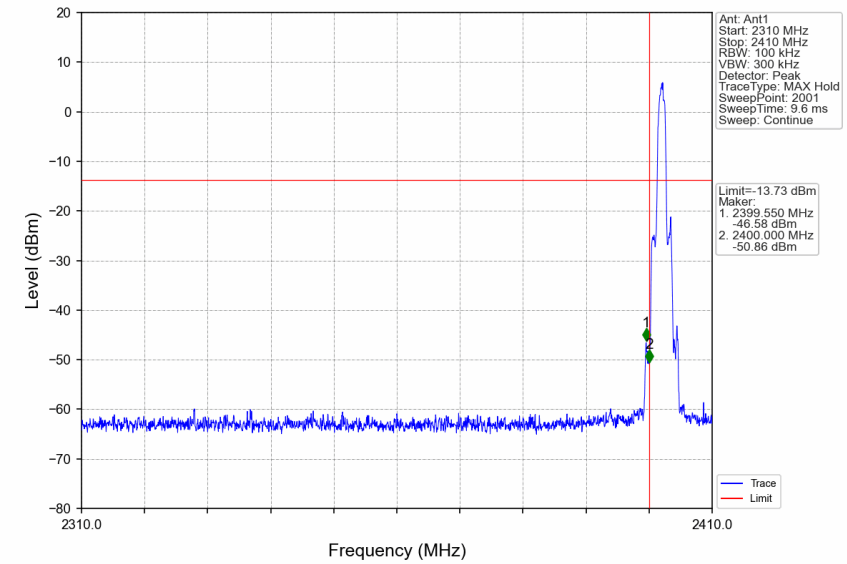

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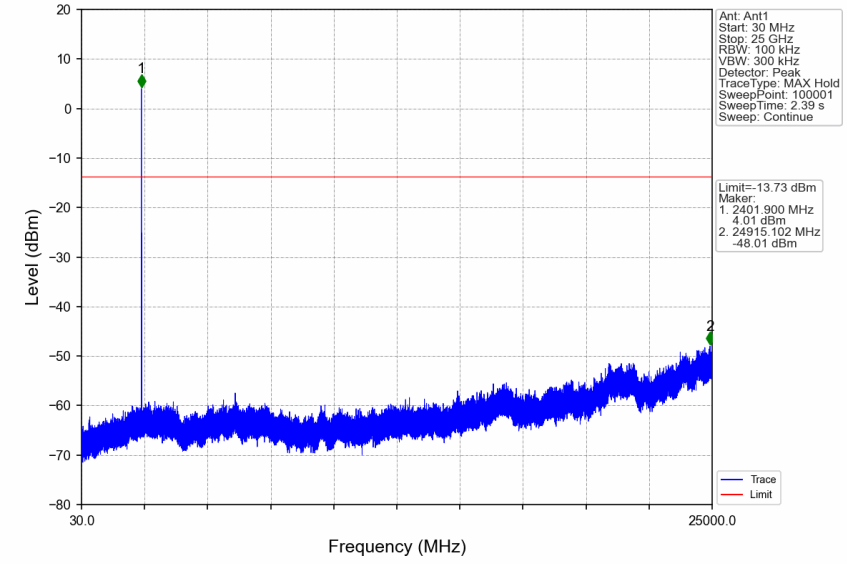

