TEST REPORT

Application No.:	GZCR2307000774HS
Applicant:	ZHUHAI SPECIAL ECONOMIC ZONE RUNWIN ELECTRIC CO., LTD
Address of Applicant:	QINSHI INDUSTRIAL ZONE, NO.33 SANZAO TOWN, ZHUHAI, 519040, GUANGDONG PROVINCE, CHINA.
Manufacturer:	ZHUHAI SPECIAL ECONOMIC ZONE RUNWIN ELECTRIC CO., LTD
Address of Manufacturer:	QINSHI INDUSTRIAL ZONE, NO.33 SANZAO TOWN, ZHUHAI, 519040, GUANGDONG PROVINCE, CHINA.
Factory:	ZHUHAI SPECIAL ECONOMIC ZONE RUNWIN ELECTRIC CO., LTD
Address of Factory:	QINSHI INDUSTRIAL ZONE, NO.33 SANZAO TOWN, ZHUHAI, 519040, GUANGDONG PROVINCE, CHINA.
Equipment Under Test (EUT):	
EUT Name:	ELECTRIC PATIO HEATER
Model No.:	ZHQ1848-SPK-RM
Standard(s) :	47 CFR Part 15, Subpart C 15.247
Date of Receipt:	2023-07-26
Date of Test:	2023-07-31 to 2023-08-18
Date of Issue:	2023-09-05
Test Result:	**Pass***

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

Ricky Liu
Manager

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Revision Record			
Version	**Report No.**	**Date**	**Remark**
01	GZCR230700077402	2023-09-05	Original

Authorized for issue by				
		Michael Huang **Michael Huang/Project Engineer**		
		Vico Cui **Vico Cui/Reviewer**		

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2 Test Summary

Radio Spectrum Technical Requirement				
Item	**Standard**	**Method**	**Requirement**	**Result**
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)	Pass
Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence		N/A	47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)	Pass

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

Note:

E.U.T./EUT means Equipment Under Test.

Pass means the test result passed the test standard requirement, please find the detailed decision rule in the report relative section.

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4 General Information

4.1 Details of E.U.T.

Power supply:	AC 120V, 60Hz
Test voltage:	AC 120V, 60Hz
Cable(s):	3 wires x about 1.8m unscreened AC mains cable.
Operation Frequency:	2402MHz to 2480MHz
Bluetooth Version:	V5.0 classic only
Modulation Type:	GFSK, π/4DQPSK
Number of Channels:	79
Channel Spacing:	1MHz
Spectrum Spread Technology:	Frequency Hopping Spread Spectrum(FHSS)
Antenna Type:	PIFA
Antenna Gain:	1.9 dBi

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Mobile Phone	APPLE	iPhone 12 mini	F71DP3NG0GQY

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4.3 Measurement Uncertainty

Test Item	Measurement Uncertainty
Conducted Emissions at AC Power Line (150kHz-30MHz)	±2.76dB
Conducted Peak Output Power	± 0.75dB
20dB Bandwidth	± 3%
Carrier Frequencies Separation	± 7.25 x 10^{-8}
Hopping Channel Number	± 7.25 x 10^{-8}
Dwell Time	± 0.37%
Conducted Band Edges Measurement	± 0.75dB
Conducted Spurious Emissions	± 0.75dB
Radiated Emissions which fall in the restricted bands	±5.00dB (30MHz-1GHz; 3m) ±4.38dB (30MHz-1GHz; 10m) ± 5.12dB (1GHz-6GHz) ±5.38dB (6GHz-18GHz) ±5.61dB (18GHz-40GHz)
Radiated Spurious Emissions Below 1GHz	±5.00dB (3m) ±4.38dB (10m)
Radiated Spurious Emissions Above 1GHz	±5.12dB (1GHz-6GHz) ±5.38dB (6GHz-18GHz) ±5.61dB(18GHz-40GHz)

4.4 Test Location

All tests were performed at:

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No tests were sub-contracted.

4.5 Test Facility

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

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- **SGS UK(Certificate No.: 32), SGS-TUV SAARLAND and SGS-FIMKO**

Have approved SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory as a supplier of EMC TESTING SERVICES and SAFETY TESTING SERVICES.

- **FCC Recognized Accredited Test Firm(Registration No.: 486818)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: CN5016, Test Firm Registration Number: 486818.

- **ISED (Registration No.: 4620B, CAB identifier: CN0052)**

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- **VCCI (Registration No.: R-12460, C-12584, G-20107 and T-11179)**

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- **CBTL (Lab Code: TL129)**

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4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None

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5 Equipment List

Conducted Emissions at AC Power Line (150kHz-30MHz)					
Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal Date**	**Cal Due Date**
Coaxial Cable	HangTianXing	2m	EMC0107	2023-08-04	2024-08-03
Shielding Room	ChangZhou ZhongYu	8m x 3m x 3.8m	EMC0306	2022-10-16	2025-10-15
Two-Line V-Network-GZ	Rohde & Schwarz	ENV216	EMC2135	2022-09-09	2023-09-08
EMI Test Receiver (9kHz-3.6GHz)	Rohde & Schwarz	ESR3	EMC2221	2023-05-19	2024-05-18
Test Software E3r	Audix	Ver.6.11812	GZE100-77	N/A	N/A

Conducted Peak Output Power					
Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal Date**	**Cal Due Date**
MI CABLE	SGS-EMC	0.8M	EMC2137	2021-11-02	2023-11-01
EXA Signal Analyzer (10Hz-44GHz)	Keysight	N9010A	EMC2138	2023-08-23	2024-08-22
4X4 Power sensor Unit	TST	TSPS2023R	EMC2226	2023-08-23	2024-08-22
Test Software	TST	V2.0	GZE100-78	N/A	N/A

20dB Bandwidth					
Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal Date**	**Cal Due Date**
MI CABLE	SGS-EMC	0.8M	EMC2137	2021-11-02	2023-11-01
EXA Signal Analyzer (10Hz-44GHz)	Keysight	N9010A	EMC2138	2023-08-23	2024-08-22
4X4 Power sensor Unit	TST	TSPS2023R	EMC2226	2023-08-23	2024-08-22
Test Software	TST	V2.0	GZE100-78	N/A	N/A

Carrier Frequencies Separation					
Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal Date**	**Cal Due Date**
MI CABLE	SGS-EMC	0.8M	EMC2137	2021-11-02	2023-11-01
EXA Signal Analyzer (10Hz-44GHz)	Keysight	N9010A	EMC2138	2023-08-23	2024-08-22
4X4 Power sensor Unit	TST	TSPS2023R	EMC2226	2023-08-23	2024-08-22
Test Software	TST	V2.0	GZE100-78	N/A	N/A

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Hopping Channel Number					
Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal Date**	**Cal Due Date**
MI CABLE	SGS-EMC	0.8M	EMC2137	2021-11-02	2023-11-01
EXA Signal Analyzer (10Hz-44GHz)	Keysight	N9010A	EMC2138	2023-08-23	2024-08-22
4X4 Power sensor Unit	TST	TSPS2023R	EMC2226	2023-08-23	2024-08-22
Test Software	TST	V2.0	GZE100-78	N/A	N/A

Dwell Time					
Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal Date**	**Cal Due Date**
MI CABLE	SGS-EMC	0.8M	EMC2137	2021-11-02	2023-11-01
EXA Signal Analyzer (10Hz-44GHz)	Keysight	N9010A	EMC2138	2023-08-23	2024-08-22
4X4 Power sensor Unit	TST	TSPS2023R	EMC2226	2023-08-23	2024-08-22
Test Software	TST	V2.0	GZE100-78	N/A	N/A

Conducted Band Edges Measurement					
Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal Date**	**Cal Due Date**
MI CABLE	SGS-EMC	0.8M	EMC2137	2021-11-02	2023-11-01
EXA Signal Analyzer (10Hz-44GHz)	Keysight	N9010A	EMC2138	2023-08-23	2024-08-22
4X4 Power sensor Unit	TST	TSPS2023R	EMC2226	2023-08-23	2024-08-22
Test Software	TST	V2.0	GZE100-78	N/A	N/A

Conducted Spurious Emissions					
Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal Date**	**Cal Due Date**
MI CABLE	SGS-EMC	0.8M	EMC2137	2021-11-02	2023-11-01
EXA Signal Analyzer (10Hz-44GHz)	Keysight	N9010A	EMC2138	2023-08-23	2024-08-22
4X4 Power sensor Unit	TST	TSPS2023R	EMC2226	2023-08-23	2024-08-22
Test Software	TST	V2.0	GZE100-78	N/A	N/A

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Radiated Emissions which fall in the restricted bands					
Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal Date**	**Cal Due Date**
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2022-12-16	2023-12-15
EMI Test Receiver (10Hz-26.5GHz)	Rohde & Schwarz	ESIB26	EMC0522	2022-12-16	2023-12-15
Chamber cable (Above 1GHz)	Scoflex	KMKM-8.0m	EMC0545	2022-08-24	2024-08-23
Horn Antenna (1GHz-18GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2022-09-23	2025-09-22
Horn Antenna (14-40GHz)	SCHWARZBECK	BBHA 9170	EMC2041	2023-06-18	2026-06-17
EXA Signal Analyzer (10Hz-44GHz)	Keysight	N9010A	EMC2138	2023-08-23	2024-08-22
MXE EMI Receiver (10Hz-8.4GHz)	Keysight	N9038A	EMC2139	2022-10-21	2023-10-20
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2020-12-20	2023-12-19
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A

Radiated Spurious Emissions Below 1GHz					
Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal Date**	**Cal Due Date**
966 Anechoic Chamber	Shenzhen C.R.T	CRTSGSSAC966	EMC2230	2022-04-12	2025-04-11
EMI Test Receiver(1Hz-8GHz)	Rohde & Schwarz	ESW8	EMC2229	2023-02-20	2024-02-19
Amplifier(9k-1000MHz)	SONOMA	310	EMC2237	2023-04-13	2024-04-12
TRILOG Broadband Antenna（25M-2GHz)	SCHWRZBECK	VULB 9168	EMC2238	2022-04-20	2025-04-19
Coaxial Cable	Times Microwave	BL03-NMNM-6	EMC2239	2023-06-14	2025-06-13
Test Software E3	Audix	Ver.6.191211	GZE100-81	N/A	N/A
Active Loop Antenna-RED	ETS-Lindgren	6502	EMC2190	2022-04-06	2024-04-05

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Radiated Spurious Emissions Above 1GHz					
Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal Date**	**Cal Due Date**
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2022-12-16	2023-12-15
EMI Test Receiver (10Hz-26.5GHz)	Rohde & Schwarz	ESIB26	EMC0522	2022-12-16	2023-12-15
Chamber cable (Above 1GHz)	Scoflex	KMKM-8.0m	EMC0545	2022-08-24	2024-08-23
Horn Antenna (1GHz-18GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2022-09-23	2025-09-22
Horn Antenna (14-40GHz)	SCHWARZBECK	BBHA 9170	EMC2041	2023-06-18	2026-06-17
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2022-12-16	2023-12-15
EXA Signal Analyzer (10Hz-44GHz)	Keysight	N9010A	EMC2138	2023-08-23	2024-08-22
MXE EMI Receiver (10Hz-8.4GHz)	Keysight	N9038A	EMC2139	2022-10-21	2023-10-20
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2020-12-20	2023-12-19
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A

General used equipment					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
DMM	Fluke	73	EMC0006	2023-06-11	2024-06-10

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6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

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

6.1.2 Conclusion

Standard Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.15.247(b) (4) requirement:

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

EUT Antenna:

The antenna is integrated on the main PCB and no consideration of replacement.

The best case gain of the antenna is 1.9 dBi.

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.

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

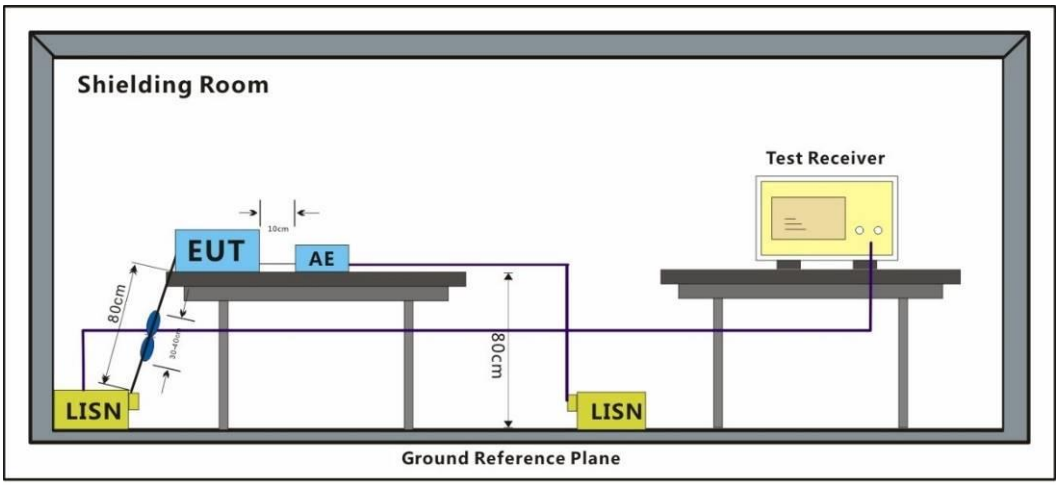
Operating Environment:

Temperature: 22.9 °C Humidity: 55.8 % RH Atmospheric Pressure: 1002 mbar

7.1.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	09	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



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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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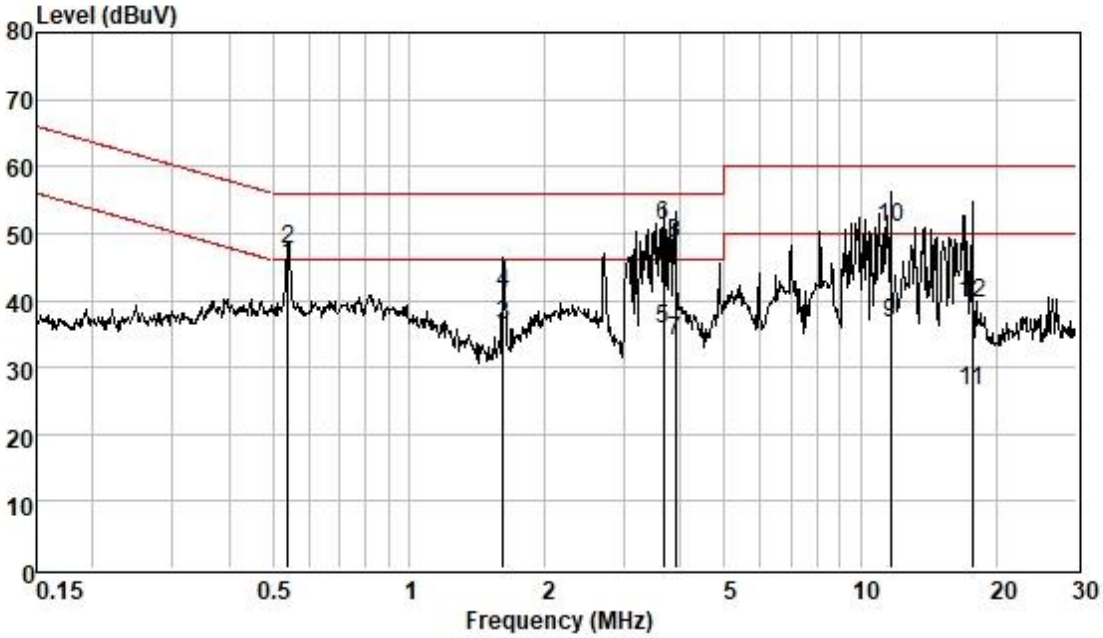
Test Mode: 09; Line: Live line



Pol :LINE
Mode :
Model :
Power :

	Frequenc MHz	Read Level dBuV	Cable Loss dB	LISN Factor dB	Measured Level dBuV	Limit Line dBuV	Over Limit dB	Remark
1	0.541	35.54	0.07	9.60	45.21	46.00	-0.79	Average
2	0.541	37.93	0.07	9.60	47.60	56.00	-8.40	QP
3	1.619	26.62	0.10	9.61	36.33	46.00	-9.67	Average
4	1.619	31.36	0.10	9.61	41.07	56.00	-14.93	QP
5	3.661	26.06	0.15	9.63	35.84	46.00	-10.16	Average
6	3.661	41.46	0.15	9.63	51.24	56.00	-4.76	QP
7	3.881	24.02	0.16	9.63	33.81	46.00	-12.19	Average
8	3.881	38.79	0.16	9.63	48.58	56.00	-7.42	QP
9	11.621	26.78	0.25	9.68	36.71	50.00	-13.29	Average
10	11.621	40.81	0.25	9.68	50.74	60.00	-9.26	QP
11	17.661	16.36	0.33	9.69	26.38	50.00	-23.62	Average
12	17.661	29.41	0.33	9.69	39.43	60.00	-20.57	QP

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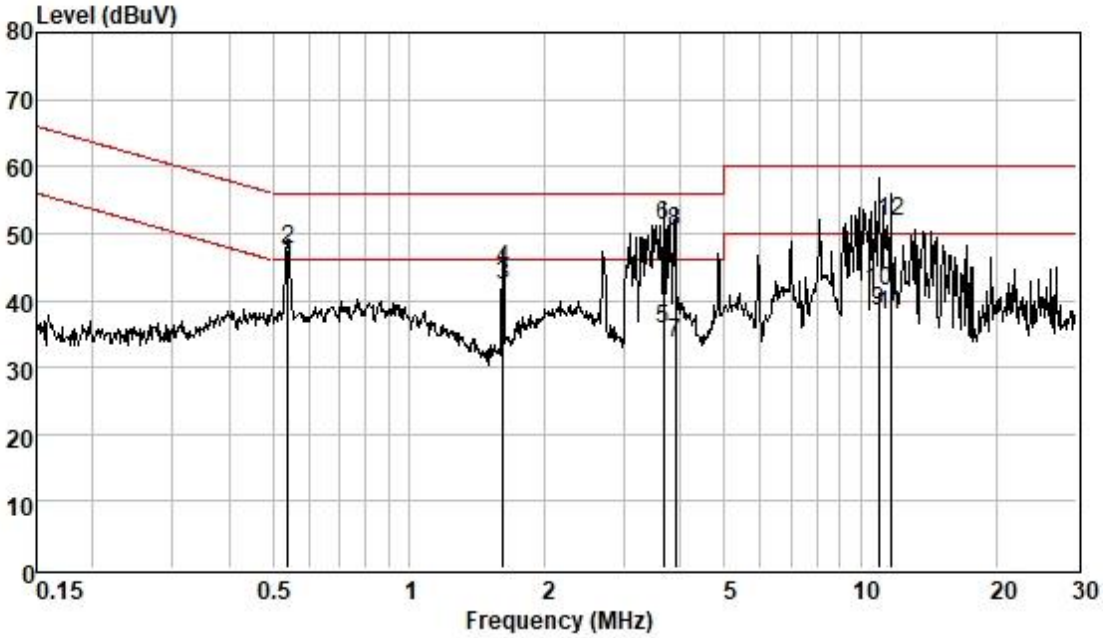
Test Mode: 09; Line: Neutral Line



Pol :NEUTRAL
Mode :
Model :
Power :

	Frequenc MHz	Read Level dBuV	Cable Loss dB	LISN Factor dB	Measured Level dBuV	Limit Line dBuV	Over Limit dB	Remark
1	0.541	35.68	0.07	9.61	45.36	46.00	-0.64	Average
2	0.541	37.95	0.07	9.61	47.63	56.00	-8.37	QP
3	1.619	32.65	0.10	9.60	42.35	46.00	-3.65	Average
4	1.619	34.99	0.10	9.60	44.69	56.00	-11.31	QP
5	3.661	25.81	0.15	9.64	35.60	46.00	-10.40	Average
6	3.661	41.38	0.15	9.64	51.17	56.00	-4.83	QP
7	3.881	23.90	0.16	9.64	33.70	46.00	-12.30	Average
8	3.881	40.41	0.16	9.64	50.21	56.00	-5.79	QP
9	10.963	28.42	0.24	9.73	38.39	50.00	-11.61	Average
10	10.963	31.24	0.24	9.73	41.21	60.00	-18.79	QP
11	11.621	27.89	0.25	9.74	37.88	50.00	-12.12	Average
12	11.621	41.85	0.25	9.74	51.84	60.00	-8.16	QP

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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: 25.1 °C Humidity: 54.5 % RH Atmospheric Pressure: 1002 mbar

7.2.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	09	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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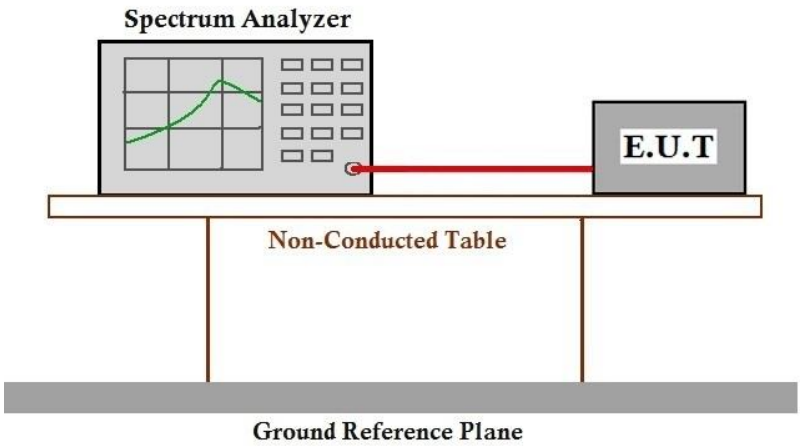
7.2.3 Test Setup Diagram



