



TEST REPORT

Application No.: GZCR2110021239AT
Applicant: Micro:bit Educational Foundation
Address of Applicant: 12 New Fetter Lane, London, United Kingdom
Manufacturer: Micro:bit Educational Foundation
Address of Manufacturer: 12 New Fetter Lane, London, United Kingdom
Factory: NOTE Electronics (Dongguan) Ltd
Address of Factory: 8 Ling Dong 3 Road, Lincun Industrial Center, Tangxia, Dongguan
Guangdong, P.R.China 523710
Equipment Under Test (EUT):
EUT Name: BBC micro:bit
Model No.: V2.20
Trade Mark: BBC micro:bit
Standard(s) : 47 CFR Part 15, Subpart C 15.247
Date of Receipt: 2021-10-21
Date of Test: 2021-10-21 to 2021-11-01
Date of Issue: 2021-11-29

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

Kobe Jian
EMC Laboratory Manager



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Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2021-11-29		Original

Authorized for issue by				
				
		Curry Wu/Project Engineer		
				
		Ricky Liu/Reviewer		

2 Test Summary

Radio Spectrum Technical Requirement				
Item	Standard	Method	Requirement	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)	Pass

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 11.9.1.3	47 CFR Part 15, Subpart C 15.247(b)(3)	Pass
Minimum 6dB Bandwidth		ANSI C63.10 (2013) Section 11.8.1	47 CFR Part 15, Subpart C 15.247a(2)	Pass
Power Spectrum Density		ANSI C63.10 (2013) Section 11.10.2	47 CFR Part 15, Subpart C 15.247(e)	Pass
Conducted Band Edges Measurement		ANSI C63.10 (2013) Section 11.13.3.2	47 CFR Part 15, Subpart C 15.247(d)	Pass
Conducted Spurious Emissions		ANSI C63.10 (2013) Section 11.11	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 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions (Above 1GHz)		ANSI C63.10 (2013) Section 6.4,6.5,6.6	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.

The model No V2.20, this version of the product will have two variants, Variant 1 with IC: nRF52820-ODAA and Var2 with IC: nRF52833-ODAA. They are identical in circuitry design, PCB layout, electrical components used, internal wiring and functions, only different in terms of specification is that the nRF52820-ODAA has 256kB Flash, 32kB RAM while the nRF52833-ODAA has 512kB Flash, 64kB RAM.

Considering to the difference of two variants, Only the Variant 2 was tested fully.



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4 General Information

4.1 Details of E.U.T.

Power supply:	DC5V from USB port or DC3V by AAA type battery*2
Cable(s):	Micro USB cable: 30cm, Shielded
Operation Frequency:	2402MHz to 2480MHz
Bluetooth Version:	V5.0 LE
Modulation Type:	GFSK
Number of Channels:	40
Channel Spacing:	2MHz
Data Rate:	1Mbps, 2Mbps
Antenna Type:	PCB Antenna
Antenna Gain:	-0.1dBi
Function:	Bluetooth

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Note Book Computer	LENOVO	ThinkPad T490	PF1D1MVJ
Mouse	LENOVO	MOJU00	00BABF8



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4.3 Measurement Uncertainty

Test Item	Measurement Uncertainty
Conducted Emissions at AC Power Line (150kHz-30MHz)	$\pm 3.12\text{dB}$
Conducted Peak Output Power	$\pm 0.75\text{dB}$
Minimum 6dB Bandwidth	$\pm 3\%$
Power Spectrum Density	$\pm 2.84\text{dB}$
Conducted Band Edges Measurement	$\pm 0.75\text{dB}$
Conducted Spurious Emissions	$\pm 0.75\text{dB}$
Radiated Emissions which fall in the restricted bands	$\pm 5.08\text{dB}$ (1GHz-6GHz); $\pm 5.14\text{dB}$ (above 6GHz)
Radiated Spurious Emissions (Below 1GHz)	$\pm 5.06\text{dB}$ (3m); $\pm 4.46\text{dB}$ (10m)
Radiated Spurious Emissions (Above 1GHz)	$\pm 5.08\text{dB}$ (1GHz-6GHz); $\pm 5.14\text{dB}$ (above 6GHz)
Remark: The U_{lab} (lab Uncertainty) is less than U_{CISPR} (CISPR Uncertainty), so the test results – compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit; – non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.	

4.4 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou Branch EMC Laboratory,
198 Kezhu Road, Sciencetech Park, Guangzhou Economic & Technology Development District,
Guangzhou, China 510663

Tel: +86 20 82155555 Fax: +86 20 82075059

No tests were sub-contracted.

4.5 Test Facility

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

- **NVLAP (Lab Code: 200611-0)**

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou EMC Laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 200611-0.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

- **ACMA**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory can also perform testing for the Australian/New Zealand Regulatory Compliance Mark (RCM).

- **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.

- **CNAS (Lab Code: L0167)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been assessed and in compliance with CNAS-CL01:2018 accreditation criteria for testing laboratories (identical to ISO/IEC 17025:2017 General Requirements) for the Competence of Testing Laboratories.

- **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)**

SGS-CSTC Standards Technical Services Co., Ltd., has been registered by Innovation Science and Economic Development Canada for Wireless Device Testing laboratories to test to Canadian radio equipment requirements. Registration No. 4620B, CAB identifier: CN0052.