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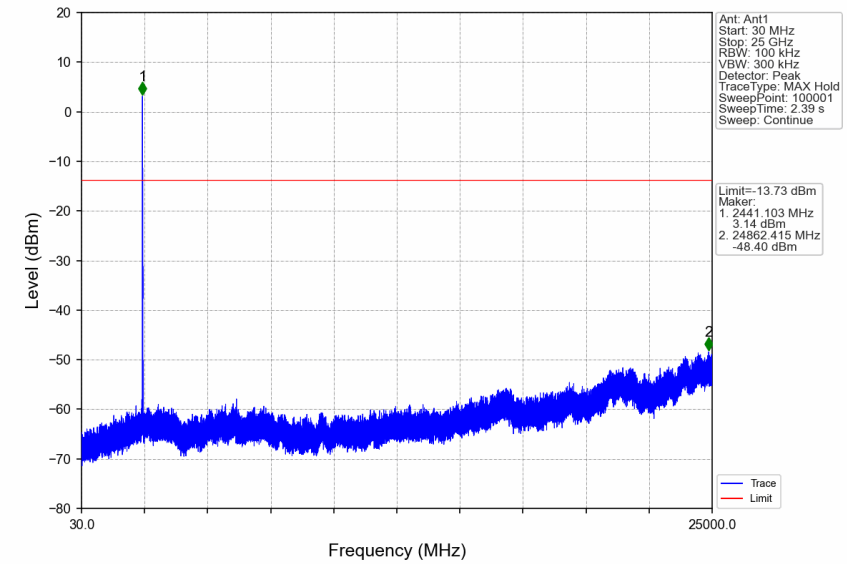
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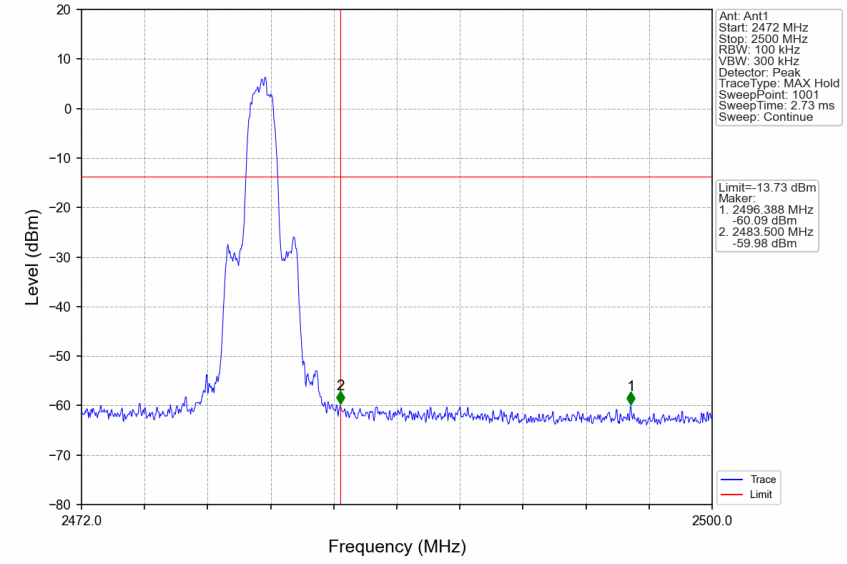