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

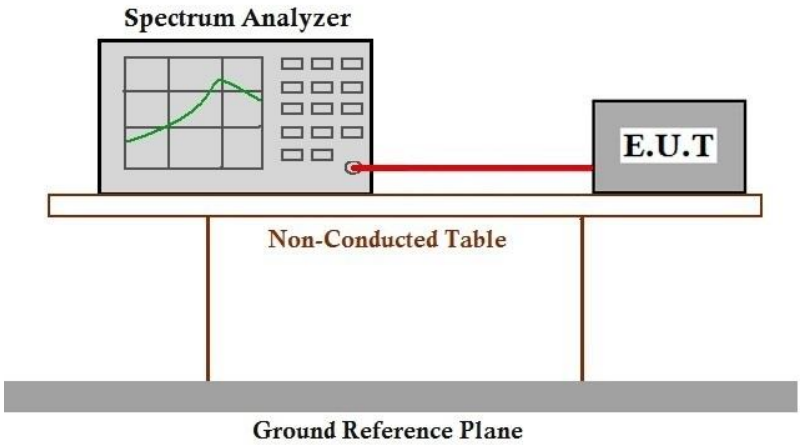
Operating Environment:

Temperature: 25.1 °C Humidity: 54.5 % RH Atmospheric Pressure: 1002 mbar

7.3.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	09	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

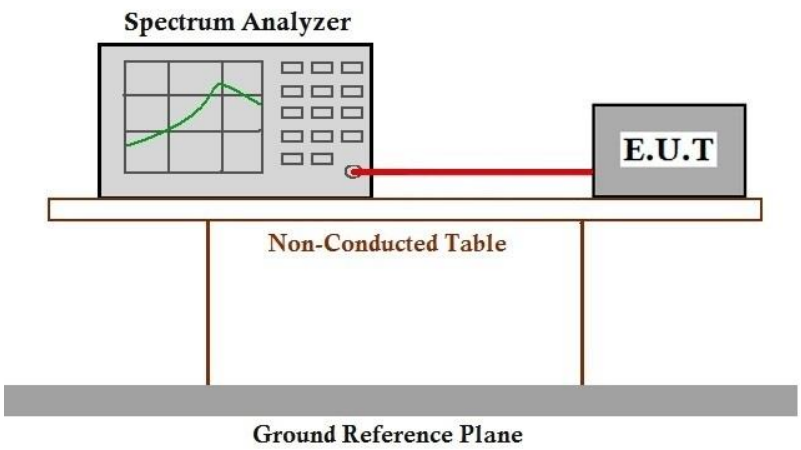
Operating Environment:

Temperature: 25.1 °C Humidity: 54.5 % RH Atmospheric Pressure: 1002 mbar

7.4.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	09	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



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

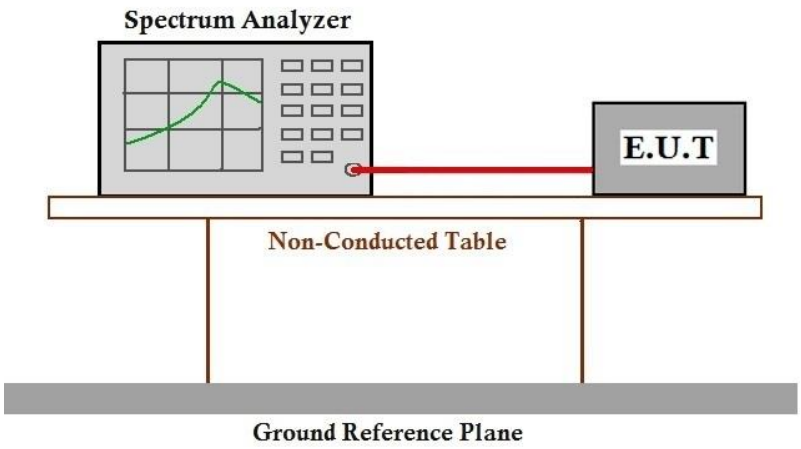
Operating Environment:

Temperature: 25.1 °C Humidity: 54.5 % RH Atmospheric Pressure: 1002 mbar

7.5.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	09	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

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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

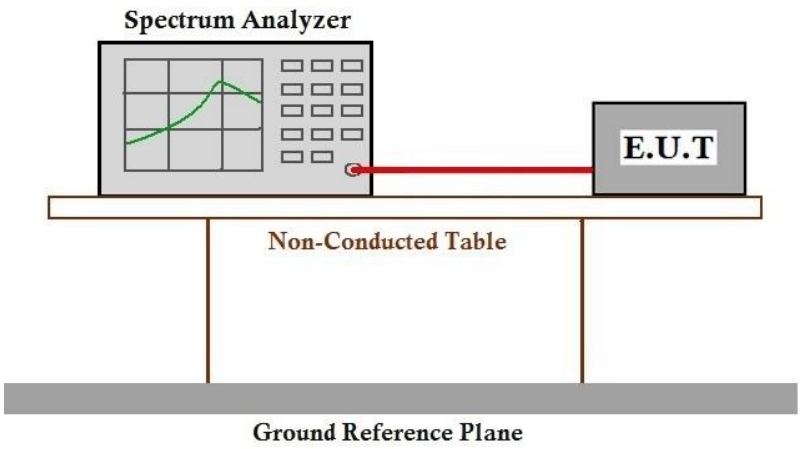
Operating Environment:

Temperature: 25.1 °C Humidity: 54.5 % RH Atmospheric Pressure: 1002 mbar

7.6.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	09	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

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7.7 Conducted Band Edges Measurement

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

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

Limit:

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

7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 25.1 °C Humidity: 54.5 % RH Atmospheric Pressure: 1002 mbar

7.7.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	09	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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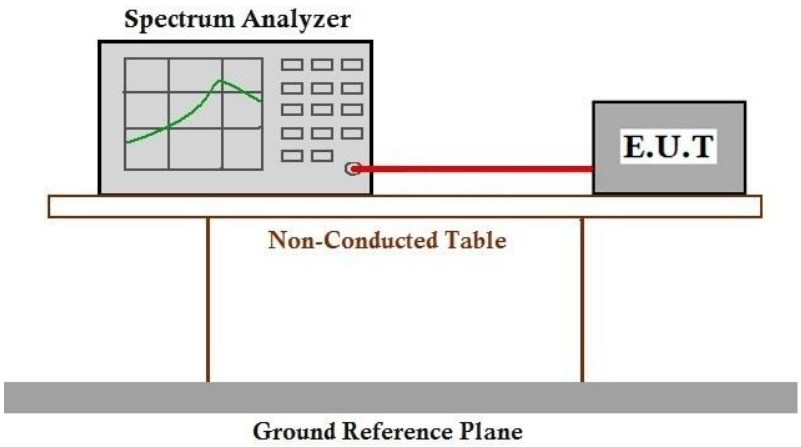
7.7.3 Test Setup Diagram



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: 25.1 °C Humidity: 54.5 % RH Atmospheric Pressure: 1002 mbar

7.8.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	09	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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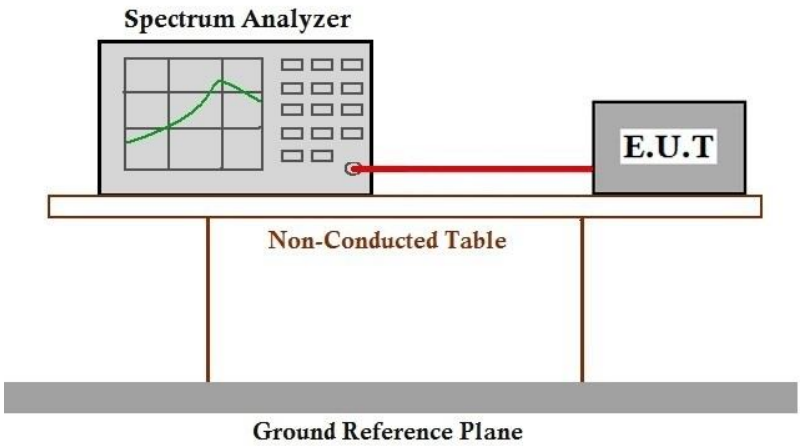
7.8.3 Test Setup Diagram



7.8.4 Measurement Procedure and Data

Please Refer to Appendix for Details

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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:

Test Distance: 3 m

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: 25.2 °C Humidity: 50.4 % RH Atmospheric Pressure: 1002 mbar

7.9.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	09	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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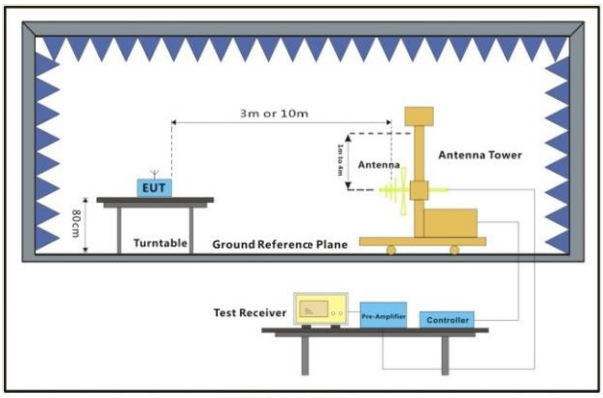
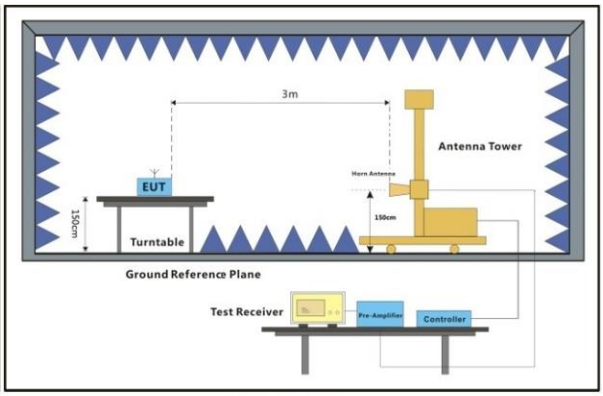
7.9.3 Test Setup Diagram



30MHz-1GHz



Above 1GHz

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 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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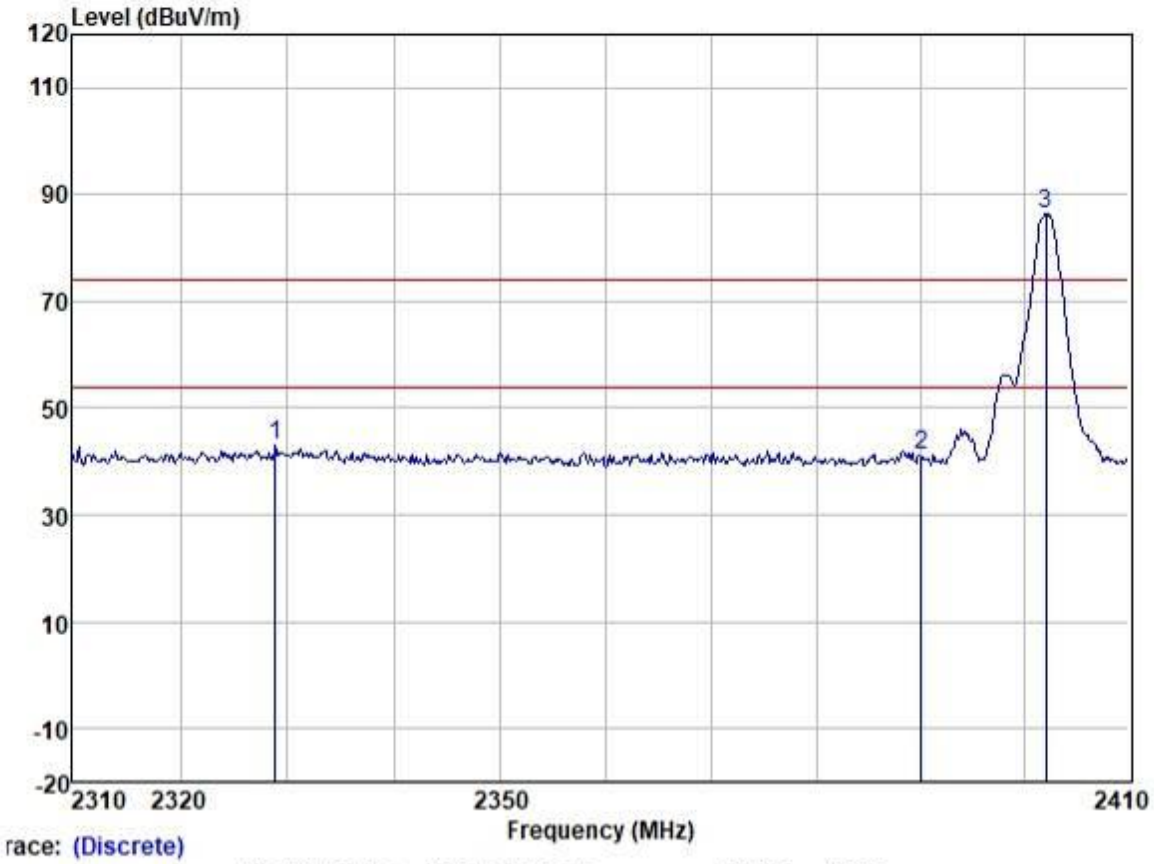
Test Mode: 09; Polarity: Vertical; Modulation:GFSK; Channel:Low



	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2328.873	48.47	27.54	4.85	37.79	43.07	74.00	-30.93	VERTICAL	Peak
2	2390.000	46.95	27.68	4.22	37.76	41.09	74.00	-32.91	VERTICAL	Peak
3 *	2402.000	92.29	27.71	4.11	37.76	86.35	74.00	12.35	VERTICAL	Peak

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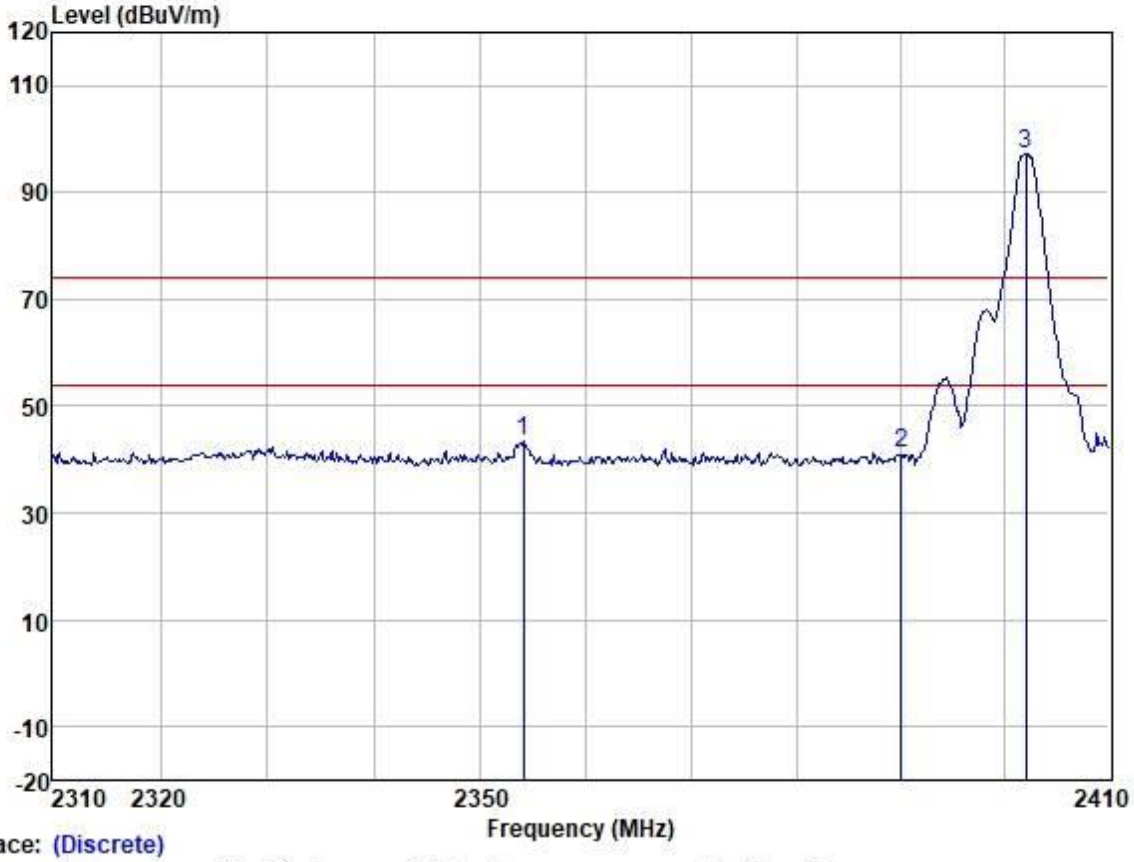
Test Mode: 09; Polarity: Horizontal; Modulation:GFSK; Channel:Low



race: (Discrete)

	Freq	ReadLevel	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2354.077	48.97	27.61	4.53	37.78	43.33	74.00	-30.67	HORIZONTAL	Peak
2	2390.000	46.96	27.68	4.22	37.76	41.10	74.00	-32.90	HORIZONTAL	Peak
3 *	2402.000	103.08	27.71	4.11	37.76	97.14	74.00	23.14	HORIZONTAL	Peak

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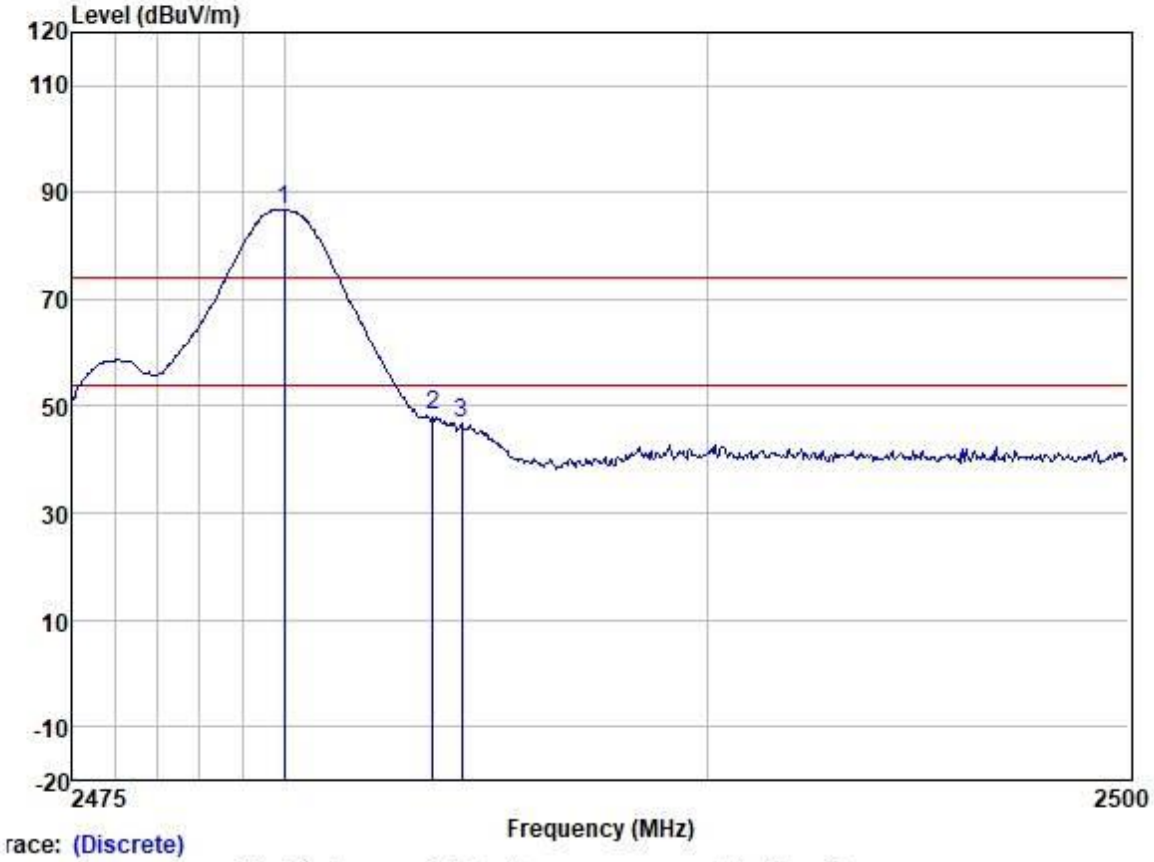
Test Mode: 09; Polarity: Vertical; Modulation:GFSK; Channel:High



race: (Discrete)

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1 *	2480.000	93.11	27.84	3.50	37.73	86.72	74.00	12.72	VERTICAL	Peak
2	2483.500	54.64	27.85	3.42	37.73	48.18	74.00	-25.82	VERTICAL	Peak
3	2484.171	53.30	27.85	3.42	37.73	46.84	74.00	-27.16	VERTICAL	Peak