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

The 10m Semi-anechoic chamber, 966 Anechoic Chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-12460, C-12584, G-20107 and T-11179 respectively.

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

SGS-CSTC Standards Technical Services Co., Ltd., E&E Laboratory has been assessed and fully comply with the requirements of ISO/IEC 17025:2017, the Basic Rules, IECEE 01 and Rules of procedure IECEE 02, and the relevant IECEE CB-Scheme Operational documents.



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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
Shielding Room	ChangZhou ZhongYu	8m x 3m x 3.8m	EMC0306	N/A	N/A
Two-Line V-Network	Rohde & Schwarz	ENV216	EMC0118	2021-01-08	2022-01-06
Two-Line V-Network-GZ	Rohde & Schwarz	ENV216	EMC2135	2021-09-24	2022-09-23
Coaxial Cable	HangTianXing	2m	EMC0107	2020-09-09	2022-09-08
Test Software E3c	Audix	Ver. 5.4.1221b	GZE100-62	N/A	N/A
EMI Test Receiver(9kHz-3.6GHz)	Rohde & Schwarz	ESR3	EMC2221	2021-06-01	2022-05-31

Conducted Peak Output Power					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Power Meter (U2021XA_Ch2)	Agilent Technologies	U2021XA_Ch2	SEM009-02	2021-05-19	2022-05-18
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Minimum 6dB Bandwidth					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2021-09-16	2022-09-15
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Power Spectrum Density					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2021-09-16	2022-09-15
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Conducted Band Edges Measurement					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2021-09-16	2022-09-15
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01



Conducted Spurious Emissions					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2021-09-16	2022-09-15
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Radiated Emissions which fall in the restricted bands					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EMI Test Receiver(20Hz-26.5GHz)	Rohde & Schwarz	ESIB26	EMC0522	2021-01-08	2022-01-07
Chamber cable(Above 1GHz)	Scoflex	KMKM-8.0m	EMC0545	2020-09-09	2022-09-08
Horn Antenna(1GHz-18GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2019-09-25	2022-09-24
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2021-01-08	2022-01-07
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2021-01-08	2022-01-07
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2020-12-20	2023-12-19
MXE EMI Receiver(10Hz-8.4GHz)	Keysight	N9038A	EMC2139	2020-11-13	2021-11-12
EXA Signal Analyzer(10Hz-44GHz)	Keysight	N9010A	EMC2138	2021-09-16	2022-09-15
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A
Horn Antenna(14-40GHz)	SCHWARZBECK	BBHA 9170	EMC2041	2020-06-28	2023-06-27
Microwave Broadband Preamplifier (18-40GHz)	SCHWARZBECK	BBV 9721	EMC2172	2021-09-08	2022-09-07

Radiated Spurious Emissions (Below 1GHz)					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Chamber cable	HangTianXing	N/A	EMC0542	2020-09-09	2022-09-08
Trilog Broadband Antenna(25MHz-1GHz)-Lab	SCHWARZBECK MESS-ELEKTRONIK	VULB 9168	SEM003-18	2019-02-22	2022-02-22
Amplifier(9kHz-1.3GHz)	HP	8447F	EMC2065	2021-05-19	2022-05-18
Active Loop Antenna-RED	ETS-Lindgren	6502	EMC2190	2019-12-27	2021-12-26
10m Semi-Anechoic Chamber	ETS	N/A	EMC0530	2019-10-20	2022-10-19
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A



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EMI Test Receiver(1Hz-8GHz)	Rohde & Schwarz	ESW8	EMC2220	2021-05-26	2022-05-25
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Radiated Spurious Emissions (Above 1GHz)					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EMI Test Receiver(20Hz-26.5GHz)	Rohde & Schwarz	ESIB26	EMC0522	2021-01-08	2022-01-07
Chamber cable(Above 1GHz)	Scoflex	KMKM-8.0m	EMC0545	2020-09-09	2022-09-08
Horn Antenna(1GHz-18GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2019-09-25	2022-09-24
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2021-01-08	2022-01-07
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2021-01-08	2022-01-07
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2020-12-20	2023-12-19
MXE EMI Receiver(10Hz-8.4GHz)	Keysight	N9038A	EMC2139	2020-11-13	2021-11-12
EXA Signal Analyzer(10Hz-44GHz)	Keysight	N9010A	EMC2138	2021-09-16	2022-09-15
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A
Horn Antenna(14-40GHz)	SCHWARZBECK	BBHA 9170	EMC2041	2020-06-28	2023-06-27
Microwave Broadband Preamplifier (18-40GHz)	SCHWARZBECK	BBV 9721	EMC2172	2021-08-30	2022-08-29

General used equipment					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DMM	Fluke	73	EMC0006	2021-07-05	2022-07-05
DMM	Fluke	73	EMC0007	2021-07-05	2022-07-05

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:

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level. When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

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 -0.1 dBi.

Antenna location: Refer to external photo.