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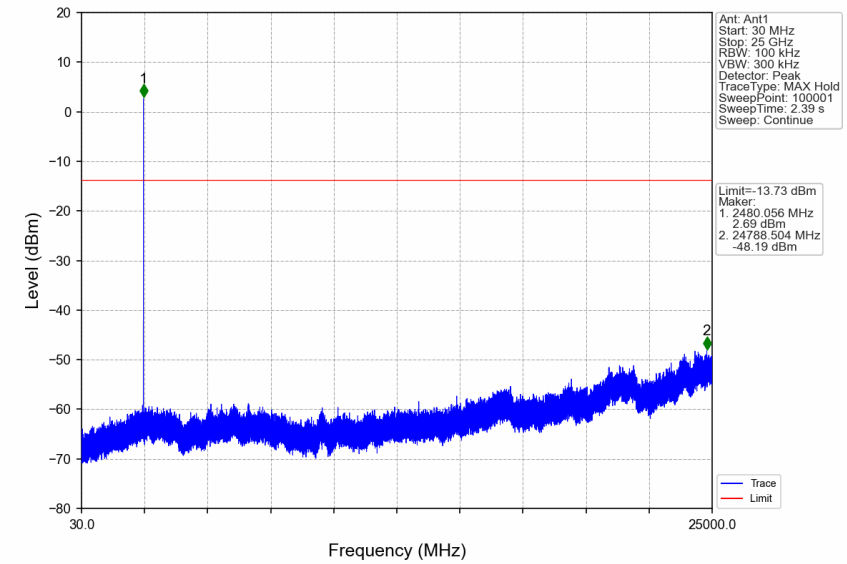
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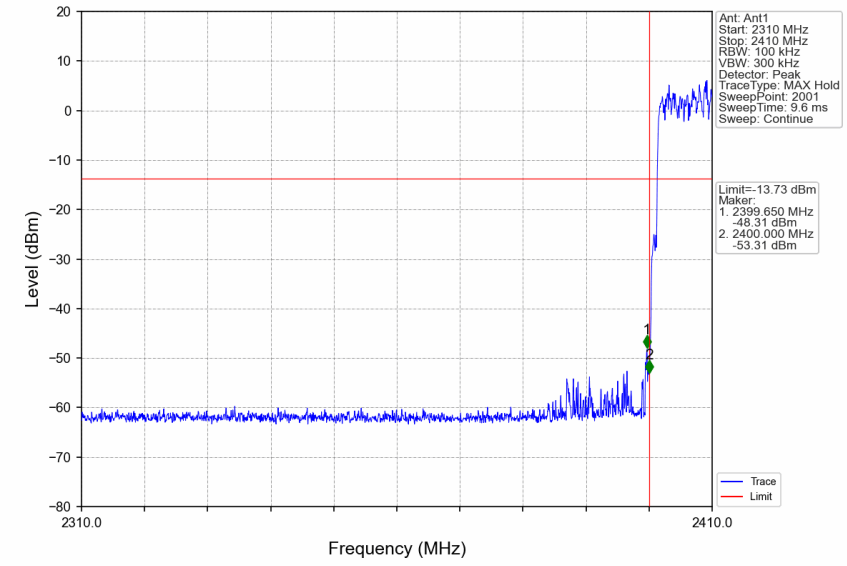
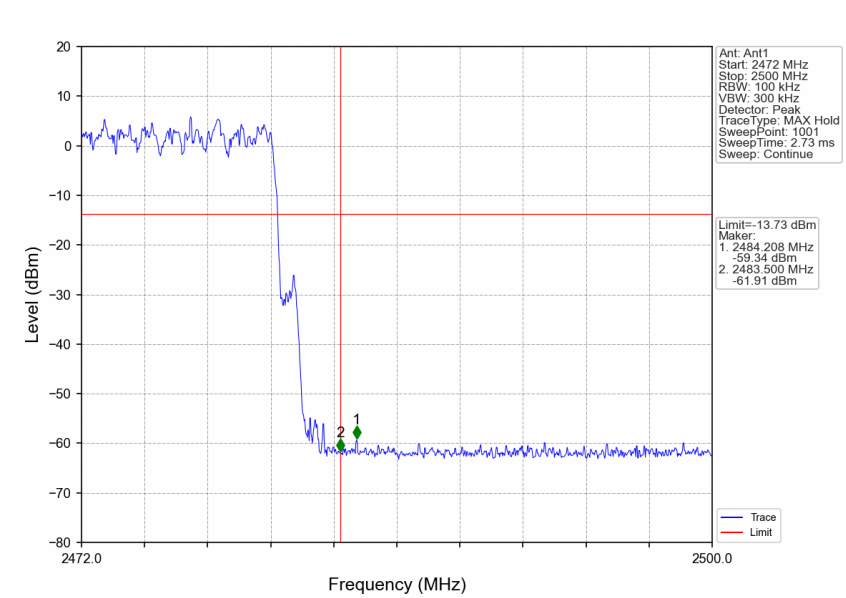


8DPSK_3DH5_HOPP_Ant1_NTNV



- End of the Report -