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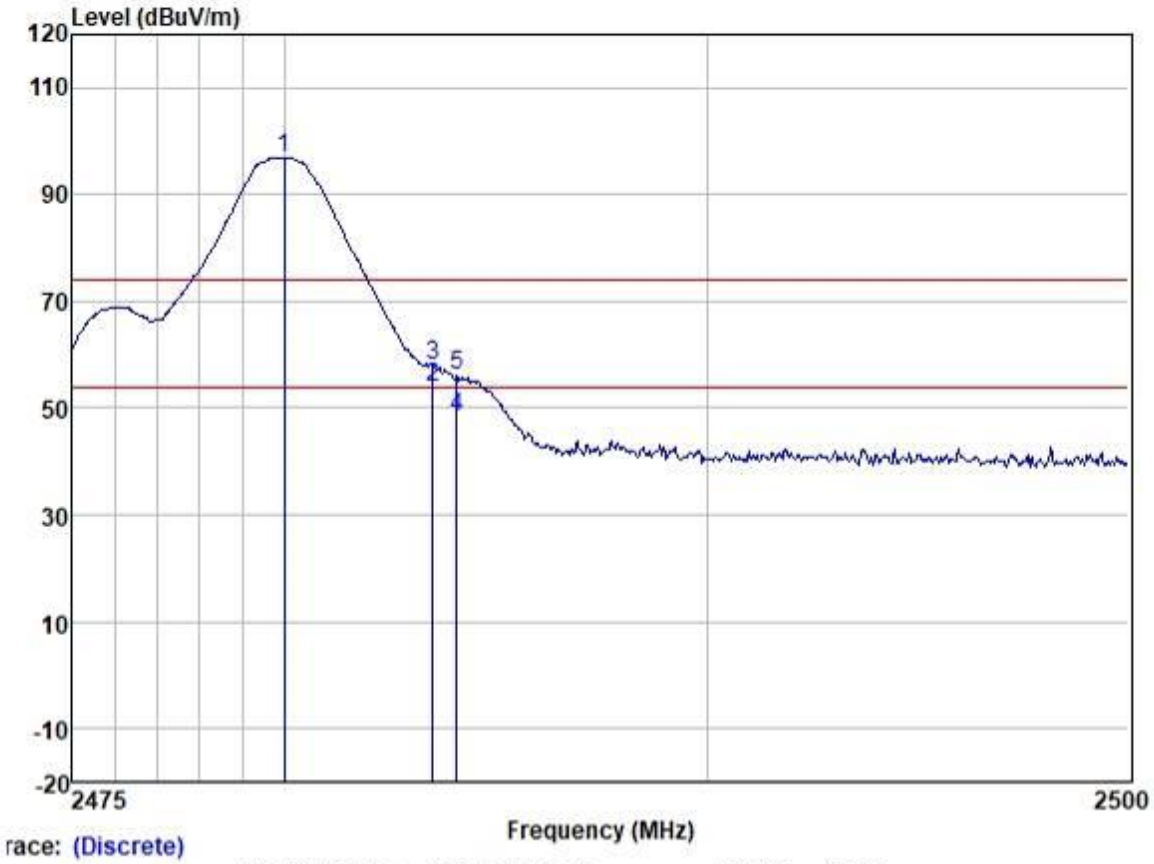
Test Mode: 09; Polarity: Horizontal; Modulation:GFSK; Channel:High



race: (Discrete)

		Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
		MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	*	2480.000	103.37	27.84	3.50	37.73	96.98	74.00	22.98	HORIZONTAL	Peak
2		2483.500	60.29	27.85	3.42	37.73	53.83	54.00	-0.17	HORIZONTAL	Average
3		2483.500	64.51	27.85	3.42	37.73	58.05	74.00	-15.95	HORIZONTAL	Peak
4		2484.071	54.60	27.85	3.42	37.73	48.14	54.00	-5.86	HORIZONTAL	Average
5		2484.071	62.56	27.85	3.42	37.73	56.10	74.00	-17.90	HORIZONTAL	Peak

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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:

Test Distance: 3 m

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

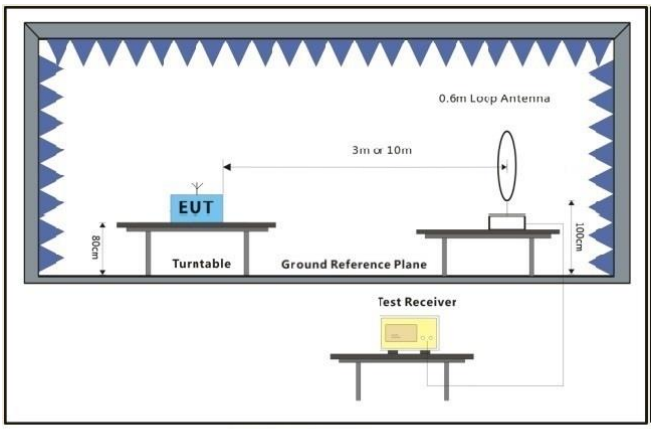
Operating Environment:

Temperature: 22.7 °C Humidity: 53.1 % RH Atmospheric Pressure: 1006 mbar

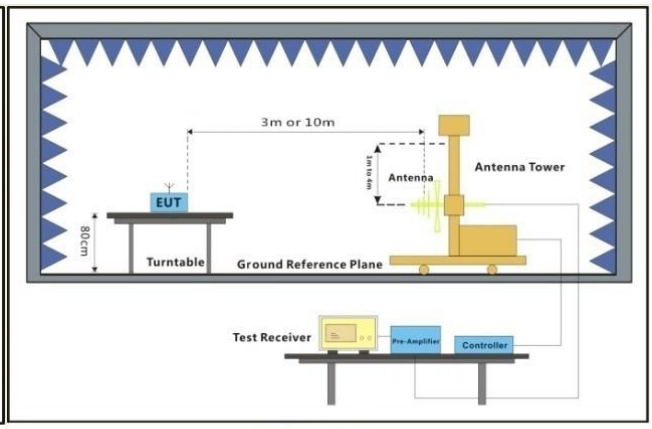
7.10.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	09	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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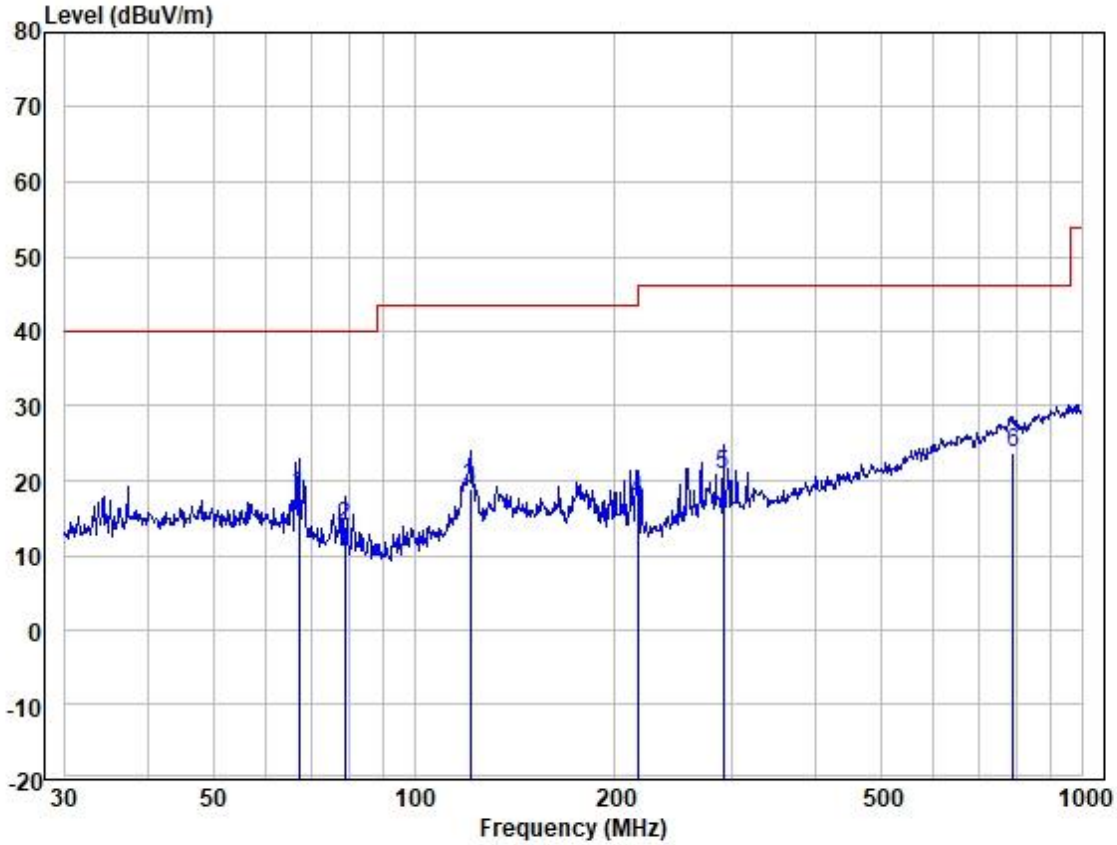
Test Mode: 09; Polarity: Horizontal



Site : 966 Chamber
Job :
Model :
Power :
Test Mode : BT

	Freq	Read Level	Anterna Factor	Cable Loss	Preamp Factor	Measured Level	Limit Line	Over Limit	Pol/ Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	67.202	32.72	17.68	0.45	32.80	18.05	40.00	-21.95	HORIZONTAL	QP
2	78.689	30.51	15.53	0.50	32.80	13.74	40.00	-26.26	HORIZONTAL	QP
3	121.549	33.84	17.35	0.60	32.80	18.99	43.52	-24.53	HORIZONTAL	QP
4	216.024	33.65	15.66	0.81	32.80	17.32	46.02	-28.70	HORIZONTAL	QP
5	290.017	33.46	19.08	0.97	32.80	20.71	46.02	-25.31	HORIZONTAL	QP
6	787.851	25.93	28.39	1.65	32.32	23.65	46.02	-22.37	HORIZONTAL	QP

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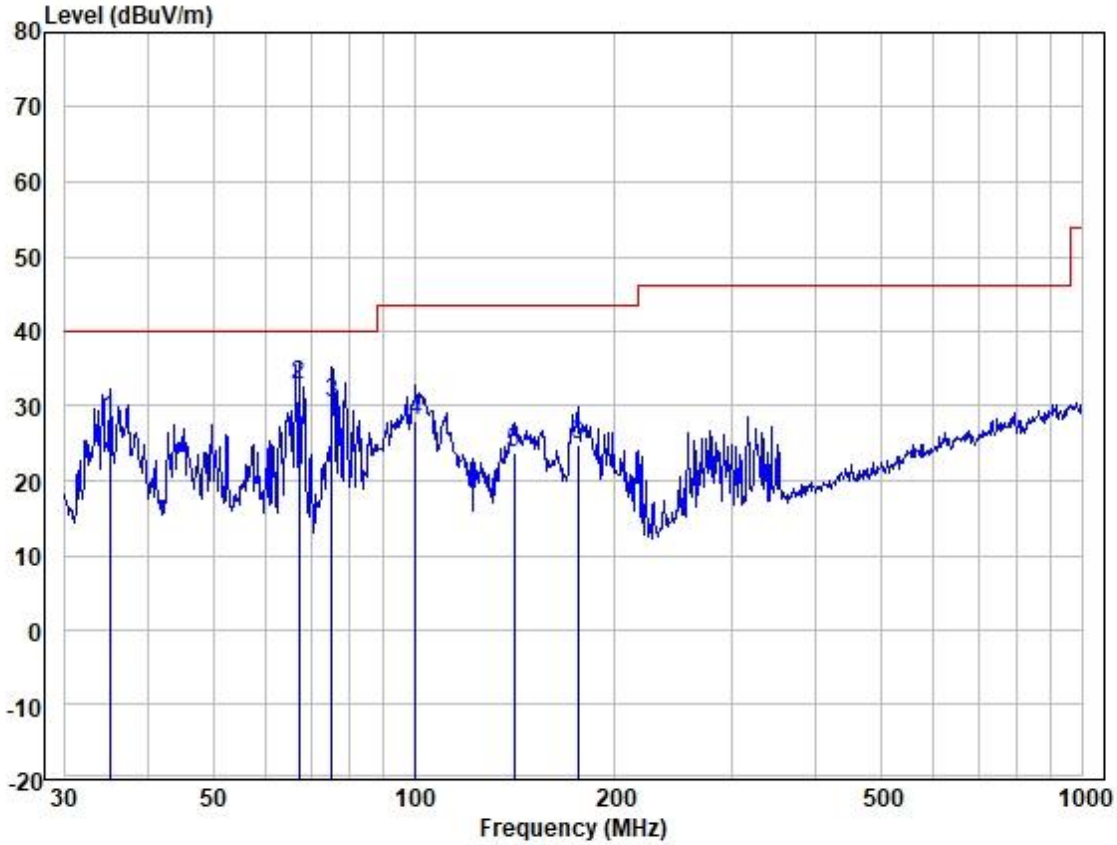
Test Mode: 09; Polarity: Vertical



Site : 966 Chamber
Job :
Model :
Power :
Test Mode : BT

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Measured Level	Limit Line	Over Limit	Pol/ Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	35.005	42.60	18.23	0.32	32.85	28.30	40.00	-11.70	VERTICAL	QP
2	67.202	47.38	17.68	0.45	32.80	32.71	40.00	-7.29	VERTICAL	QP
3	75.446	46.54	16.07	0.48	32.80	30.29	40.00	-9.71	VERTICAL	QP
4	100.581	45.43	14.71	0.54	32.80	27.88	43.52	-15.64	VERTICAL	QP
5	141.330	37.12	18.70	0.64	32.80	23.66	43.52	-19.86	VERTICAL	QP
6	175.652	38.63	18.20	0.74	32.80	24.77	43.52	-18.75	VERTICAL	QP

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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

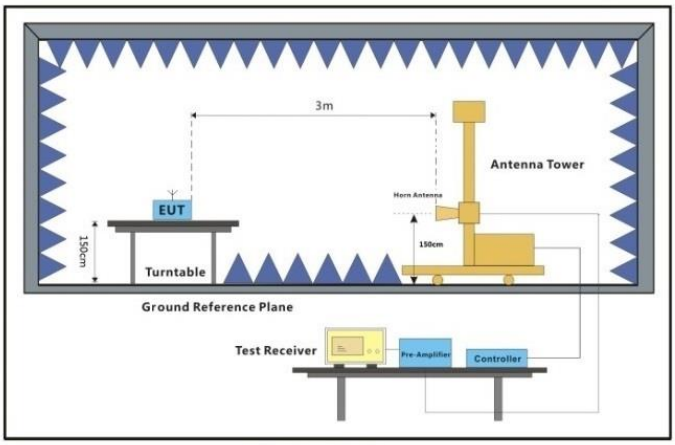
Operating Environment:

Temperature: 25.2 °C Humidity: 50.4 % RH Atmospheric Pressure: 1002 mbar

7.11.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	09	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



Above 1GHz

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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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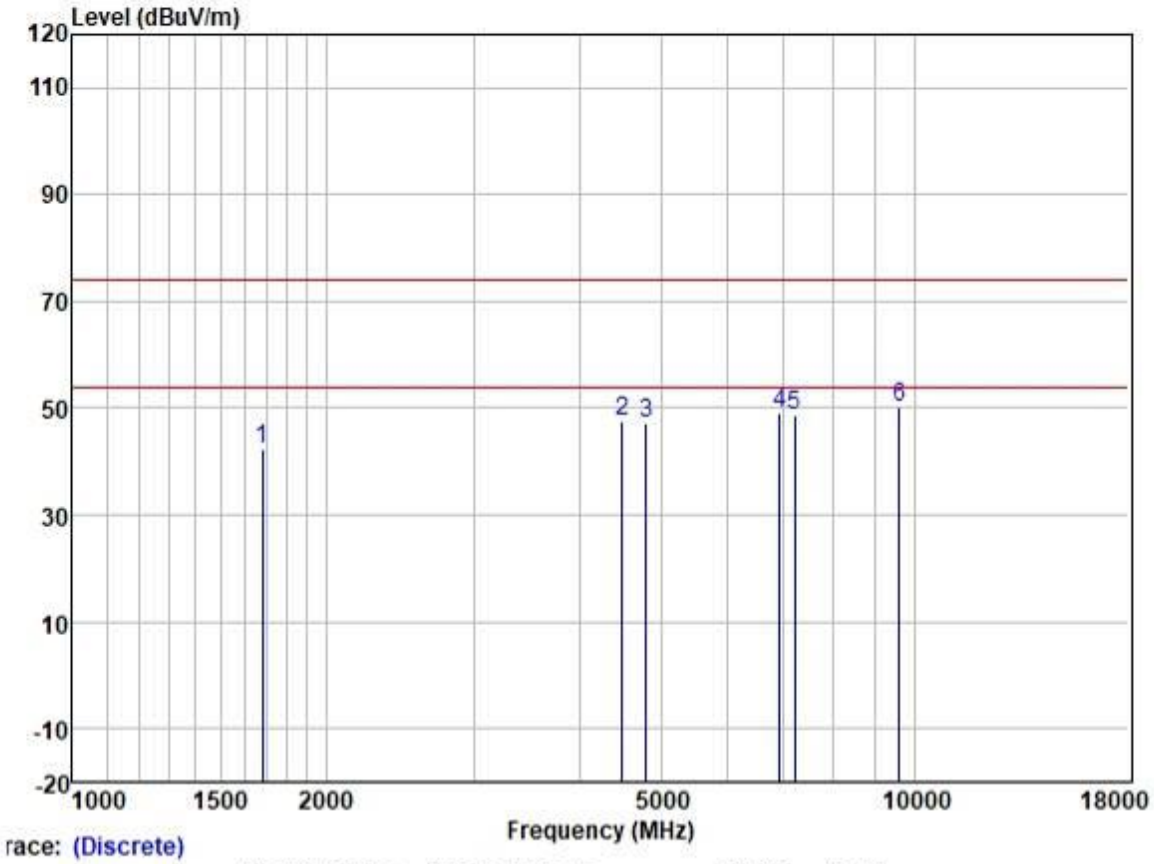
Test Mode: 09; Polarity: Vertical; Modulation:GFSK; Channel:Low



	Freq	ReadLevel	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1682.477	52.11	25.03	3.25	37.93	42.46	74.00	-31.54	VERTICAL	peak
2	4495.125	45.02	34.17	5.33	36.83	47.69	74.00	-26.31	VERTICAL	peak
3	4804.000	44.49	34.16	5.46	36.86	47.25	74.00	-26.75	VERTICAL	peak
4	6914.763	44.89	34.97	6.39	37.08	49.17	74.00	-24.83	VERTICAL	peak
5	7206.000	43.91	35.63	6.36	37.13	48.77	74.00	-25.23	VERTICAL	peak
6	9608.000	40.43	38.68	7.99	37.02	50.08	74.00	-23.92	VERTICAL	peak

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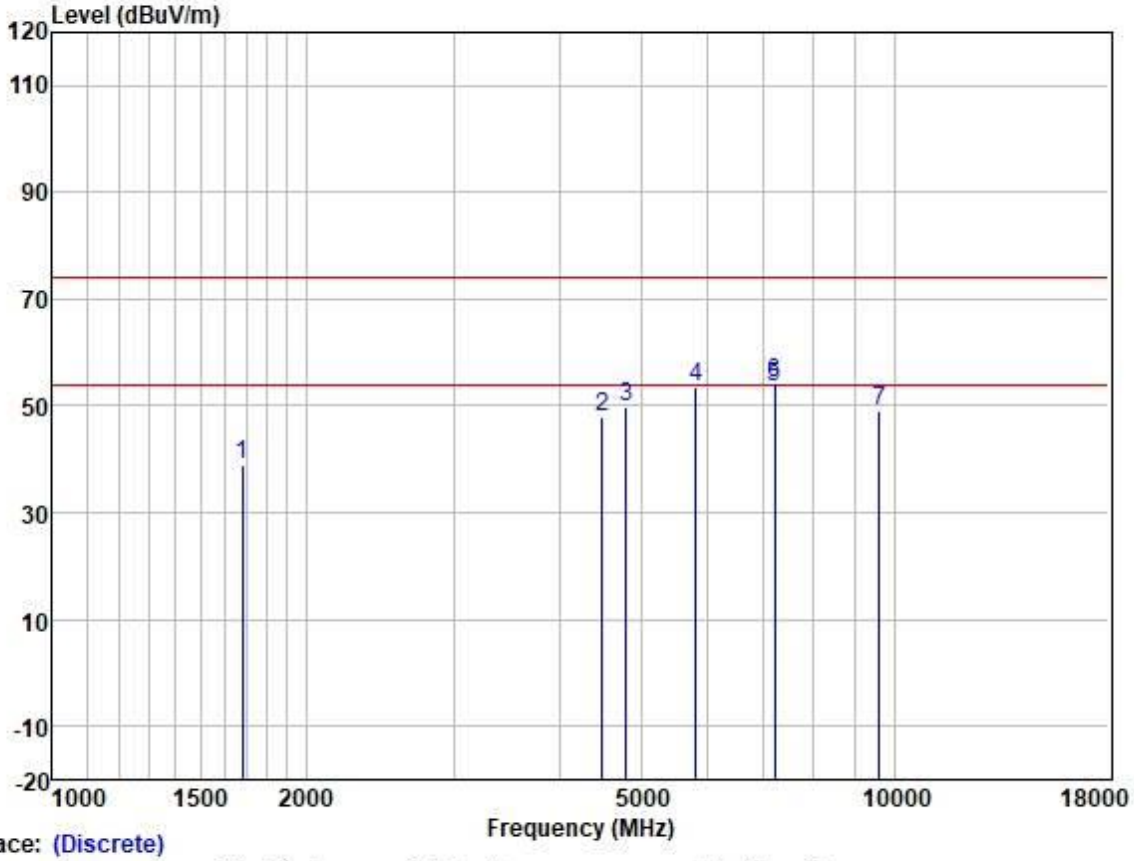
Test Mode: 09; Polarity: Horizontal; Modulation:GFSK; Channel:Low



race: (Discrete)

	Freq	ReadLevel	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1682.477	48.82	25.03	3.25	37.93	39.17	74.00	-34.83	HORIZONTAL	peak
2	4495.125	45.16	34.17	5.33	36.83	47.83	74.00	-26.17	HORIZONTAL	peak
3	4804.000	47.19	34.16	5.46	36.86	49.95	74.00	-24.05	HORIZONTAL	peak
4	5813.812	52.32	32.67	5.71	36.99	53.71	74.00	-20.29	HORIZONTAL	peak
5	7206.309	48.55	35.63	6.36	37.13	53.41	54.00	-0.59	HORIZONTAL	Average
6	7206.309	49.59	35.63	6.36	37.13	54.45	74.00	-19.55	HORIZONTAL	Peak
7	9608.000	39.36	38.68	7.99	37.02	49.01	74.00	-24.99	HORIZONTAL	peak