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: 23.8 °C

Humidity: 48.9 % RH

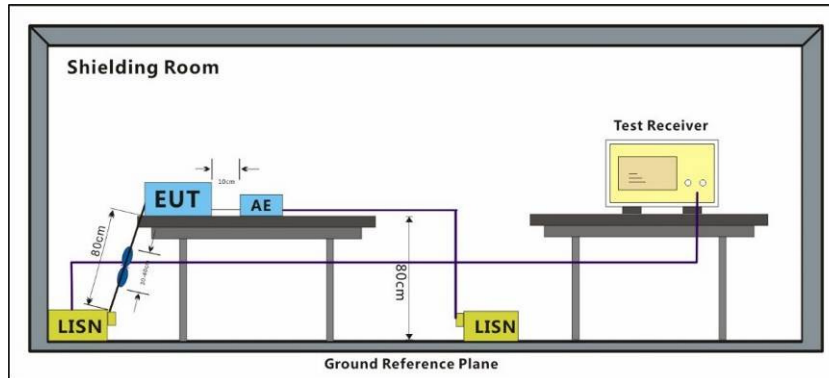
Atmospheric Pressure: 1003 mbar

7.1.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	01	TX mode(2Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.



7.1.3 Test Setup Diagram

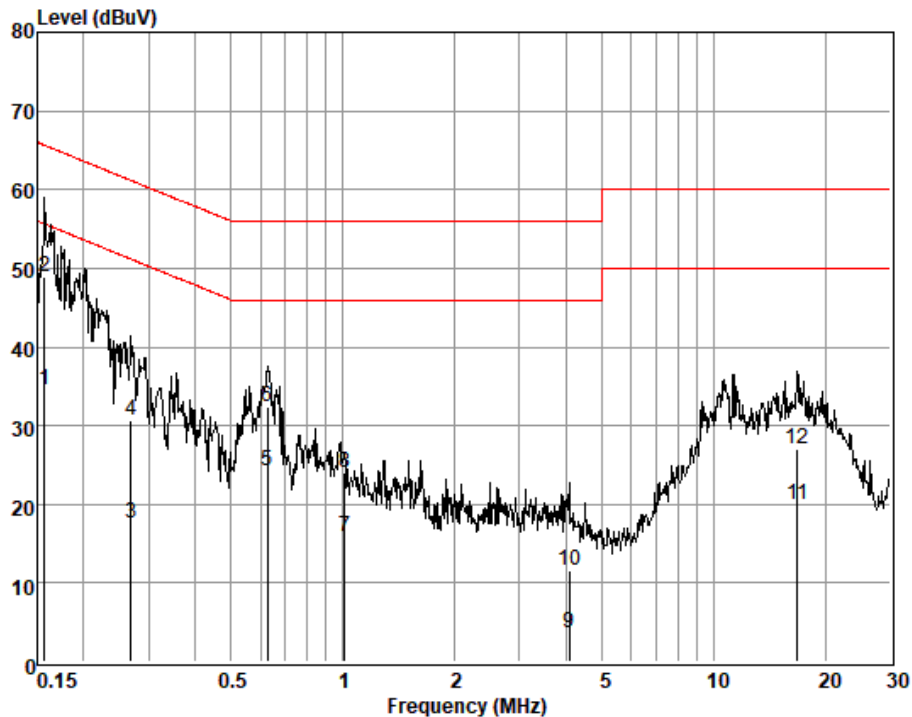


7.1.4 Measurement Procedure and Data

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

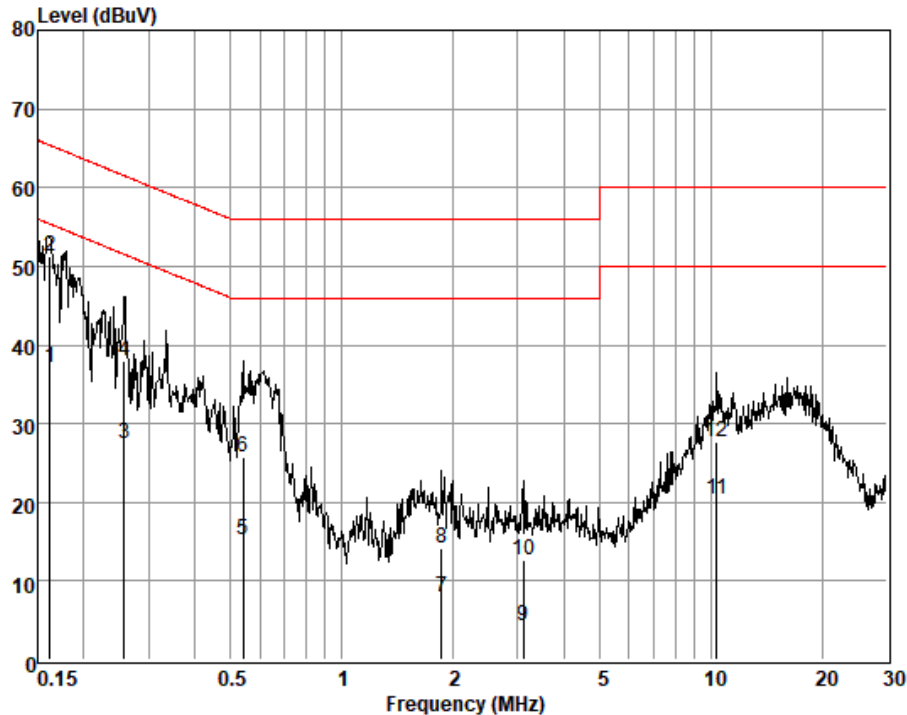
Test Mode: 00; Line: Live line Modulation:GFSK; Channel:Low