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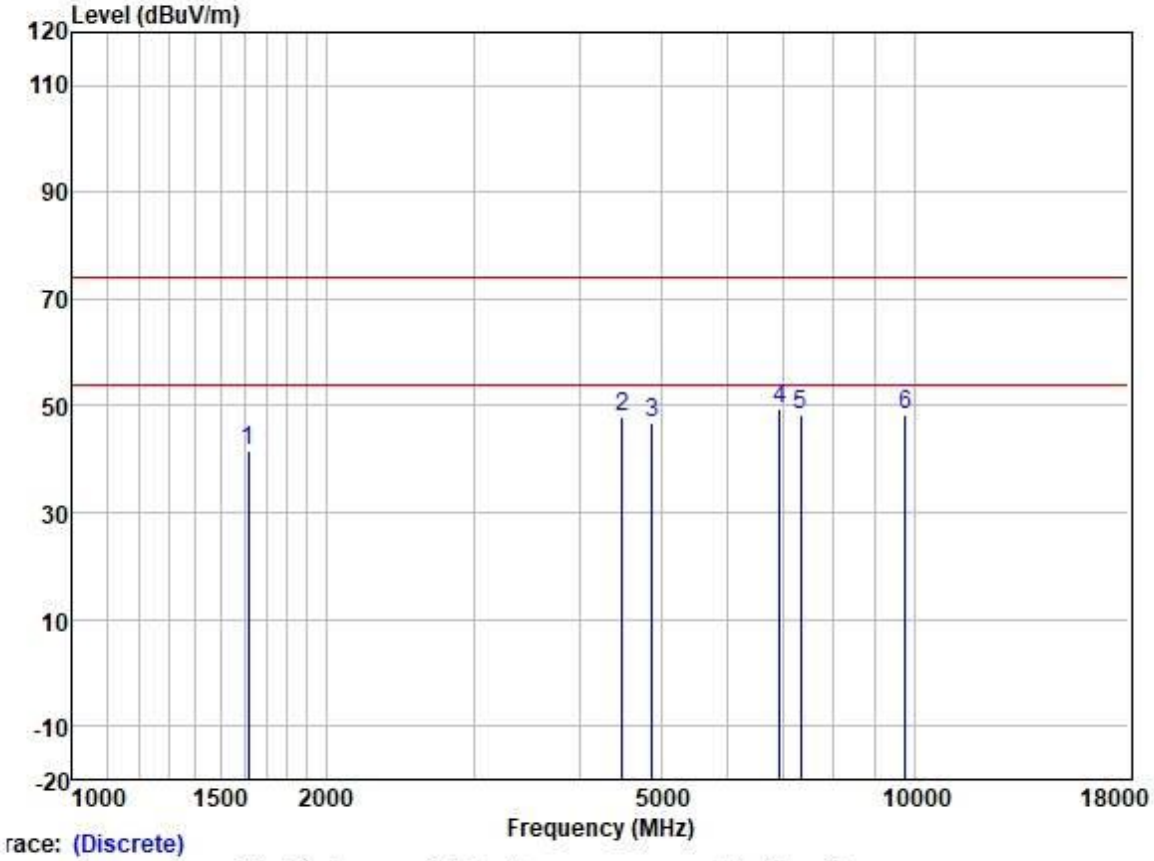

race: (Discrete)

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1615.754	51.67	24.74	3.04	37.93	41.52	74.00	-32.48	VERTICAL	peak
2	4495.125	45.10	34.17	5.33	36.83	47.77	74.00	-26.23	VERTICAL	peak
3	4882.000	44.17	34.15	5.49	36.87	46.94	74.00	-27.06	VERTICAL	peak
4	6914.763	45.04	34.97	6.39	37.08	49.32	74.00	-24.68	VERTICAL	peak
5	7323.000	42.99	36.07	6.32	37.15	48.23	74.00	-25.77	VERTICAL	peak
6	9764.000	39.06	38.81	7.43	37.01	48.29	74.00	-25.71	VERTICAL	peak

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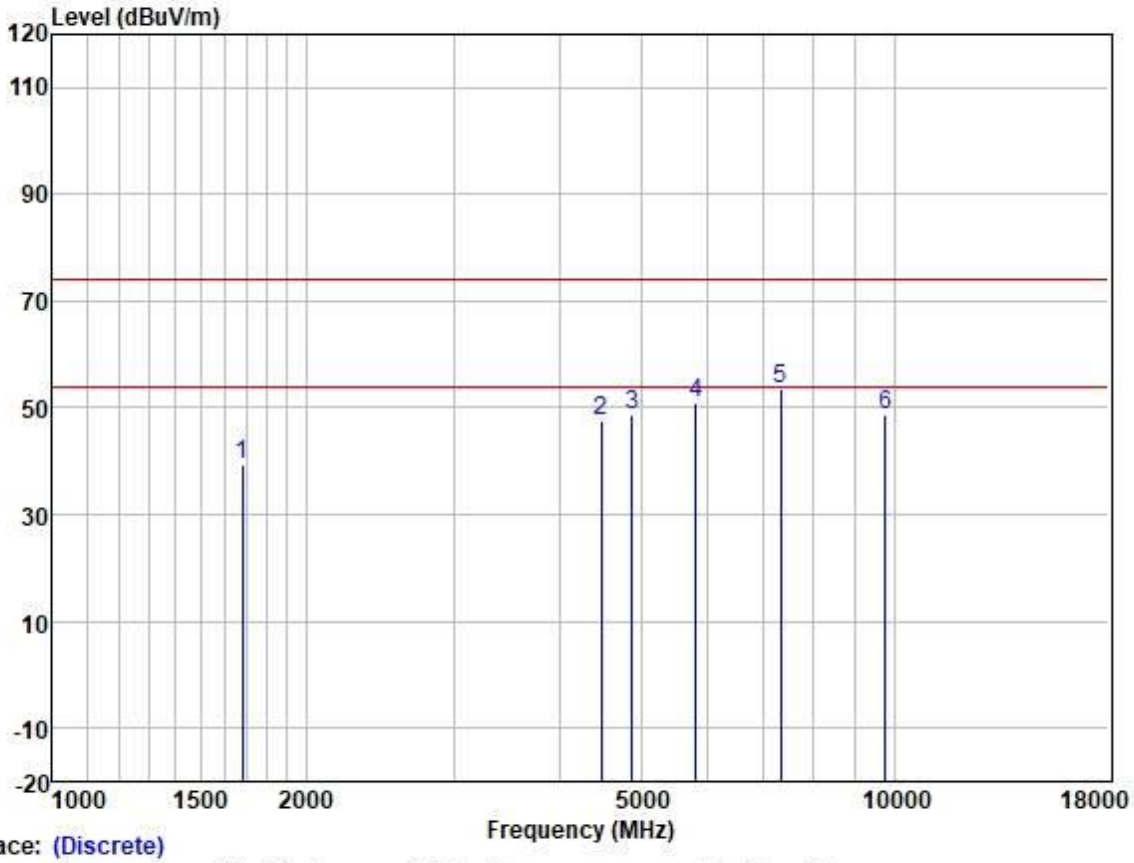
Test Mode: 09; Polarity: Horizontal; Modulation:GFSK; Channel:middle



race: (Discrete)

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1682.477	49.08	25.03	3.25	37.93	39.43	74.00	-34.57	HORIZONTAL	peak
2	4482.150	44.89	34.12	5.34	36.83	47.52	74.00	-26.48	HORIZONTAL	peak
3	4882.000	45.75	34.15	5.49	36.87	48.52	74.00	-25.48	HORIZONTAL	peak
4	5813.812	49.52	32.67	5.71	36.99	50.91	74.00	-23.09	HORIZONTAL	peak
5	7323.000	48.37	36.07	6.32	37.15	53.61	74.00	-20.39	HORIZONTAL	peak
6	9764.000	39.50	38.81	7.43	37.01	48.73	74.00	-25.27	HORIZONTAL	peak

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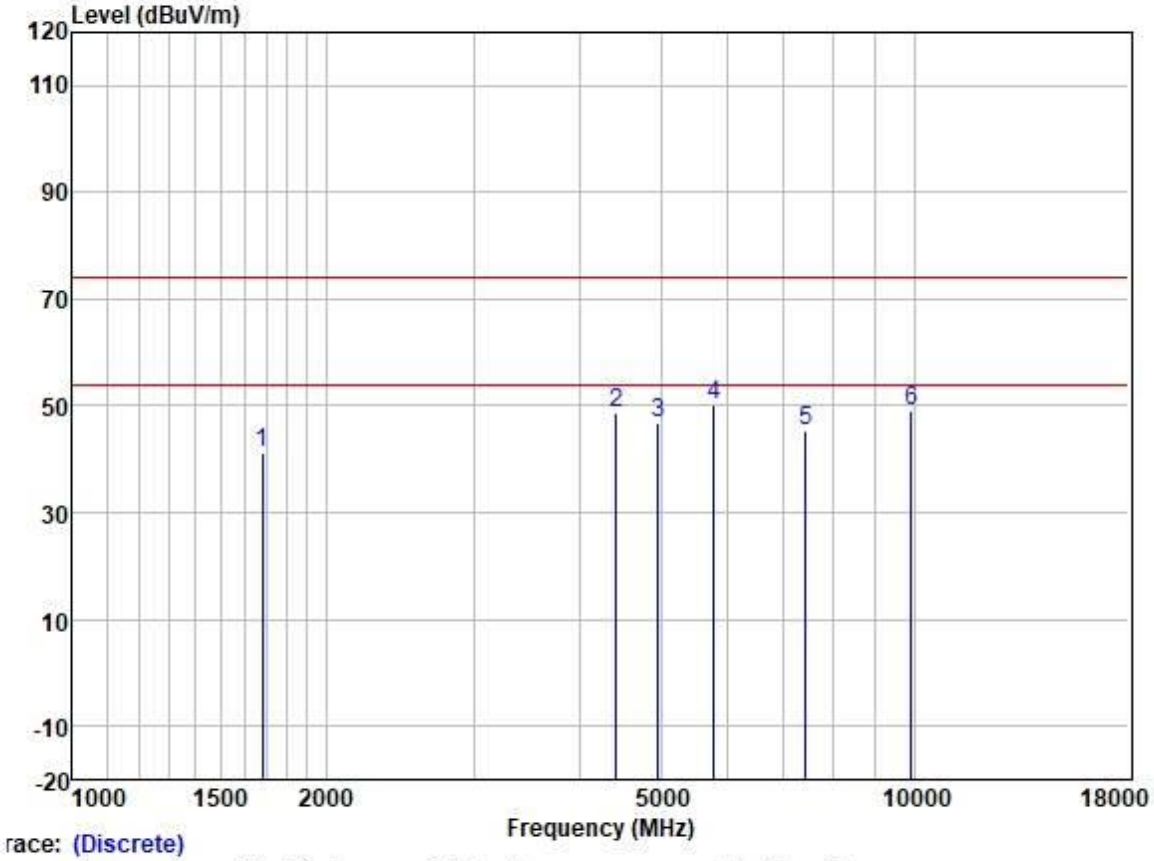
Test Mode: 09; Polarity: Vertical; Modulation:GFSK; Channel:High



	Freq	ReadLevel	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1682.477	50.96	25.03	3.25	37.93	41.31	74.00	-32.69	VERTICAL	peak
2	4430.628	46.26	33.87	5.36	36.83	48.66	74.00	-25.34	VERTICAL	peak
3	4960.000	43.97	34.15	5.53	36.89	46.76	74.00	-27.24	VERTICAL	peak
4	5780.300	48.87	32.66	5.68	36.99	50.22	74.00	-23.78	VERTICAL	peak
5	7440.000	39.76	36.33	6.29	37.16	45.22	74.00	-28.78	VERTICAL	peak
6	9920.000	40.47	38.95	6.77	37.00	49.19	74.00	-24.81	VERTICAL	peak

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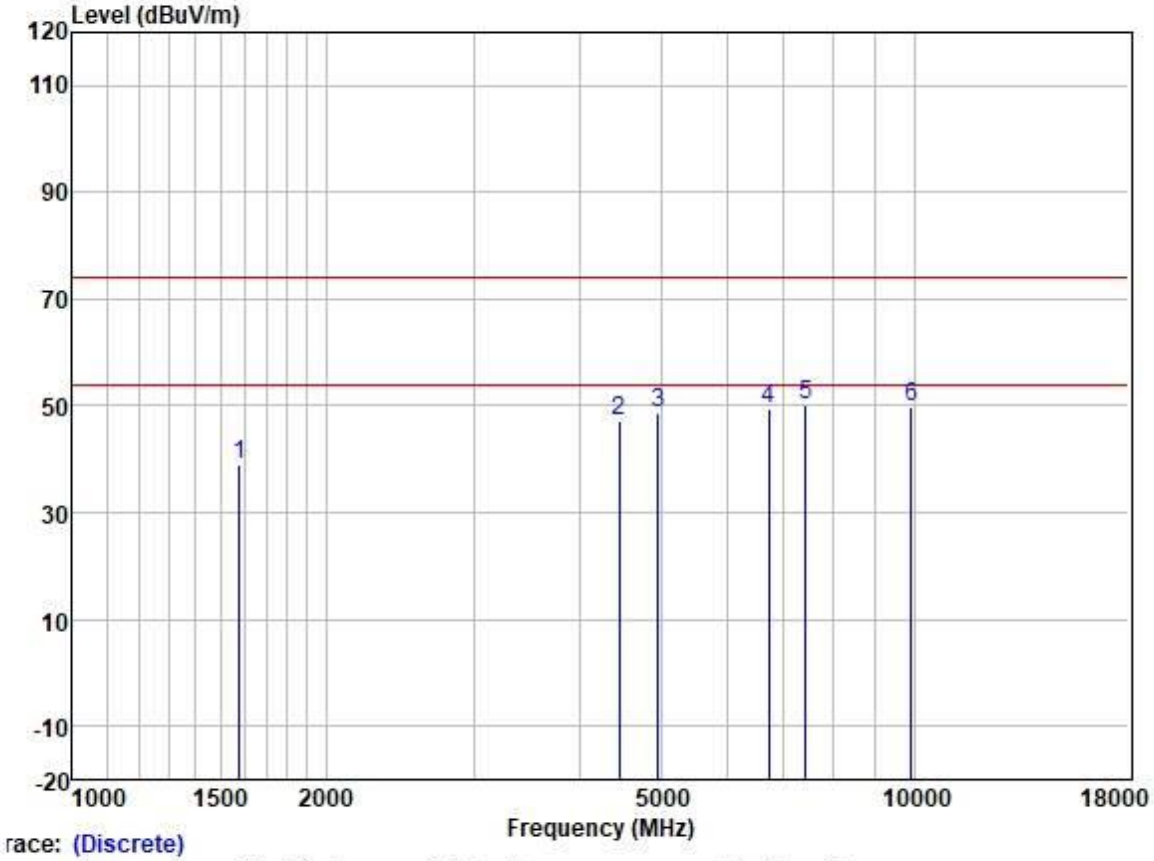
Test Mode: 09; Polarity: Horizontal; Modulation:GFSK; Channel:High



race: (Discrete)

	Freq	ReadLevel	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1578.822	49.38	24.62	2.99	37.94	39.05	74.00	-34.95	HORIZONTAL	peak
2	4456.315	44.73	34.00	5.35	36.83	47.25	74.00	-26.75	HORIZONTAL	peak
3	4960.000	46.00	34.15	5.53	36.89	48.79	74.00	-25.21	HORIZONTAL	peak
4	6717.762	45.91	34.42	6.29	37.05	49.57	74.00	-24.43	HORIZONTAL	peak
5	7440.000	44.71	36.33	6.29	37.16	50.17	74.00	-23.83	HORIZONTAL	peak
6	9920.000	41.03	38.95	6.77	37.00	49.75	74.00	-24.25	HORIZONTAL	peak

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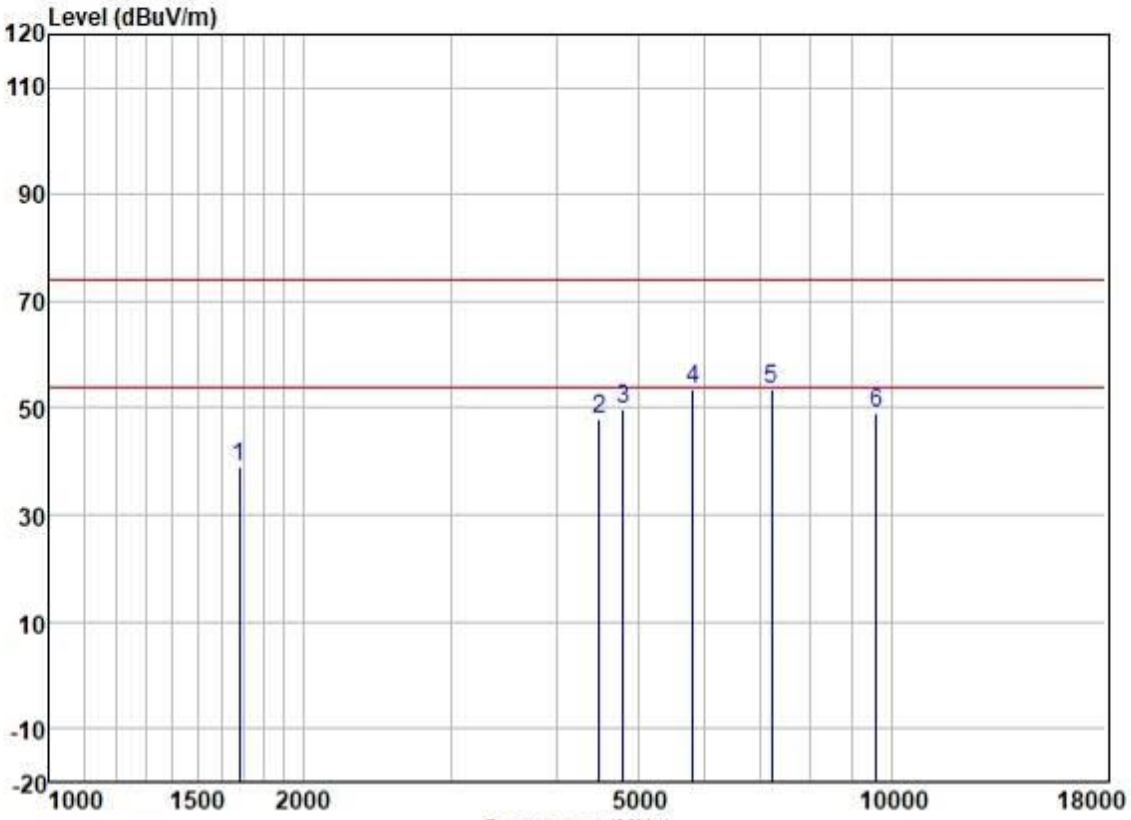

race: (Discrete)

	Freq	ReadLevel	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1682.477	48.82	25.03	3.25	37.93	39.17	74.00	-34.83	HORIZONTAL	peak
2	4495.125	45.16	34.17	5.33	36.83	47.83	74.00	-26.17	HORIZONTAL	peak
3	4804.000	47.19	34.16	5.46	36.86	49.95	74.00	-24.05	HORIZONTAL	peak
4	5813.812	52.32	32.67	5.71	36.99	53.71	74.00	-20.29	HORIZONTAL	peak
5	7206.309	48.59	35.63	6.36	37.13	53.45	74.00	-20.55	HORIZONTAL	Peak
6	9608.000	39.36	38.68	7.99	37.02	49.01	74.00	-24.99	HORIZONTAL	peak

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8 Test Setup Photo

Refer to Setup Photos for GZCR230700077402

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9 EUT Constructional Details (EUT Photos)

Refer to External and Internal Photos for GZCR2307000774HS

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10 Appendix

1. Bandwidth

1.1 20dB BW

1.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	20dB Bandwidth (MHz)	Verdict
					Result	
GFSK	SISO	2402	DH5	1	0.949	Pass
		2441	DH5	1	0.954	Pass
		2480	DH5	1	1.070	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.331	Pass
		2441	2DH5	1	1.324	Pass
		2480	2DH5	1	1.324	Pass

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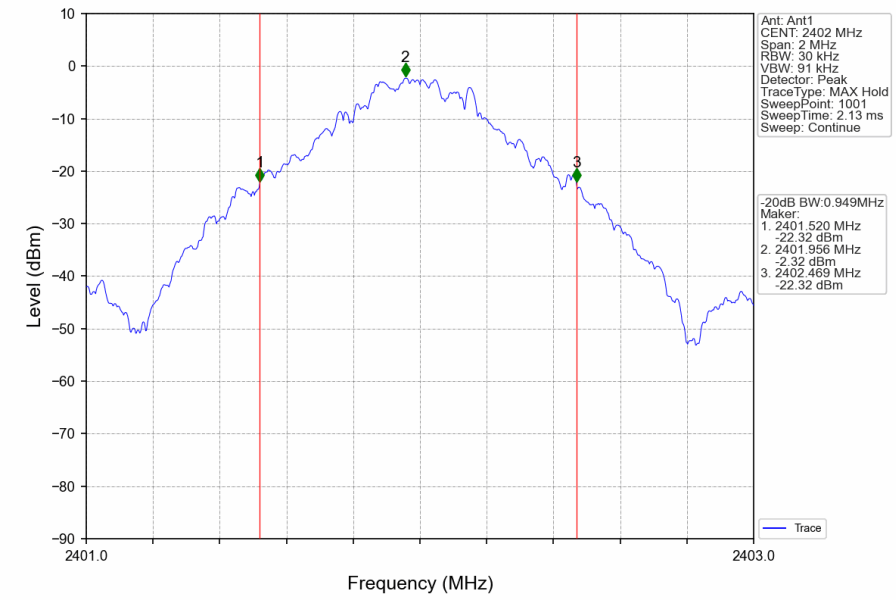
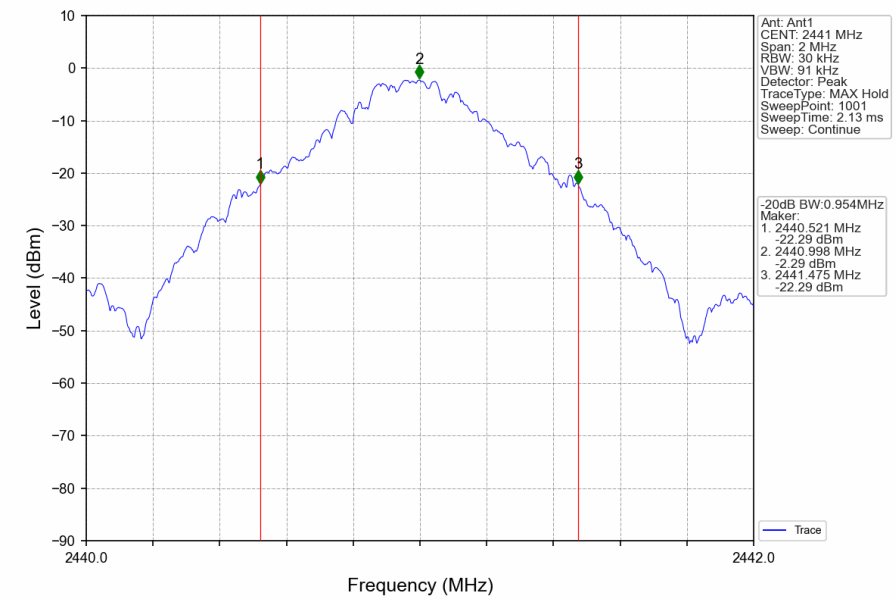
1.1.2 Test Graph