Condition: LINE
No : 21239AT
Model : V2.20
Power : AC 120V 60Hz
Mode : 00

	Freq	Read	Cable	LISN	Limit	Over	
	MHz	Level	Loss	Factor	Line	Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dB	
1	0.156	24.84	0.06	9.62	34.52	55.65	-21.13 Average
2 !	0.156	39.13	0.06	9.62	48.81	65.65	-16.84 QP
3	0.269	7.84	0.06	9.62	17.52	51.16	-33.64 Average
4	0.269	21.08	0.06	9.62	30.76	61.16	-30.40 QP
5	0.627	14.60	0.07	9.63	24.30	46.00	-21.70 Average
6	0.627	22.69	0.07	9.63	32.39	56.00	-23.61 QP
7	1.010	6.25	0.07	9.62	15.94	46.00	-30.06 Average
8	1.010	14.39	0.07	9.62	24.08	56.00	-31.92 QP
9	4.092	-6.25	0.17	9.62	3.54	46.00	-42.46 Average
10	4.092	1.78	0.17	9.62	11.57	56.00	-44.43 QP
11	16.839	9.84	0.33	9.75	19.92	50.00	-30.08 Average
12	16.839	16.87	0.33	9.75	26.95	60.00	-33.05 QP

Test Mode: 00; Line: Neutral Line Modulation:GFSK; Channel:Low



Condition: NEUTRAL
No : 21239AT
Model : V2.20
Power : AC 120V 60Hz
Mode : 00

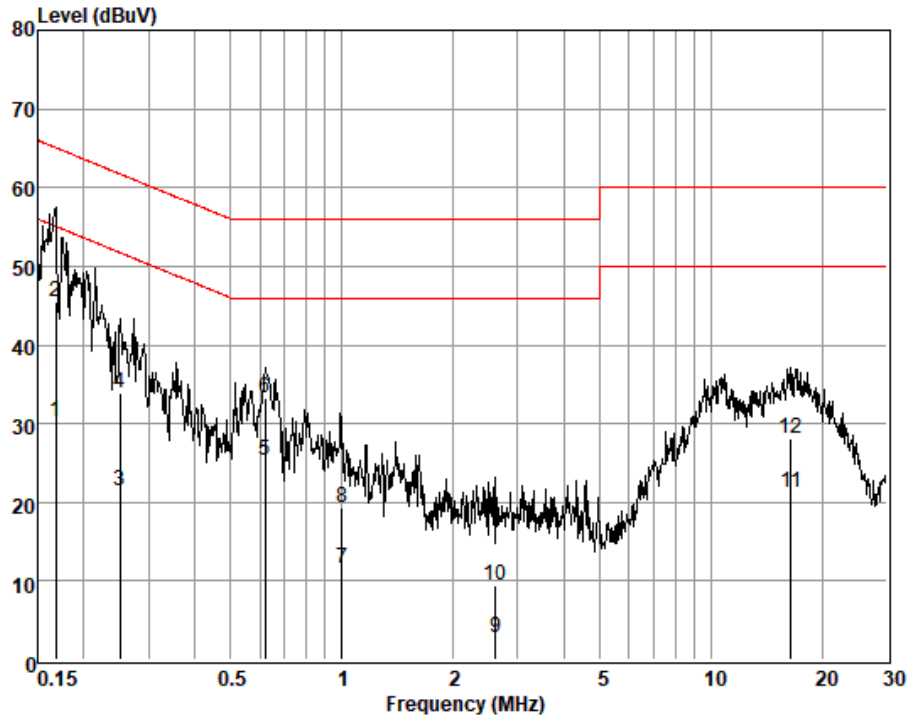
	Freq	Read Level	Cable Loss	LISN Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.162	27.52	0.06	9.55	37.13	55.38	-18.25	Average
2 !	0.162	41.68	0.06	9.55	51.29	65.38	-14.09	QP
3	0.258	17.79	0.06	9.55	27.40	51.51	-24.11	Average
4	0.258	28.33	0.06	9.55	37.94	61.51	-23.57	QP
5	0.541	5.53	0.07	9.55	15.15	46.00	-30.85	Average
6	0.541	16.20	0.07	9.55	25.82	56.00	-30.18	QP
7	1.868	-1.79	0.11	9.54	7.86	46.00	-38.14	Average
8	1.868	4.54	0.11	9.54	14.19	56.00	-41.81	QP
9	3.107	-5.50	0.15	9.56	4.21	46.00	-41.79	Average
10	3.107	2.84	0.15	9.56	12.55	56.00	-43.45	QP
11	10.397	10.55	0.24	9.59	20.38	50.00	-29.62	Average
12	10.397	17.74	0.24	9.59	27.57	60.00	-32.43	QP



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Test Mode: 01; Line: Live line Modulation:GFSK; Channel:Low