GFSK_DH5_LCH_2402MHz_Ant1_NTNV



GFSK_DH5_MCH_2441MHz_Ant1_NTNV



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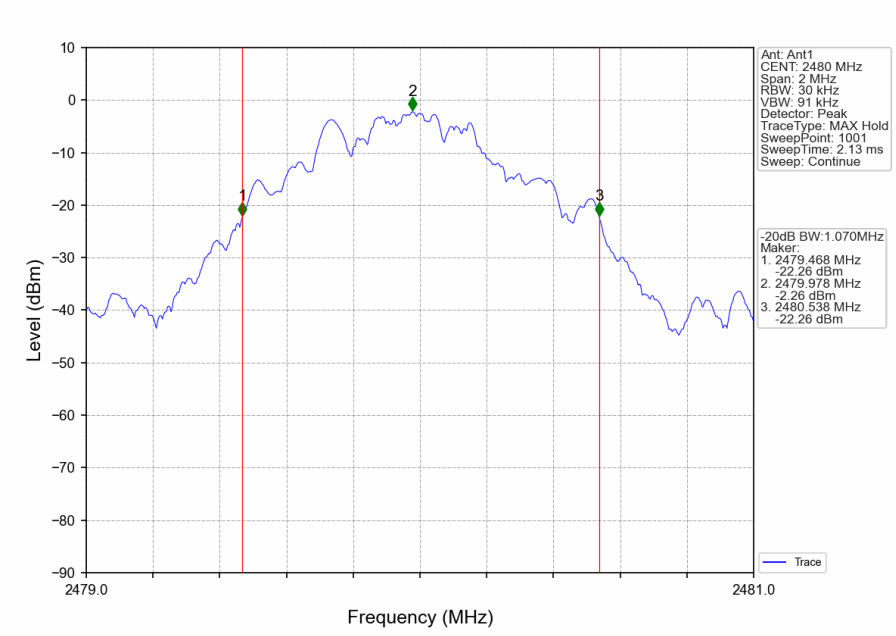
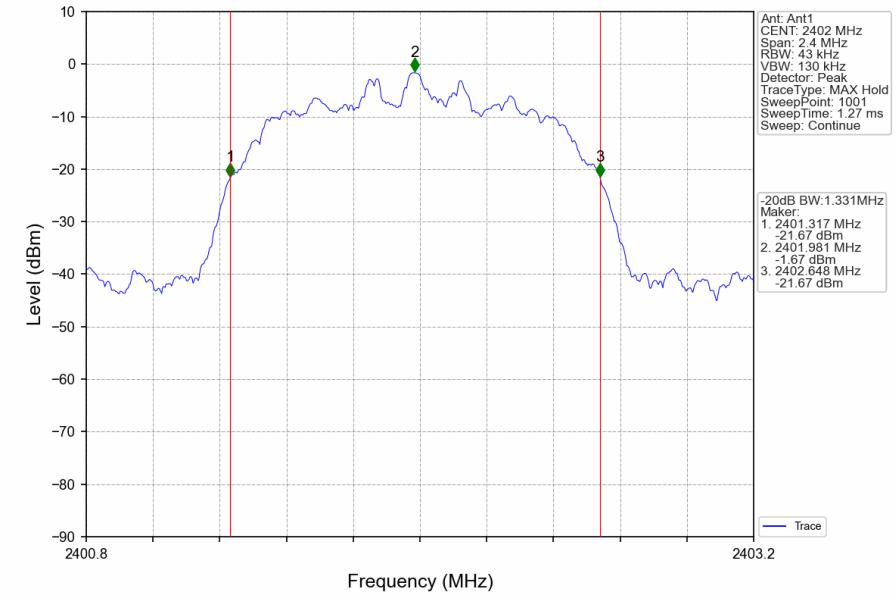
GFSK_DH5_HCH_2480MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



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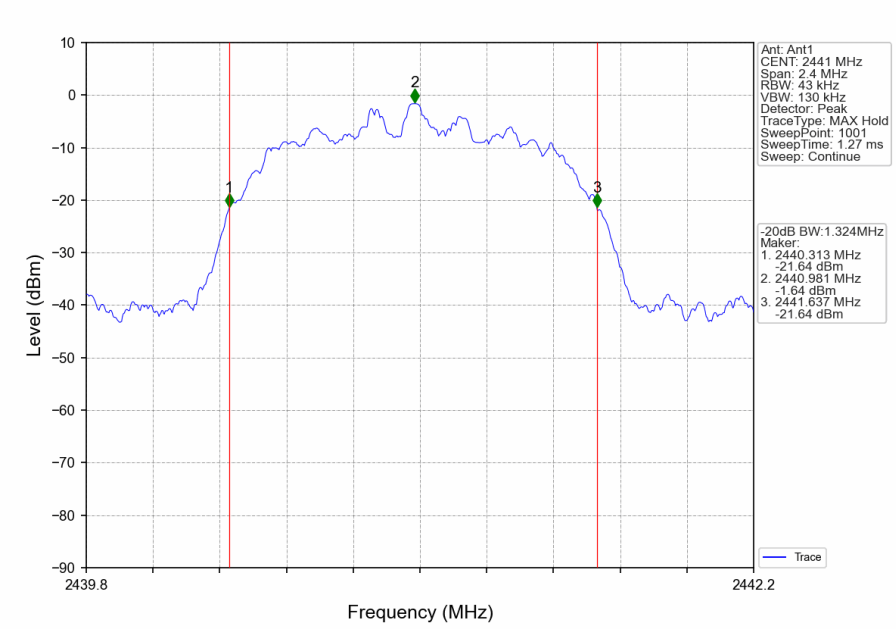
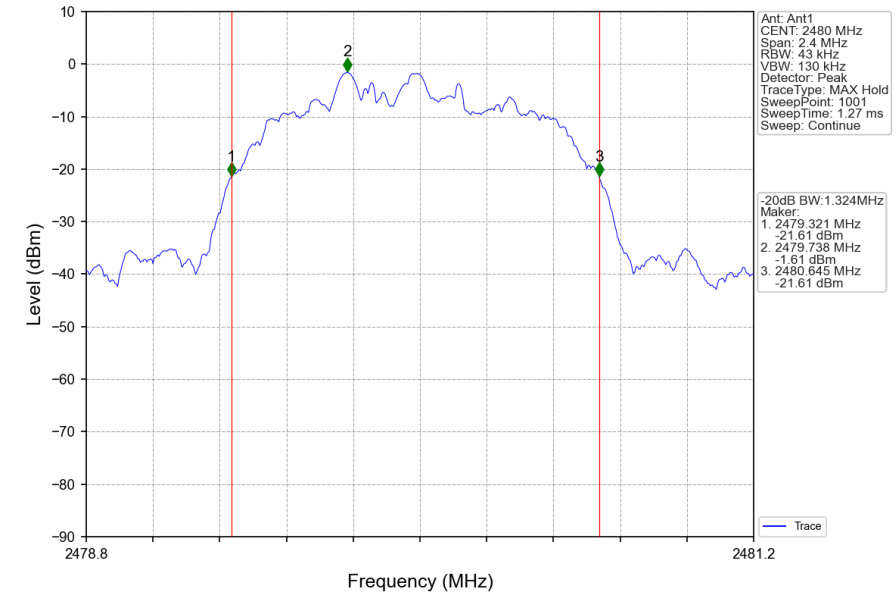
Pi/4DQPSK_2DH5_MCH_2441MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV



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2. Maximum Conducted Output Power

2.1 Power

2.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	Maximum Peak Conducted Output Power (dBm)		Verdict
				ANT1	Limit	
GFSK	SISO	2402	DH5	0.13	<=20.97	Pass
		2441	DH5	0.19	<=20.97	Pass
		2480	DH5	0.08	<=20.97	Pass
Pi/4DQPSK	SISO	2402	2DH5	1.02	<=20.97	Pass
		2441	2DH5	1.07	<=20.97	Pass
		2480	2DH5	0.74	<=20.97	Pass
Note1: Antenna Gain: Ant1: 1.90dBi;						

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2.1.2 Test Graph

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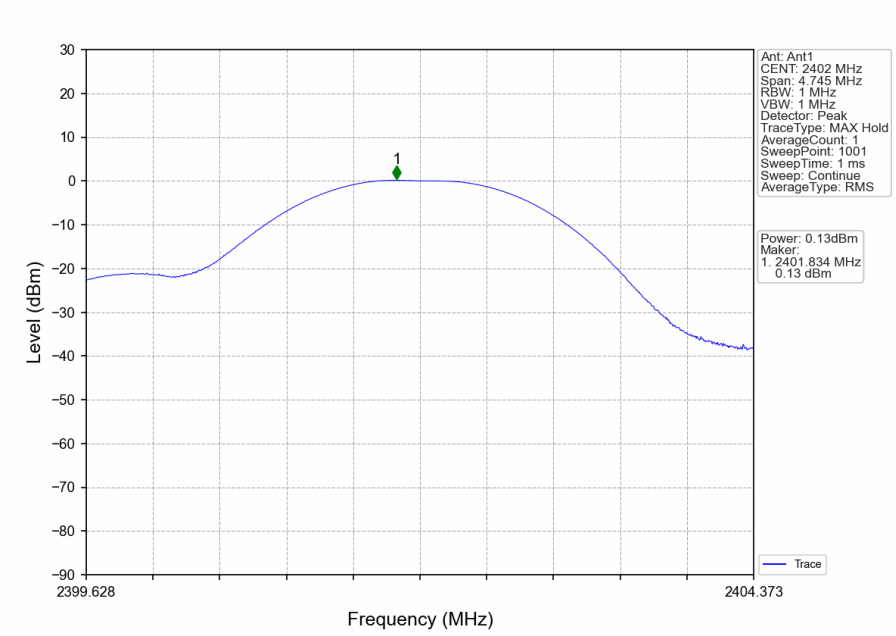
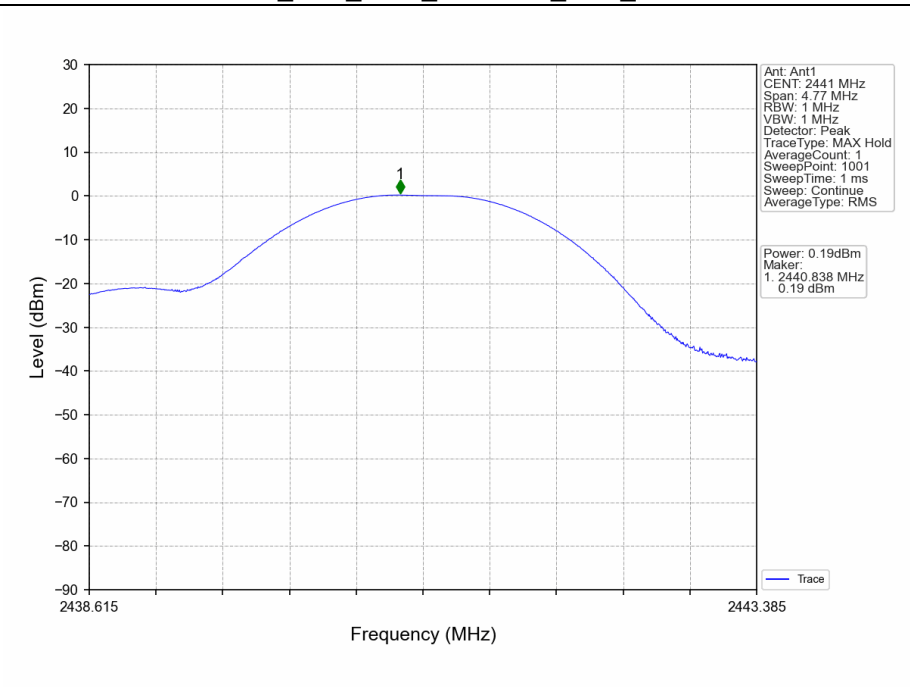


GFSK_DH5_MCH_2441MHz_Ant1_NTNV



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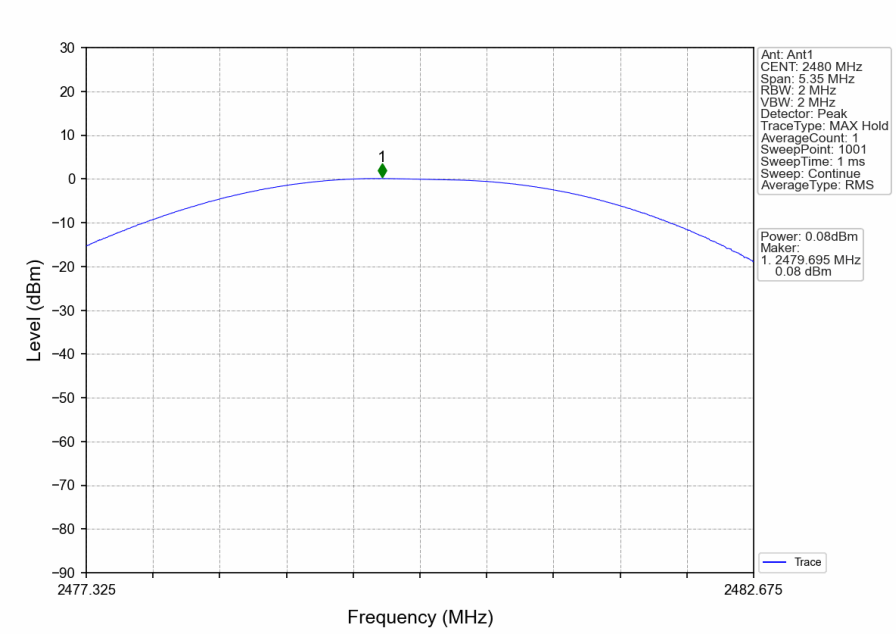
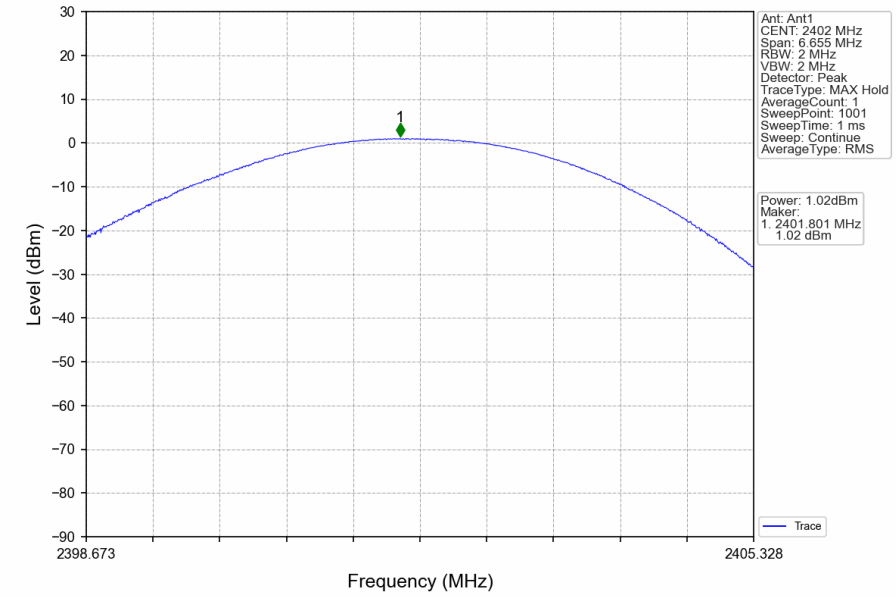


Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



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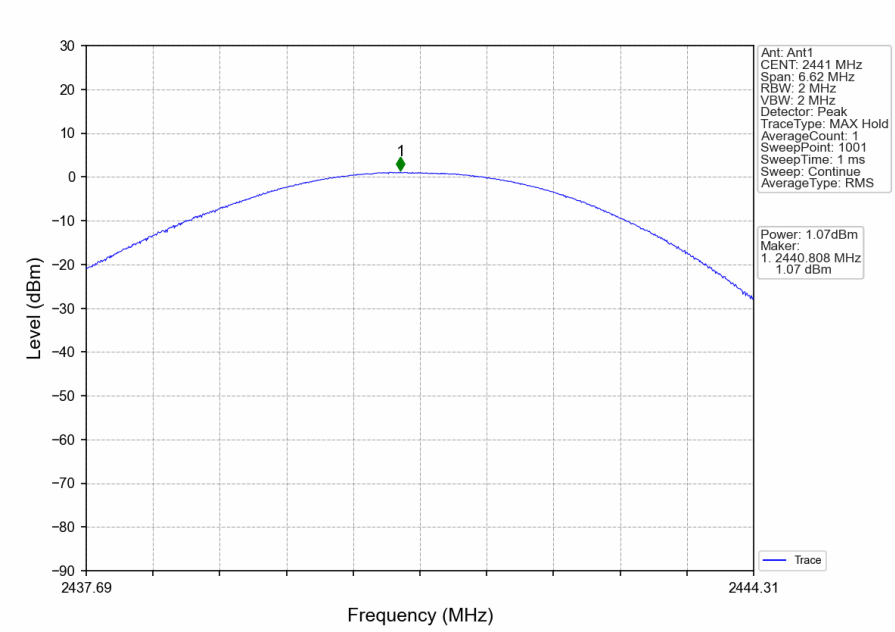

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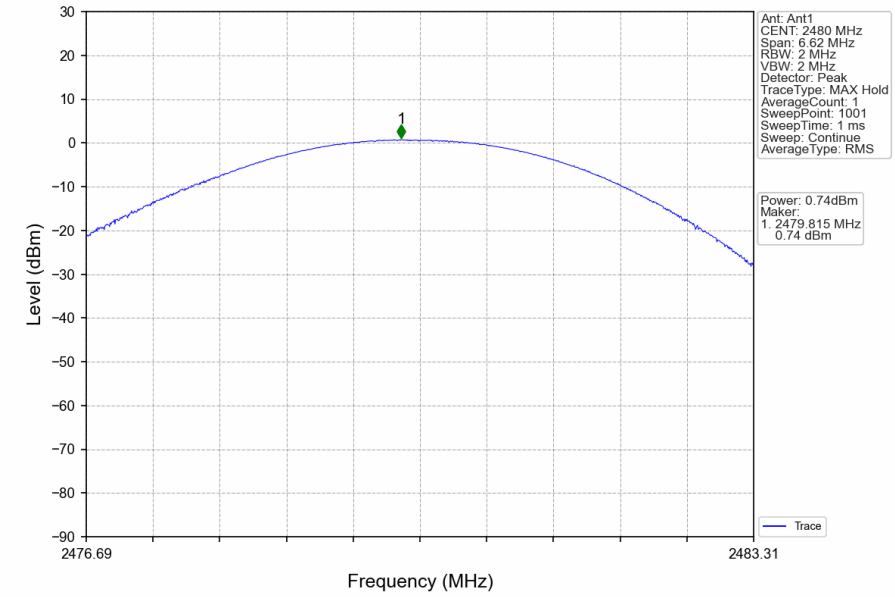

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3. Carrier Frequency Separation

3.1 Ant1

3.1.1 Test Result

Ant1							
Mode	TX Type	Frequency (MHz)	Packet Type	Channel Separation (MHz)	20dB Bandwidth (MHz)	Limit (MHz)	Verdict
GFSK	SISO	HOPP	DH5	0.998	1.070	>=0.713	Pass
Pi/4DQPSK	SISO	HOPP	2DH5	1.001	1.331	>=0.887	Pass

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3.1.2 Test Graph

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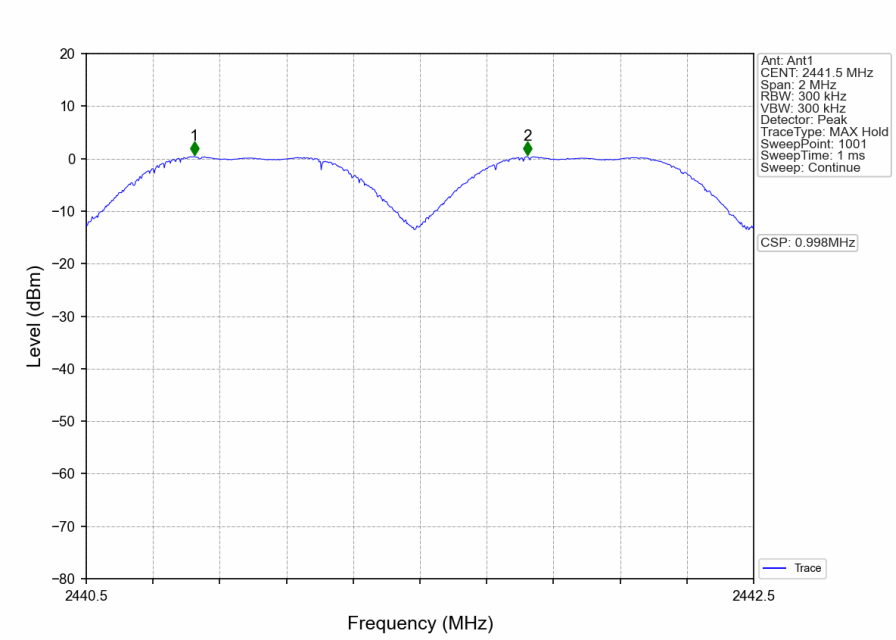
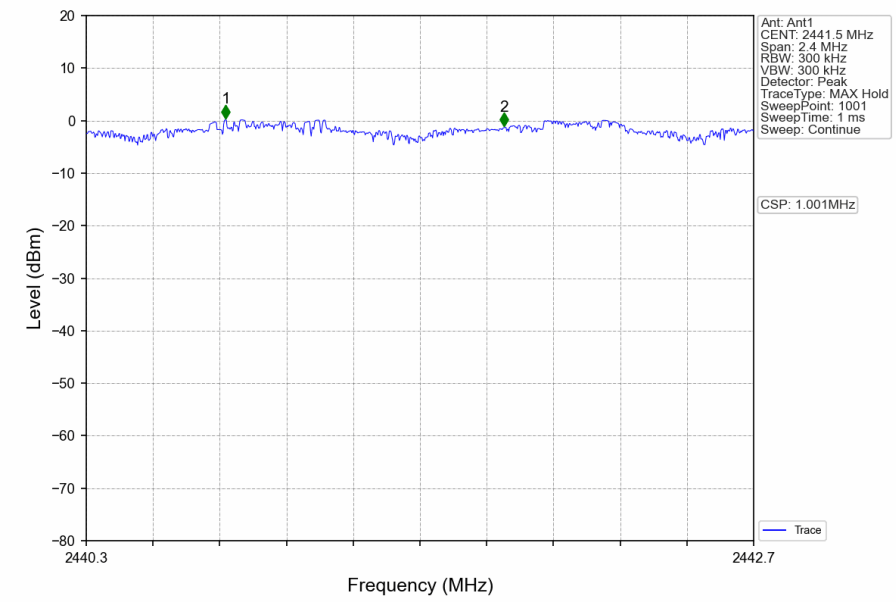


Pi/4DQPSK_2DH5_HOPP_Ant1_NTNV



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4. Number of Hopping Frequencies

4.1 HoppNum

4.1.1 Test Result

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

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4.1.2 Test Graph

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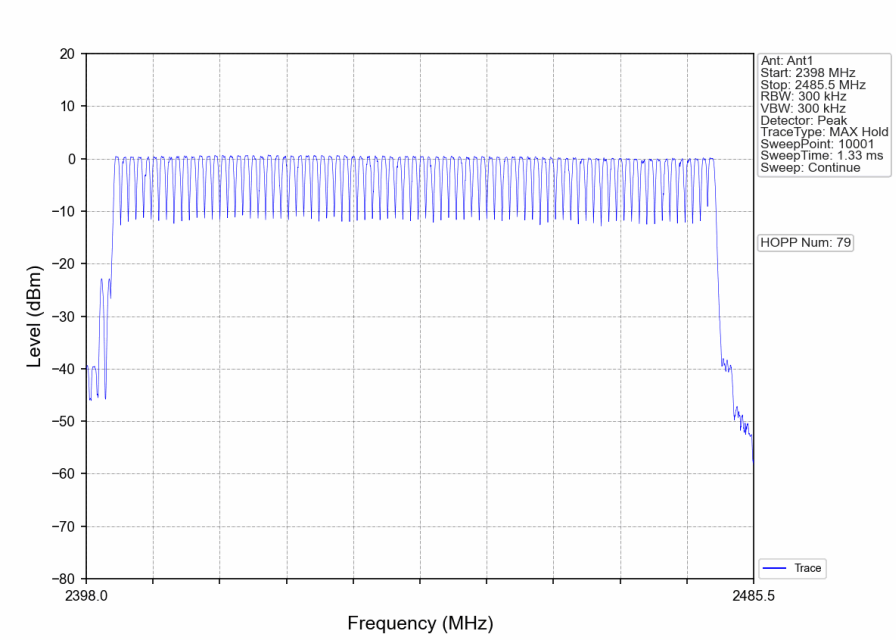
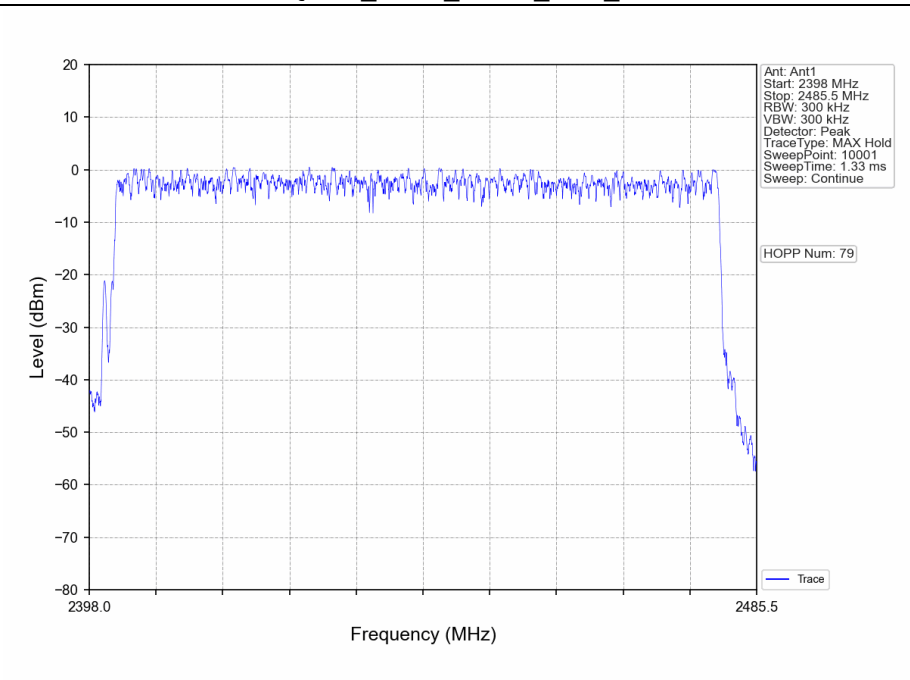


Pi/4DQPSK_2DH5_HOPP_Ant1_NTNV



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5. Time of Occupancy (Dwell Time)

5.1 Ant1

5.1.1 Test Result

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	0.376	31.600	45	16.920	<=400	Pass
			DH3	1.634	31.600	23	37.582	<=400	Pass
			DH5	2.880	31.600	15	43.200	<=400	Pass
Pi/4DQPSK	SISO	HOPP	2DH1	0.388	31.600	62	24.056	<=400	Pass
			2DH3	1.638	31.600	31	50.778	<=400	Pass
			2DH5	2.886	31.600	15	43.290	<=400	Pass

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5.1.2 Test Graph

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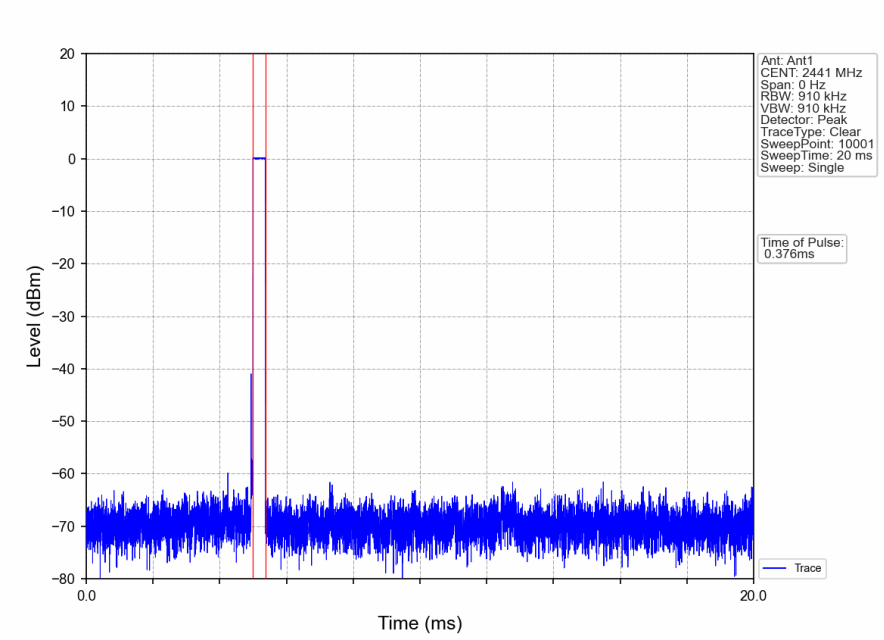

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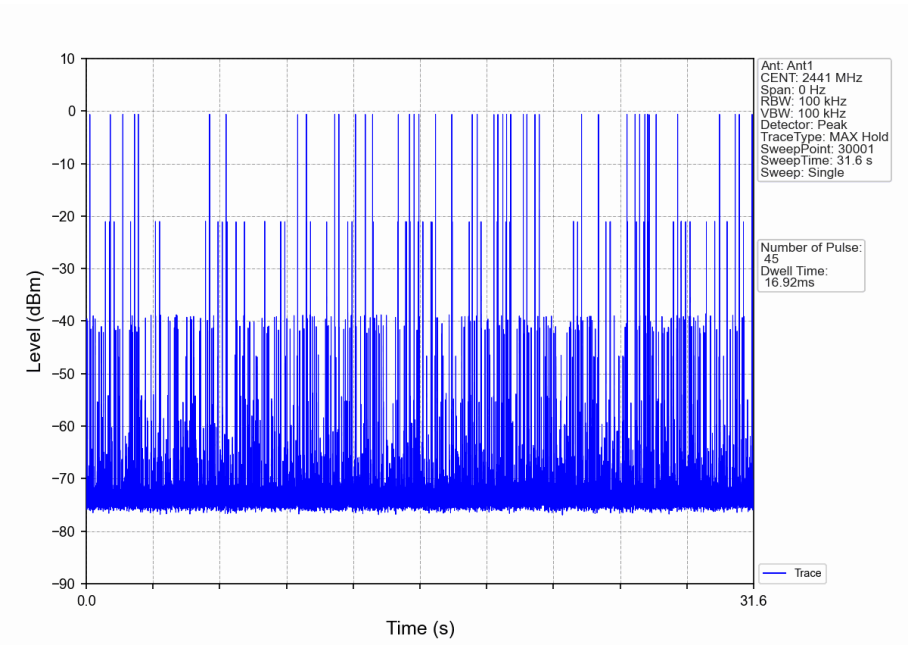

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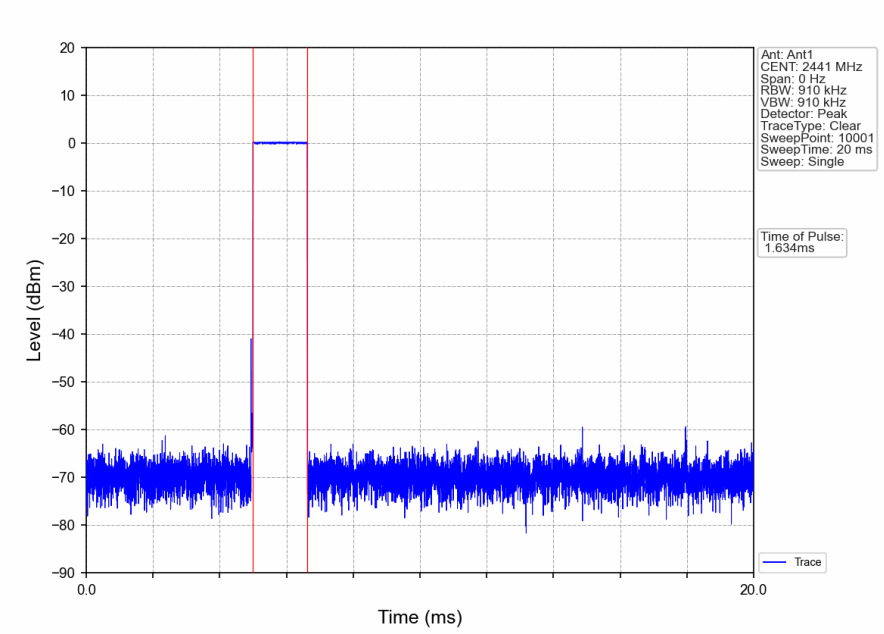
GFSK_DH3_HOPP_Ant1_NTNV



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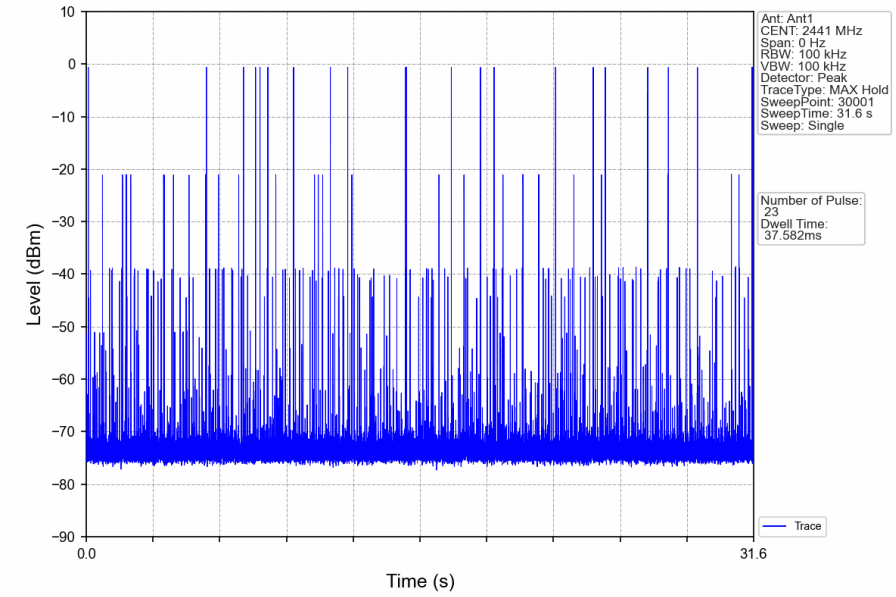

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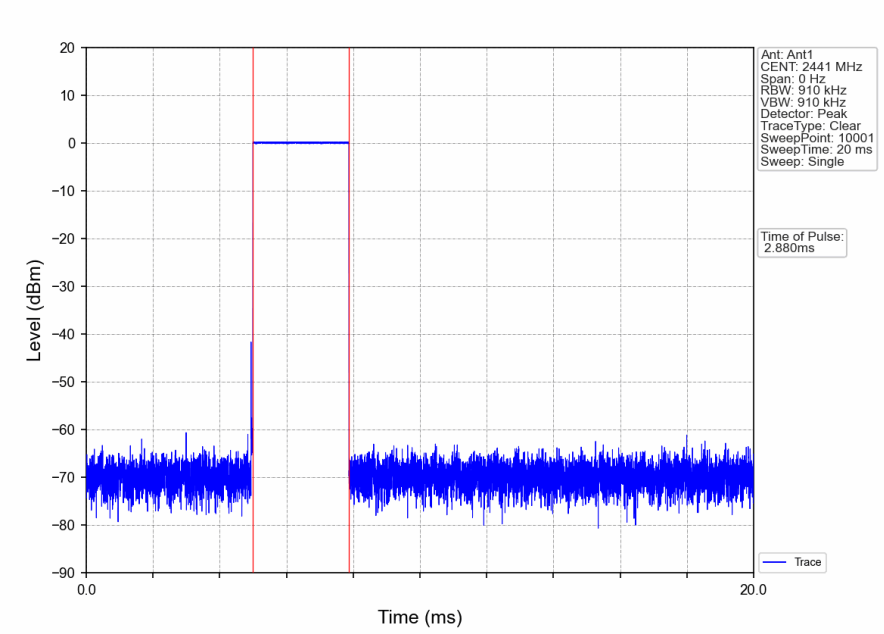

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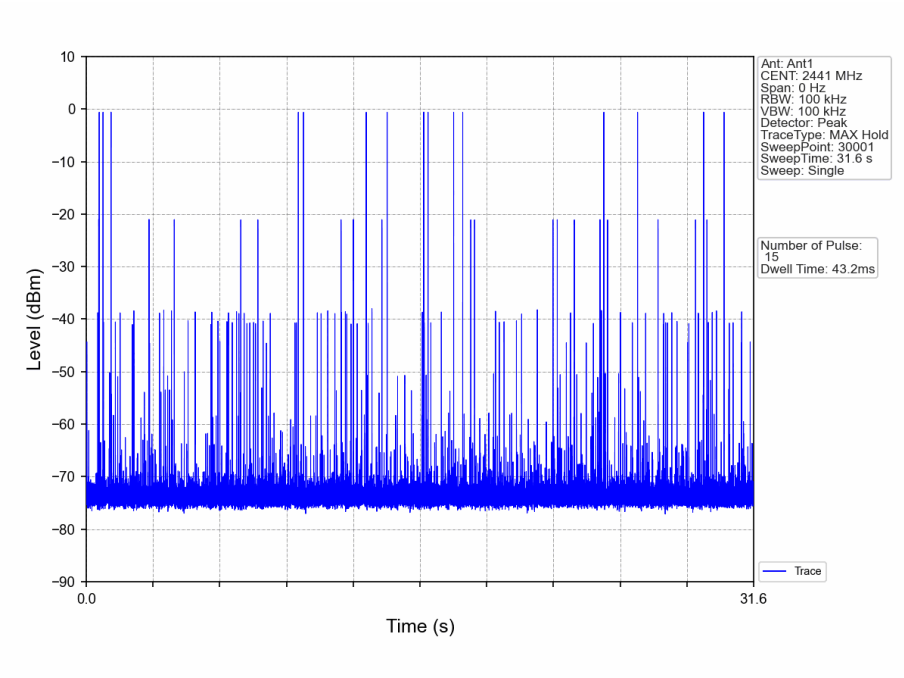

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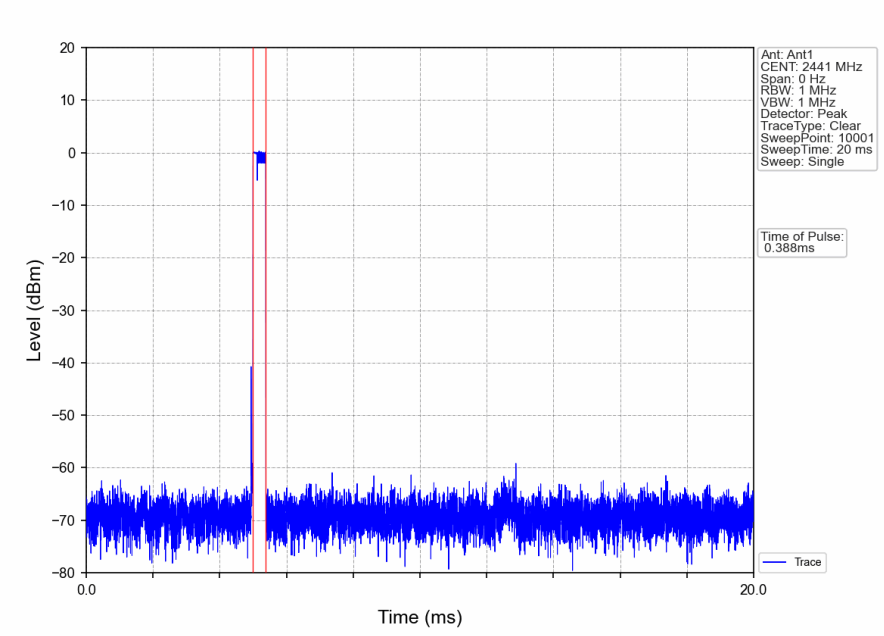

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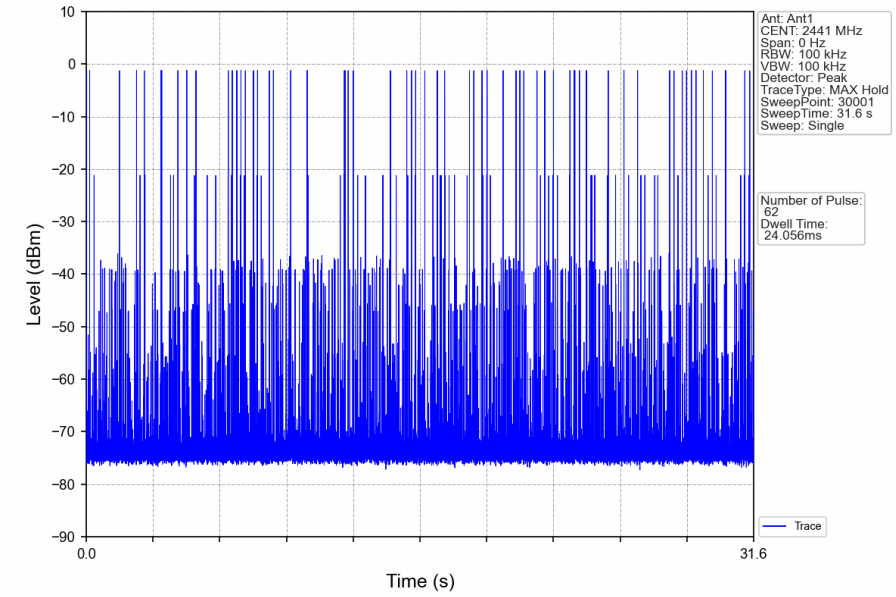