Condition: LINE
No : 21239AT
Model : V2.20
Power : AC 120V 60Hz
Mode : 01

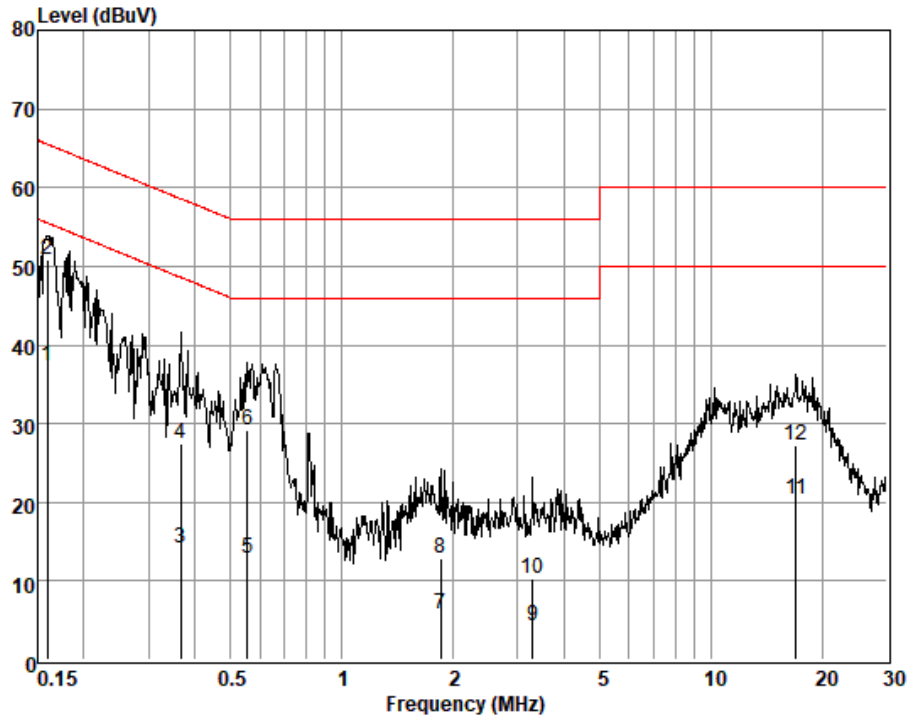
	Freq	Read	Cable	LISN	Limit	Over	
	MHz	Level	Loss	Factor	Line	Limit	Remark
		dBuV	dB	dB	dBuV	dB	
1	0.168	20.61	0.06	9.62	30.29	55.08	-24.79 Average
2 !	0.168	35.90	0.06	9.62	45.58	65.08	-19.50 QP
3	0.251	11.81	0.06	9.62	21.49	51.73	-30.24 Average
4	0.251	24.10	0.06	9.62	33.78	61.73	-27.95 QP
5	0.621	15.66	0.07	9.63	25.36	46.00	-20.64 Average
6	0.621	23.51	0.07	9.63	33.21	56.00	-22.79 QP
7	1.000	1.90	0.07	9.62	11.59	46.00	-34.41 Average
8	1.000	9.68	0.07	9.62	19.37	56.00	-36.63 QP
9	2.608	-7.07	0.14	9.62	2.69	46.00	-43.31 Average
10	2.608	-0.22	0.14	9.62	9.54	56.00	-46.46 QP
11	16.486	11.18	0.33	9.75	21.26	50.00	-28.74 Average
12	16.486	17.95	0.33	9.75	28.03	60.00	-31.97 QP



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Test Mode: 01; Line: Neutral Line Modulation:GFSK; Channel:Low



Condition: NEUTRAL
No : 21239AT
Model : V2.20
Power : AC 120V 60Hz
Mode : 01

	Freq	Read Level	Cable Loss	LISN Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.159	27.64	0.06	9.55	37.25	55.52	-18.27	Average
2 !	0.159	41.13	0.06	9.55	50.74	65.52	-14.78	QP
3	0.365	4.54	0.06	9.55	14.15	48.61	-34.46	Average
4	0.365	17.76	0.06	9.55	27.37	58.61	-31.24	QP
5	0.555	3.26	0.07	9.54	12.87	46.00	-33.13	Average
6	0.555	19.47	0.07	9.54	29.08	56.00	-26.92	QP
7	1.858	-3.97	0.11	9.54	5.68	46.00	-40.32	Average
8	1.858	3.23	0.11	9.54	12.88	56.00	-43.12	QP
9	3.293	-5.50	0.15	9.56	4.21	46.00	-41.79	Average
10	3.293	0.50	0.15	9.56	10.21	56.00	-45.79	QP
11	17.018	10.42	0.33	9.65	20.40	50.00	-29.60	Average
12	17.018	17.26	0.33	9.65	27.24	60.00	-32.76	QP



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7.2 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(3)

Test Method: ANSI C63.10 (2013) Section 11.9.1.3

Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥ 50 hopping channels
	0.25 for $25 \leq$ hopping channels < 50
	1 for digital modulation
2400-2483.5	1 for ≥ 75 non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 23.5 °C

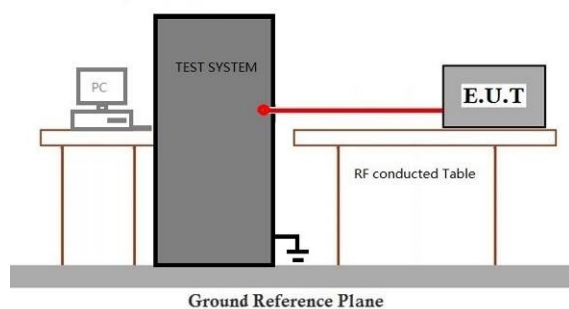
Humidity: 47.8 % RH

Atmospheric Pressure: 1003 mbar

7.2.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	01	TX mode(2Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.2.3 Test Setup Diagram



7.2.4 Measurement Procedure and Data

cable loss=0.9dB

Please Refer to Appendix for Details



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7.3 Minimum 6dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247a(2)

Test Method: ANSI C63.10 (2013) Section 11.8.1

Limit:

≥500 kHz

7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 23.5 °C

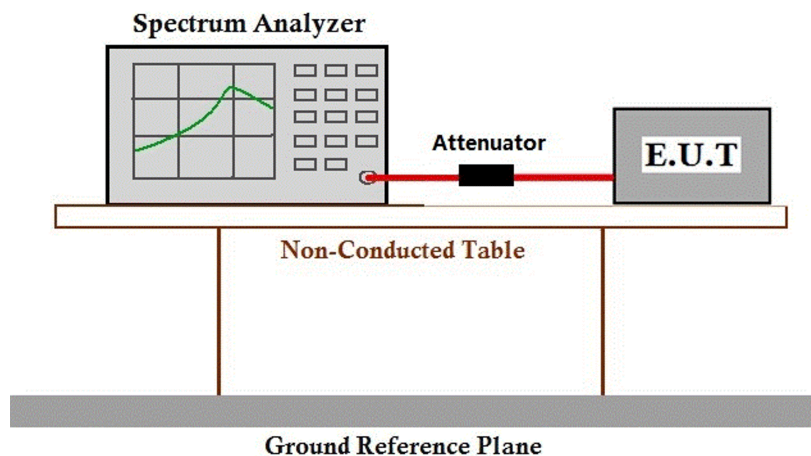
Humidity: 47.8 % RH

Atmospheric Pressure: 1003 mbar

7.3.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	01	TX mode(2Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.3.3 Test Setup Diagram



7.3.4 Measurement Procedure and Data

cable loss=0.9dB

Please Refer to Appendix for Details

7.4 Power Spectrum Density

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

Test Method: ANSI C63.10 (2013) Section 11.10.2

Limit:

≤8dBm in any 3 kHz band during any time interval of continuous transmission

7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 23.5 °C

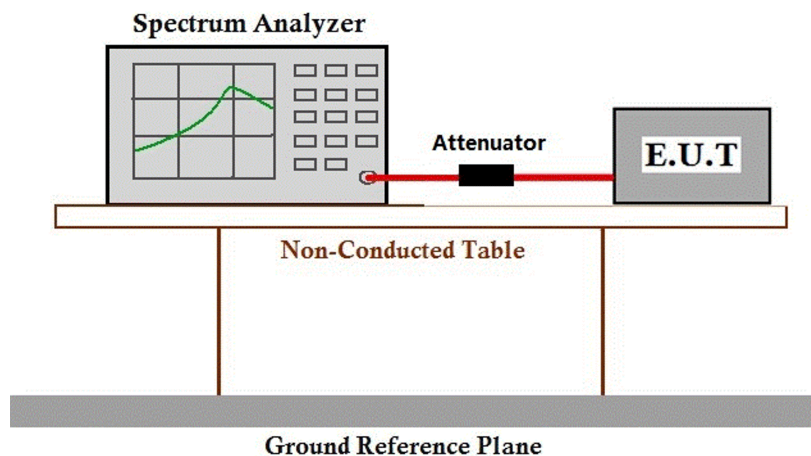
Humidity: 47.8 % RH

Atmospheric Pressure: 1003 mbar

7.4.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	01	TX mode(2Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.4.3 Test Setup Diagram



7.4.4 Measurement Procedure and Data

cable loss=0.9dB

Please Refer to Appendix for Details



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7.5 Conducted Band Edges Measurement

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)
Test Method: ANSI C63.10 (2013) Section 11.13.3.2
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)).

7.5.1 E.U.T. Operation

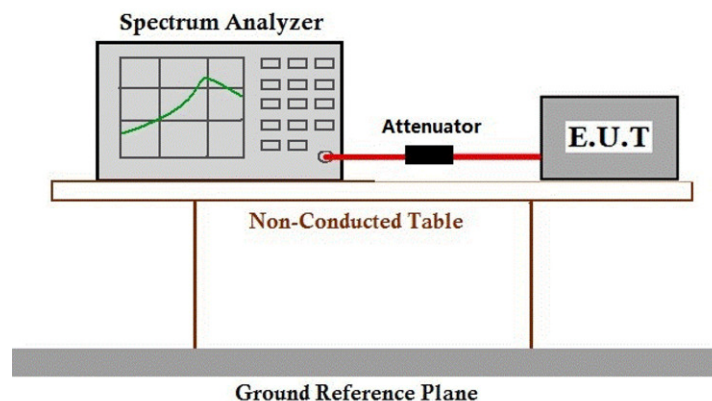
Operating Environment:

Temperature: 23.5 °C Humidity: 47.8 % RH Atmospheric Pressure: 1003 mbar

7.5.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	01	TX mode(2Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.5.3 Test Setup Diagram



7.5.4 Measurement Procedure and Data

cable loss=0.9dB

Please Refer to Appendix for Details

7.6 Conducted Spurious Emissions

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

Test Method: ANSI C63.10 (2013) Section 11.11

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)).