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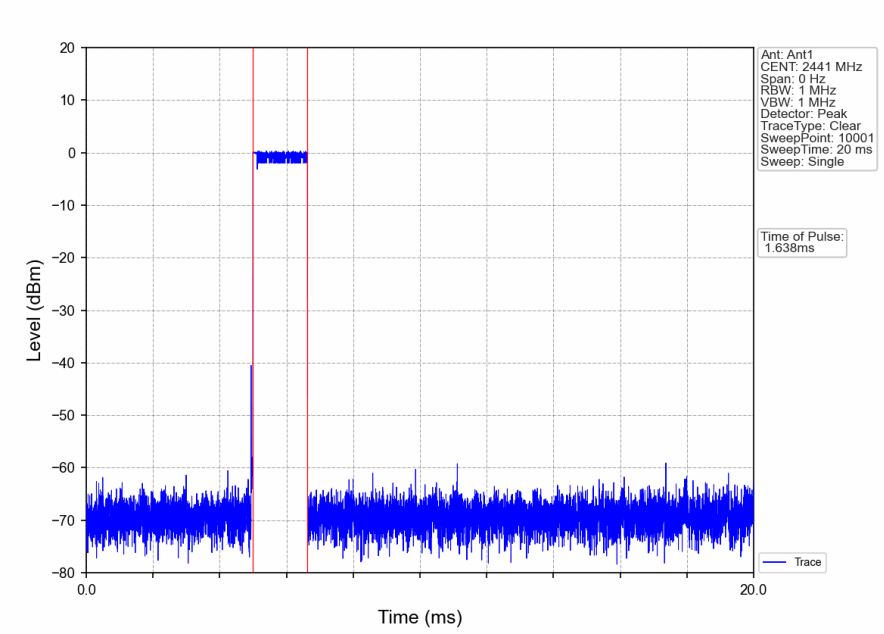
Pi/4DQPSK_2DH3_HOPP_Ant1_NTNV



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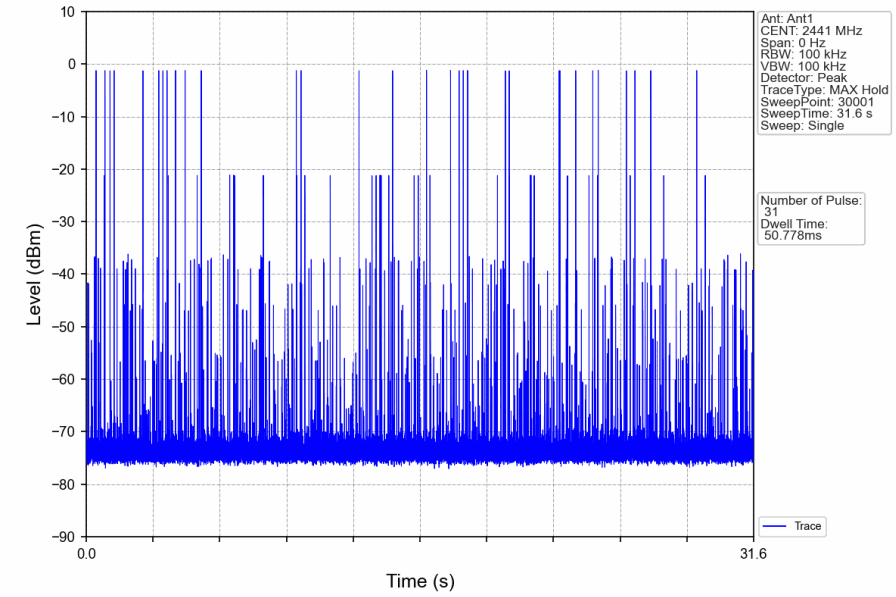

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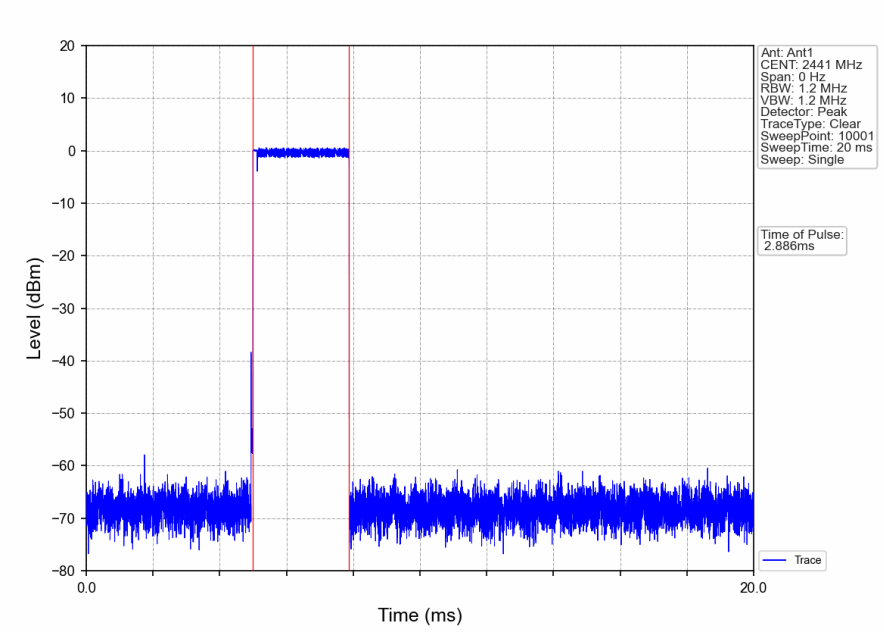
Pi/4DQPSK_2DH5_HOPP_Ant1_NTNV



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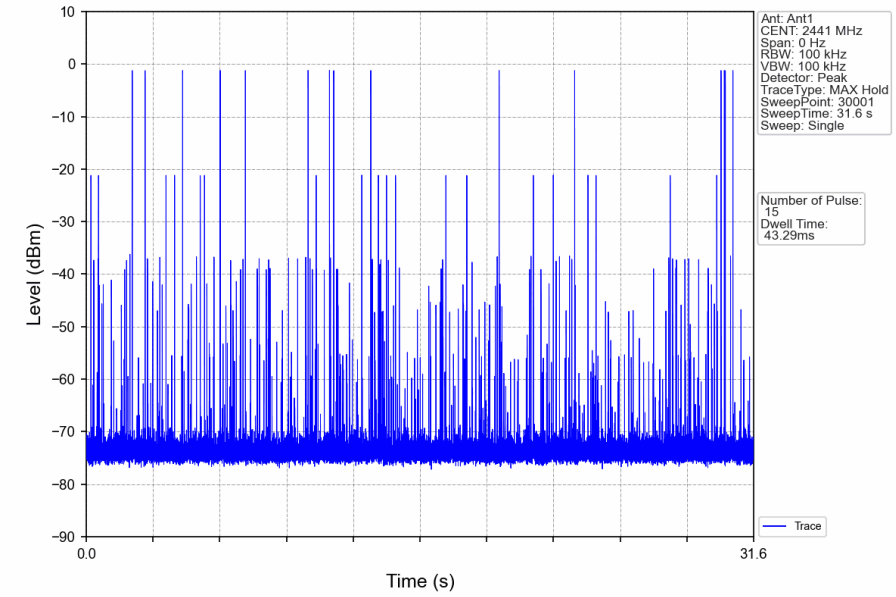

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6. Unwanted Emissions In Non-restricted Frequency Bands

6.1 Ref

6.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	Level of Reference (dBm)
GFSK	SISO	2402	DH5	1	-0.46
		2441	DH5	1	-0.38
		2480	DH5	1	0.00
Pi/4DQPSK	SISO	2402	2DH5	1	-0.25
		2441	2DH5	1	-0.35
		2480	2DH5	1	0.03
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.					

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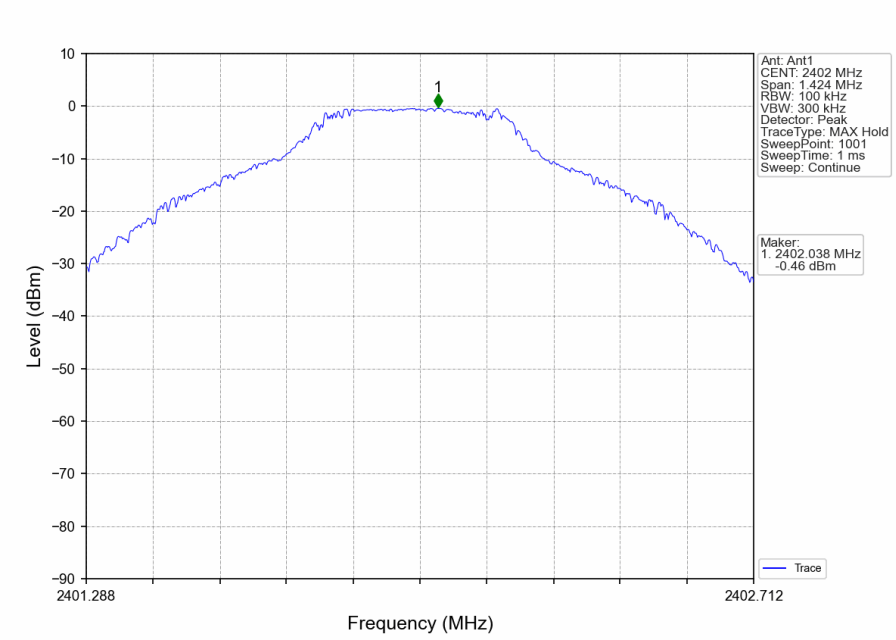
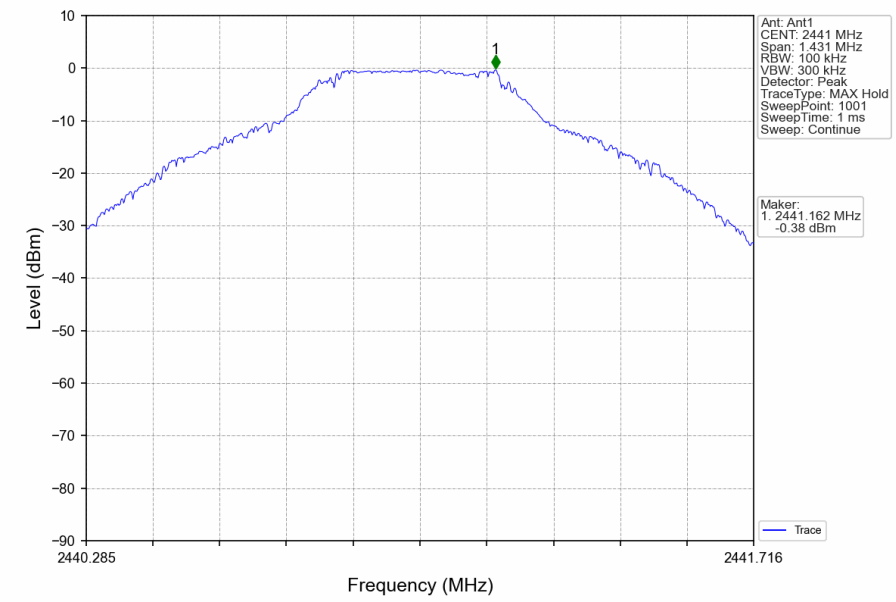
6.1.2 Test Graph

GFSK_DH5_LCH_2402MHz_Ant1_NTNV



GFSK_DH5_MCH_2441MHz_Ant1_NTNV



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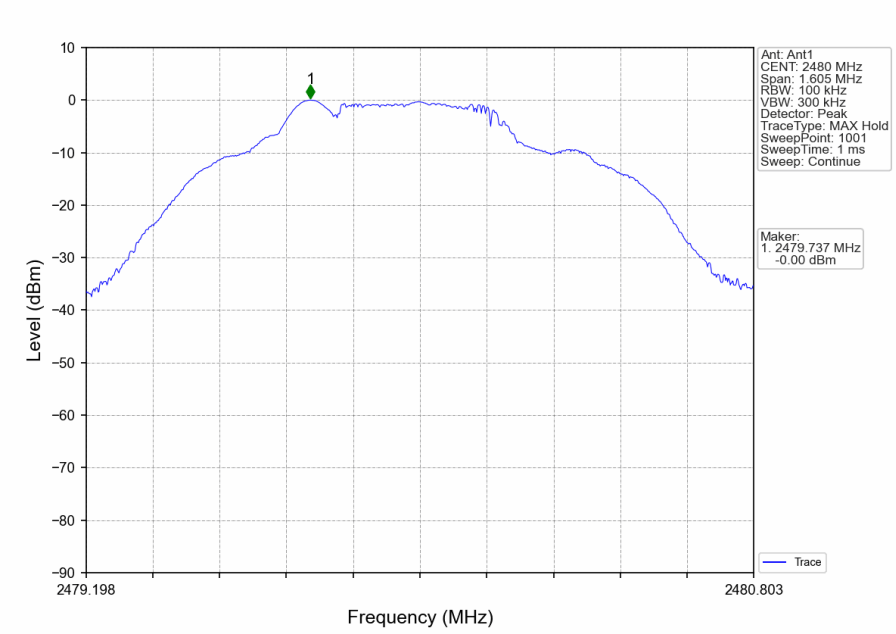
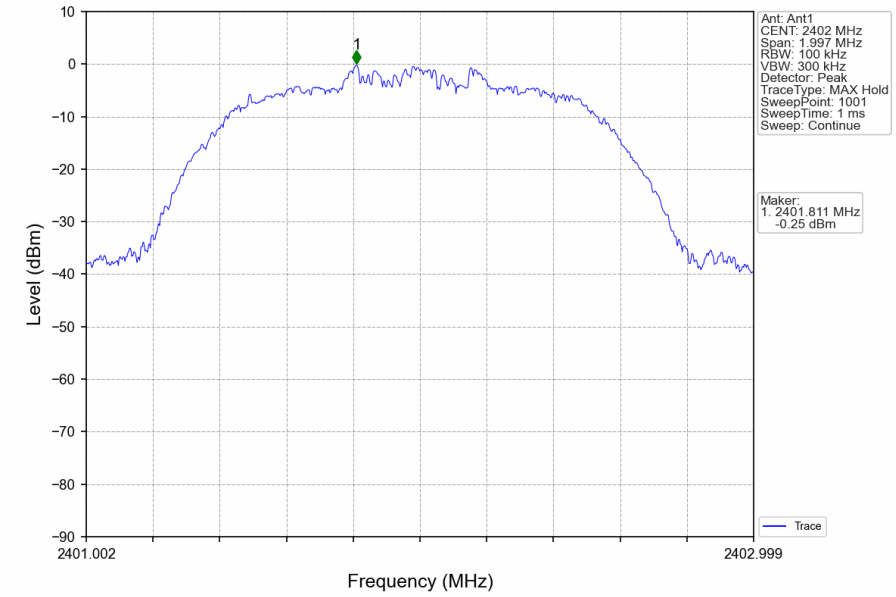
GFSK_DH5_HCH_2480MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



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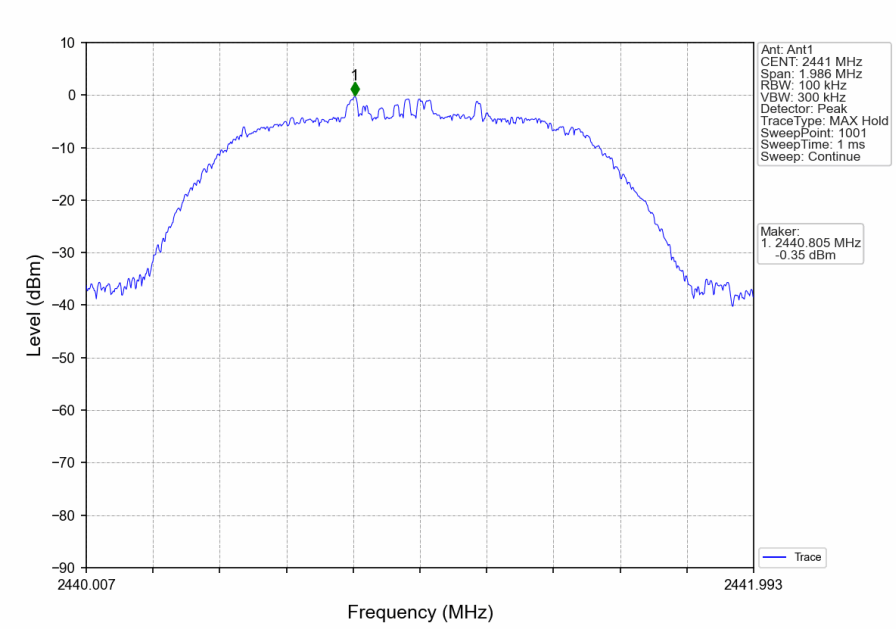
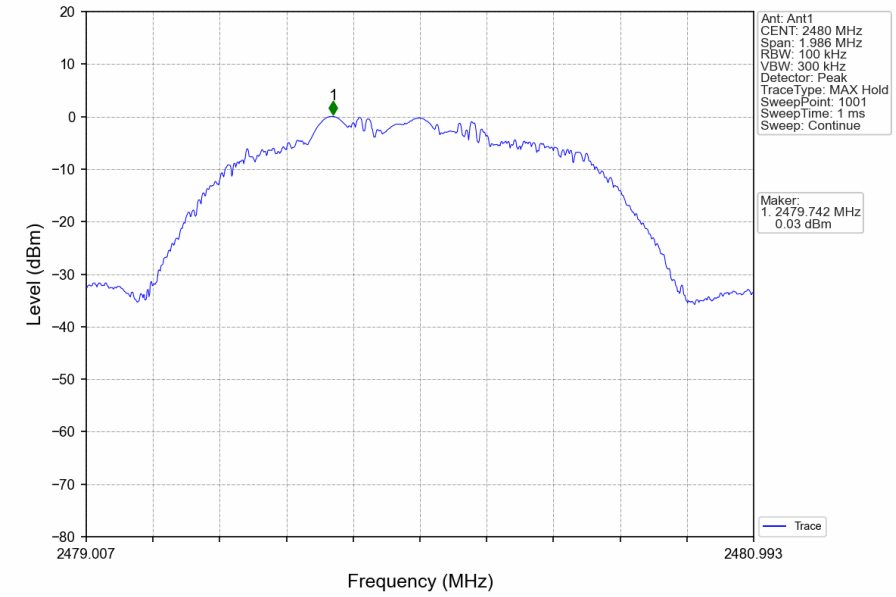
Pi/4DQPSK_2DH5_MCH_2441MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV



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6.2 CSE and Band Edges

6.2.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	Level of Reference (dBm)	Limit (dBm)	Verdict
GFSK	SISO	2402	DH5	1	0.00	-20.00	Pass
		2441	DH5	1	0.00	-20.00	Pass
		2480	DH5	1	0.00	-20.00	Pass
		HOPP	DH5	1	0.00	-20.00	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	0.03	-19.97	Pass
		2441	2DH5	1	0.03	-19.97	Pass
		2480	2DH5	1	0.03	-19.97	Pass
		HOPP	2DH5	1	0.03	-19.97	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.							

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6.2.2 Test Graph

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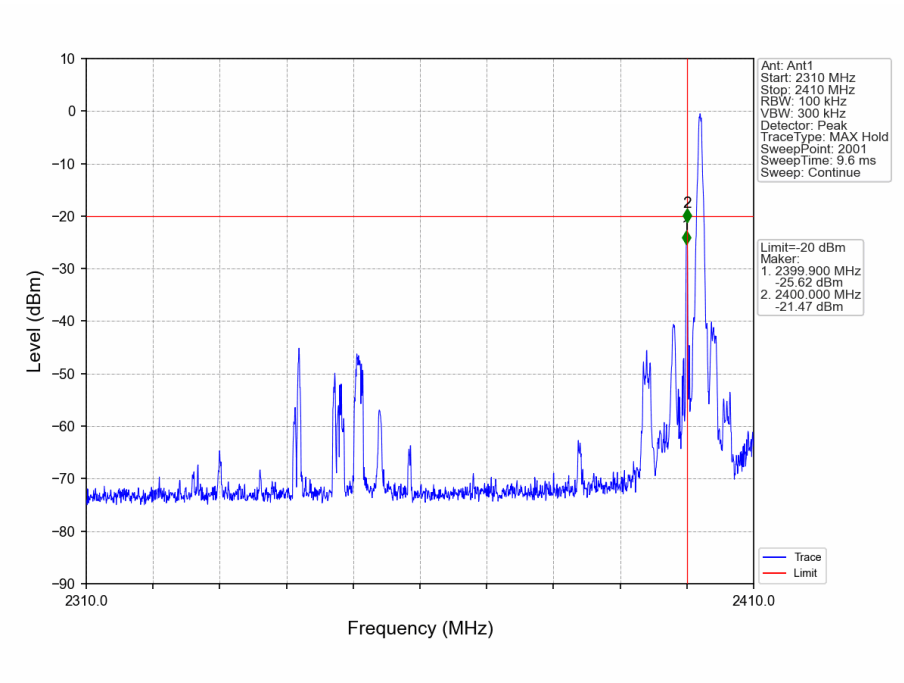

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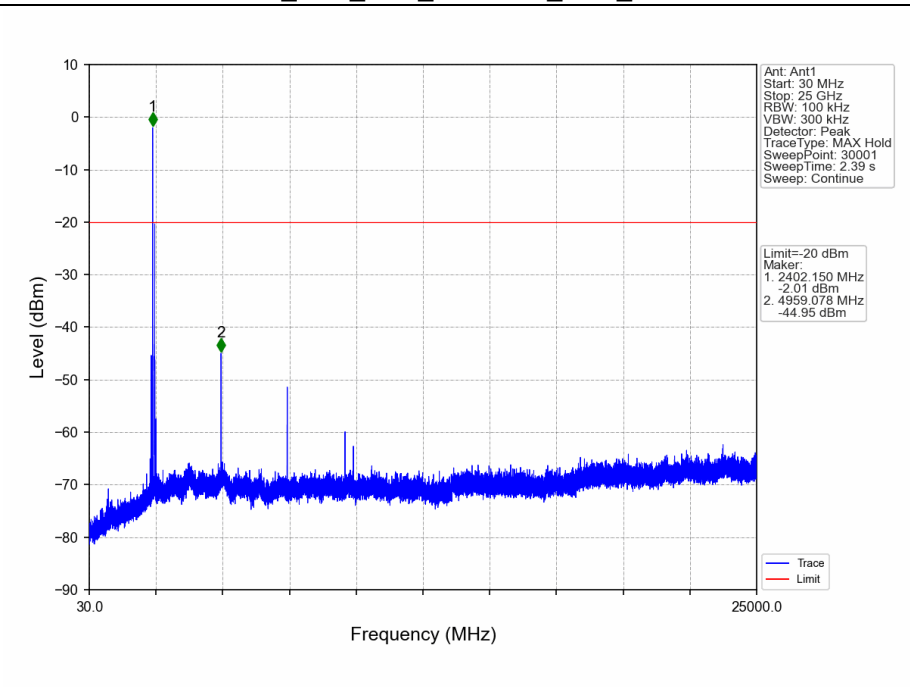