7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 23.5 °C

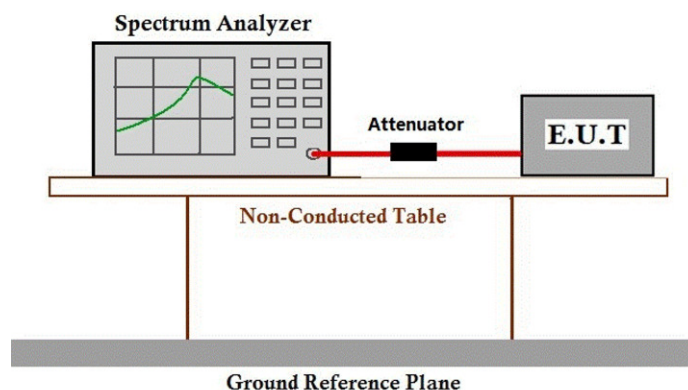
Humidity: 47.8 % RH

Atmospheric Pressure: 1003 mbar

7.6.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	01	TX mode(2Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.6.3 Test Setup Diagram



7.6.4 Measurement Procedure and Data

cable loss=0.9dB

Please Refer to Appendix for Details



7.7 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.10.5

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 24.5 °C

Humidity: 48.0 % RH

Atmospheric Pressure: 1003 mbar

7.7.2 Test Mode Description

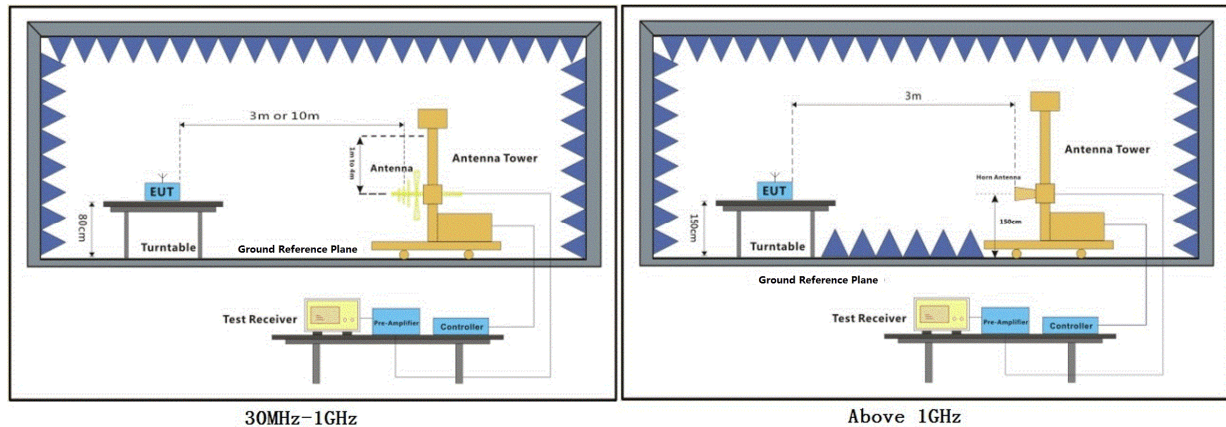
Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	01	TX mode(2Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.