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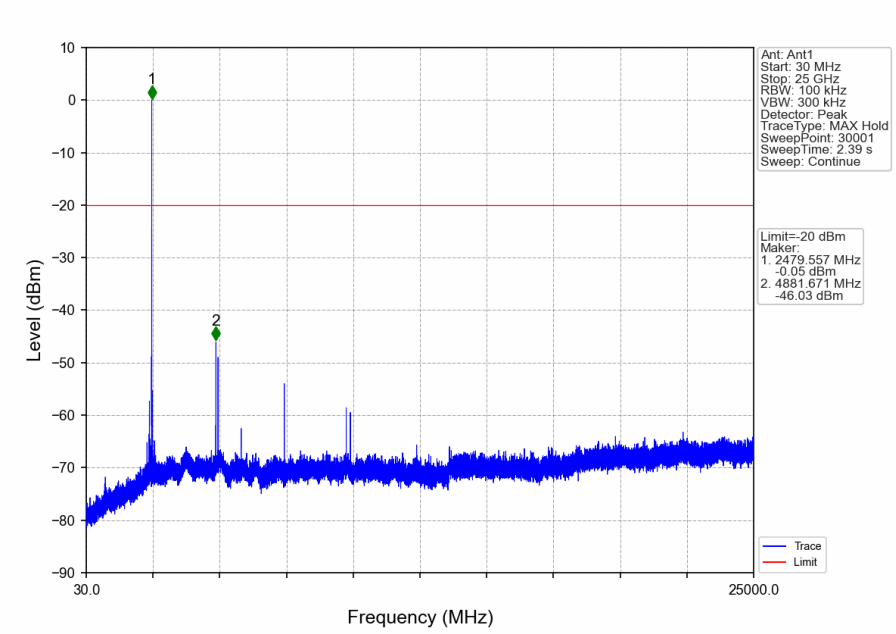
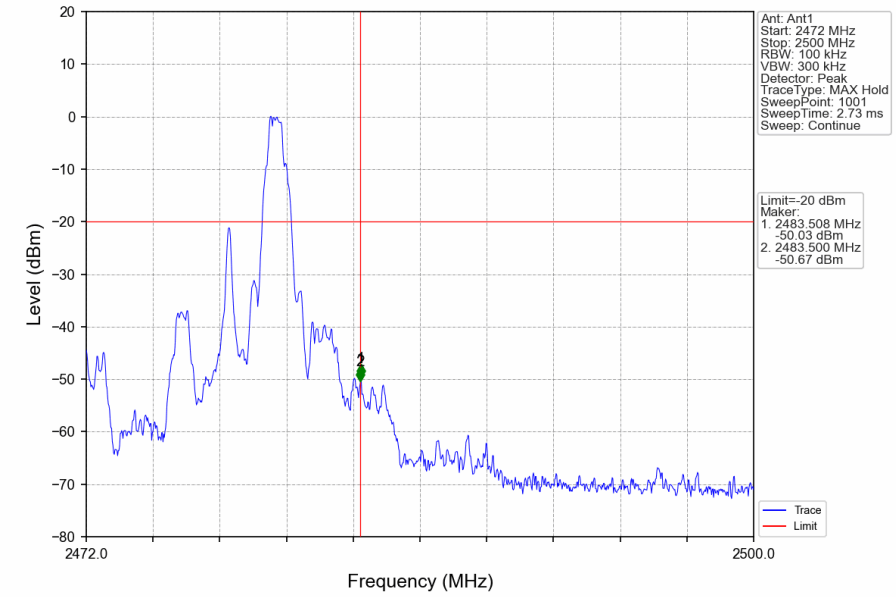
GFSK_DH5_MCH_2441MHz_Ant1_NTNV



GFSK_DH5_HCH_2480MHz_Ant1_NTNV



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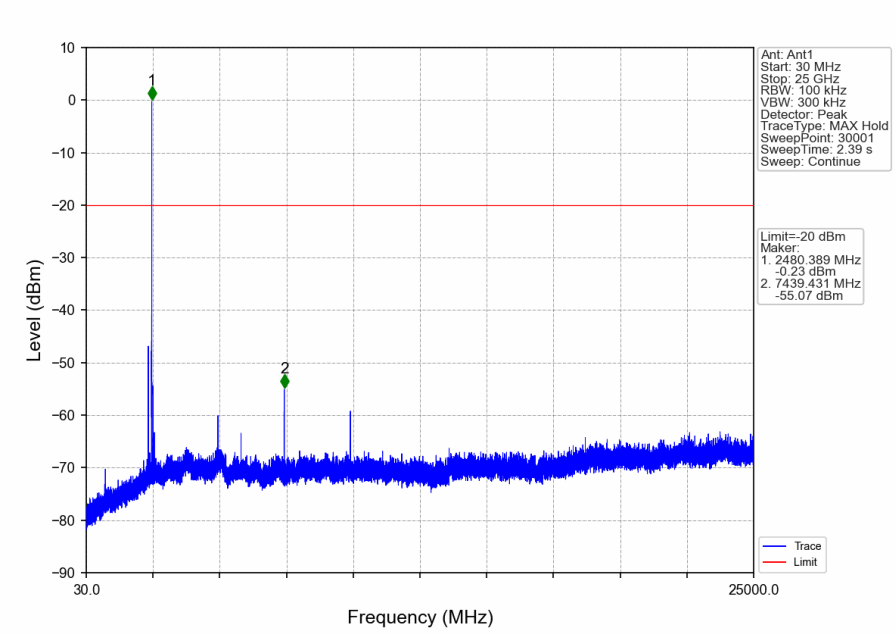
GFSK_DH5_HCH_2480MHz_Ant1_NTNV



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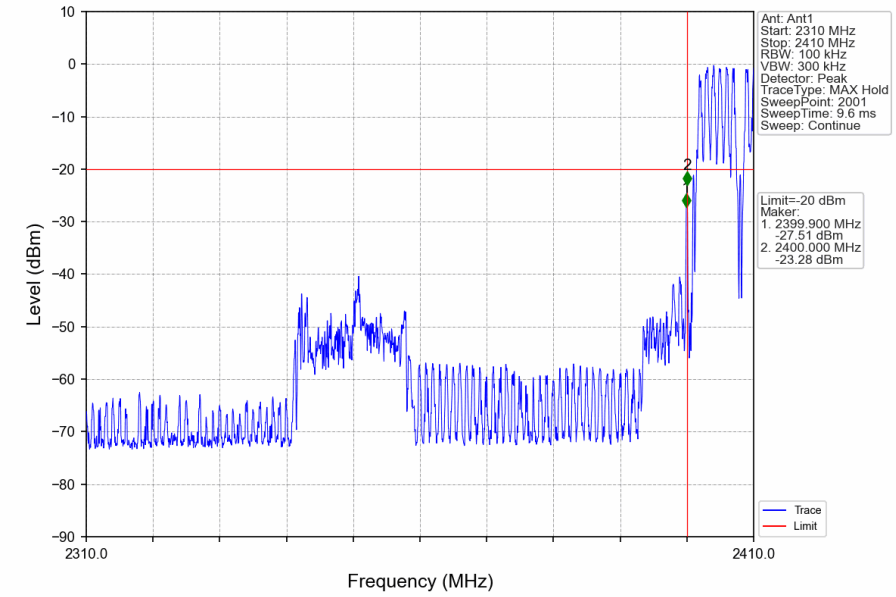

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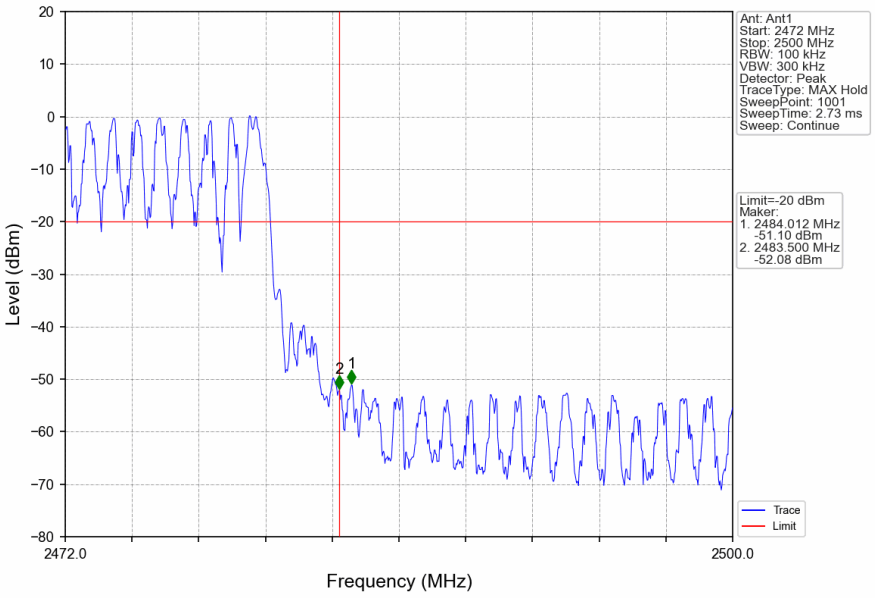
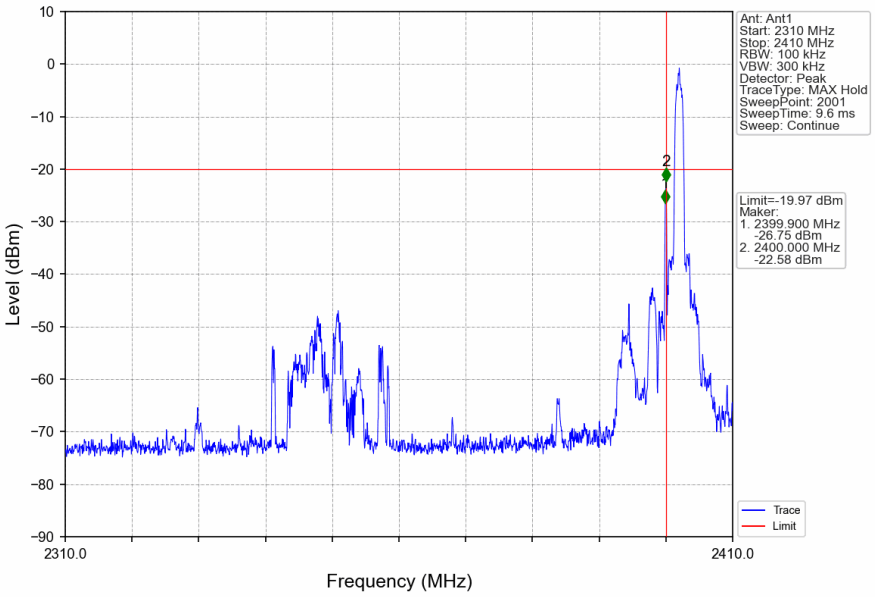
GFSK_DH5_HOPP_Ant1_NTNV



Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



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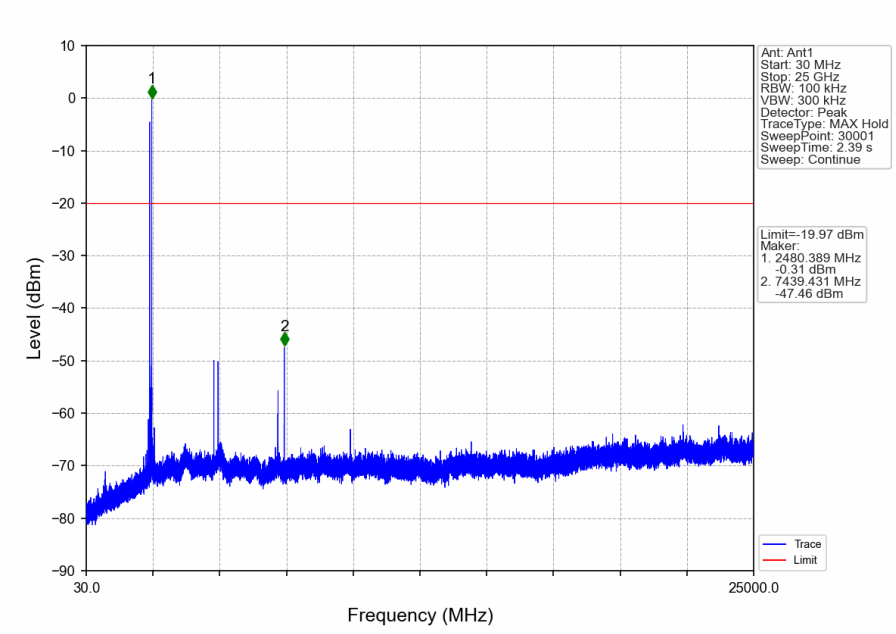

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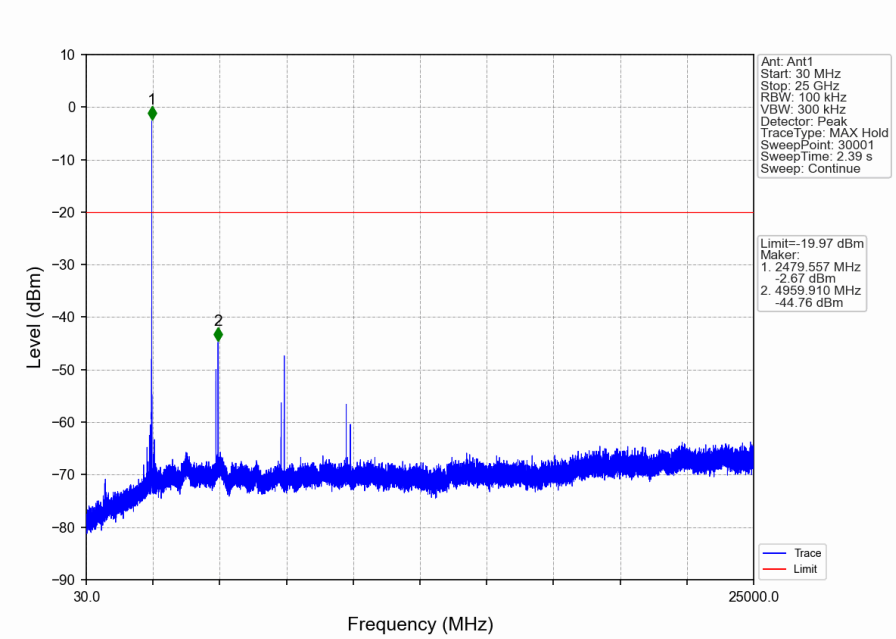

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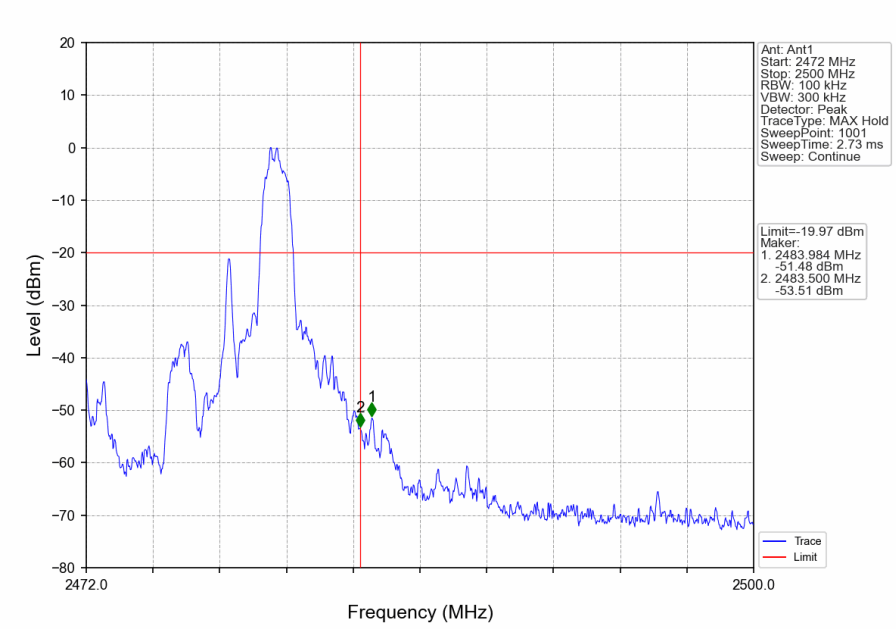
Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV



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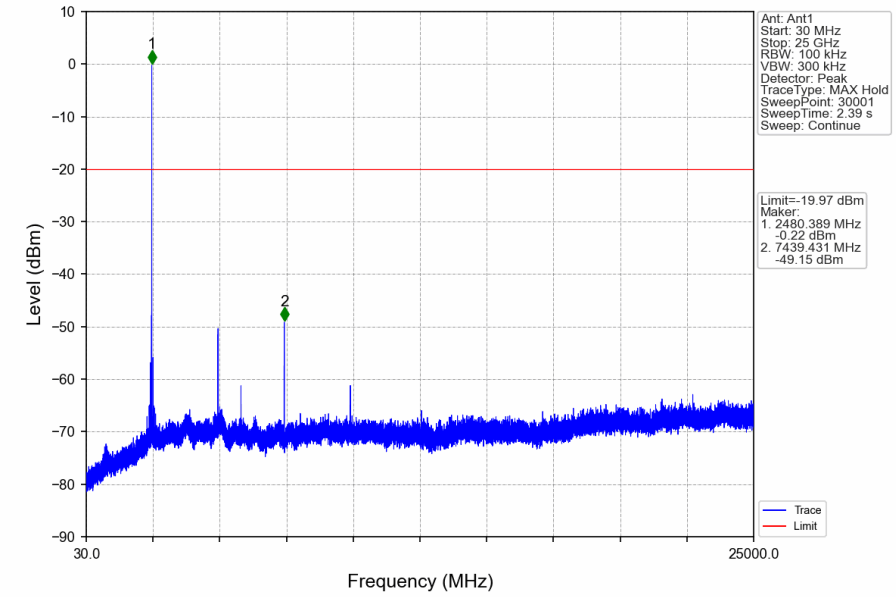

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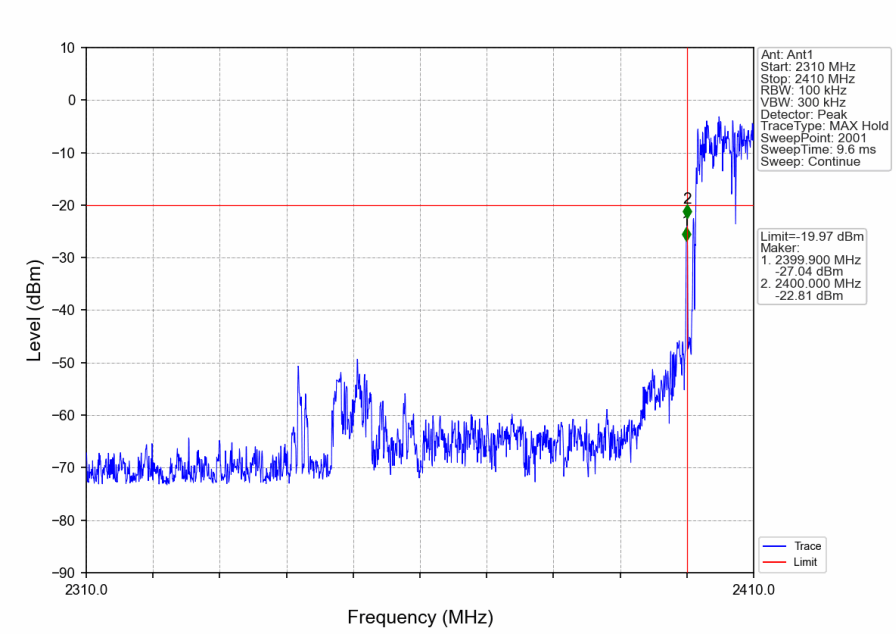
Pi/4DQPSK_2DH5_HOPP_Ant1_NTNV



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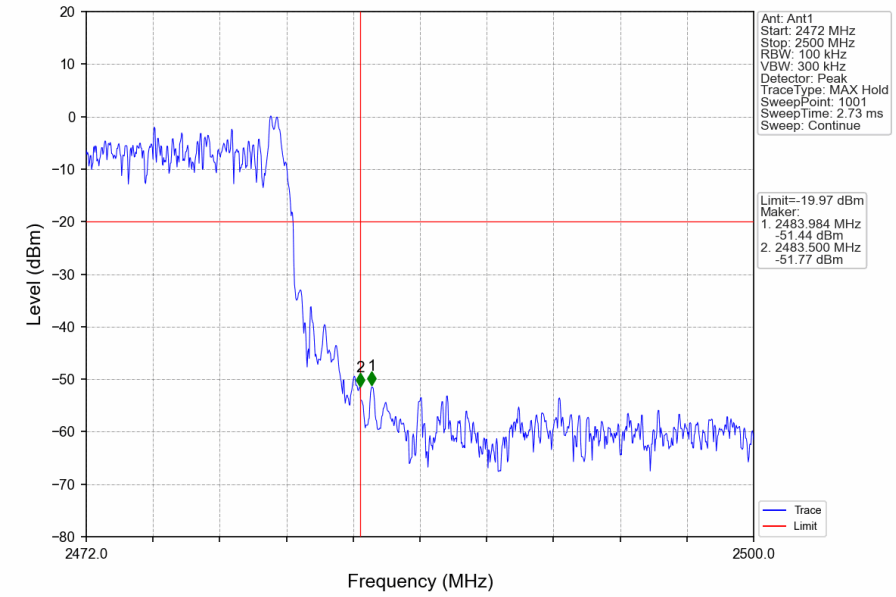

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