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7.7.3 Test Setup Diagram



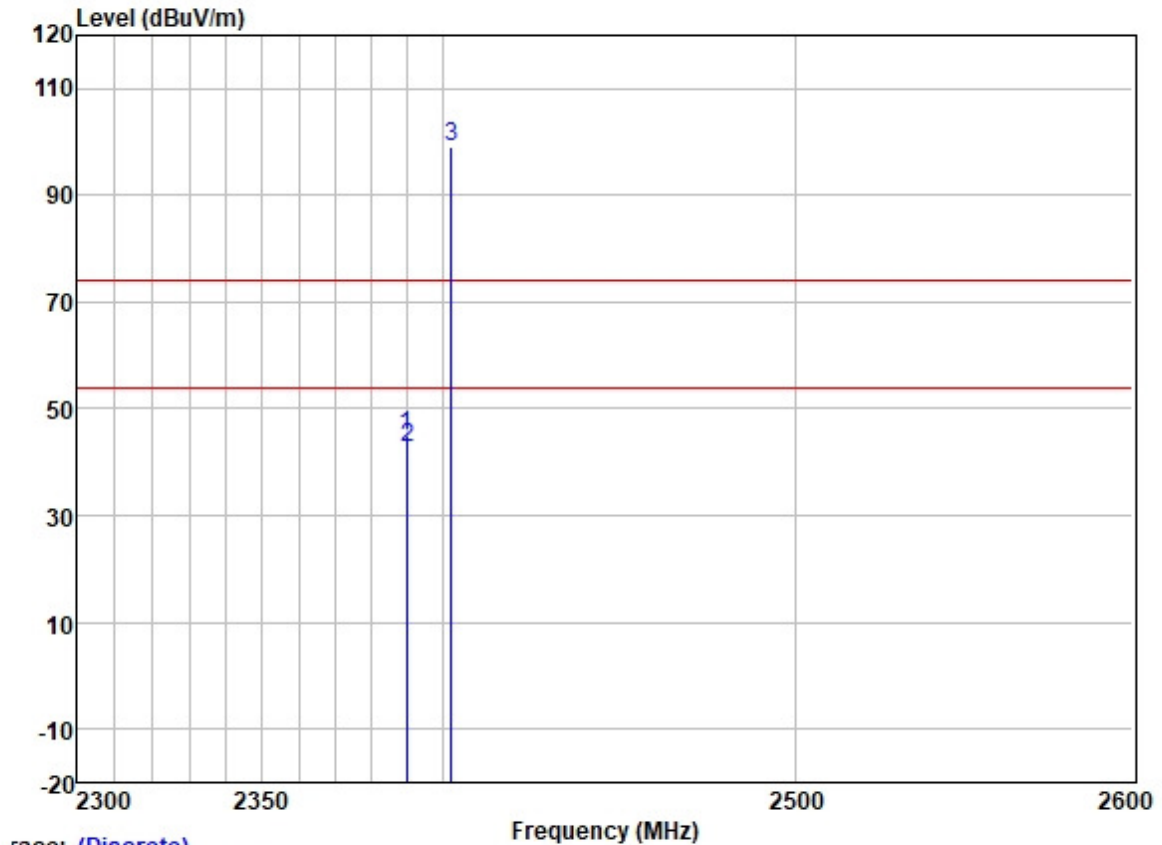
7.7.4 Measurement Procedure and Data

- 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.
- 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.
- 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.
- The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- Test the EUT in the lowest channel, the Highest channel.
- The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- Repeat above procedures until all frequencies measured was complete.

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.

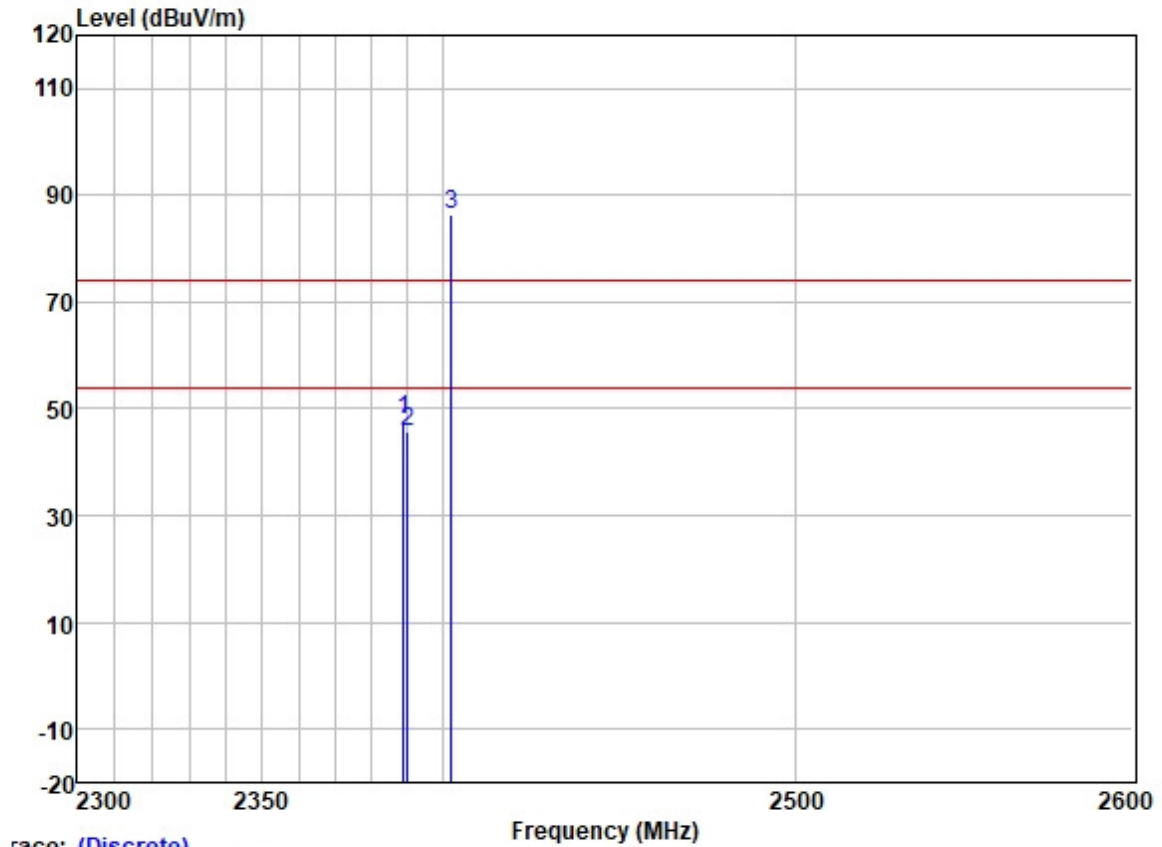
Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; ; Channel:Low



race: (Discrete)

	Freq	ReadAntenna	Cable	Preamp		Limit	Over		
		Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	Remark
1	2389.659	51.56	27.33	3.48	37.59	44.78	74.00	-29.22	HORIZONTAL Peak
2	2390.000	49.46	27.33	3.48	37.59	42.68	74.00	-31.32	HORIZONTAL Peak
3 *	2402.000	105.71	27.35	3.50	37.59	98.97	74.00	24.97	HORIZONTAL Peak

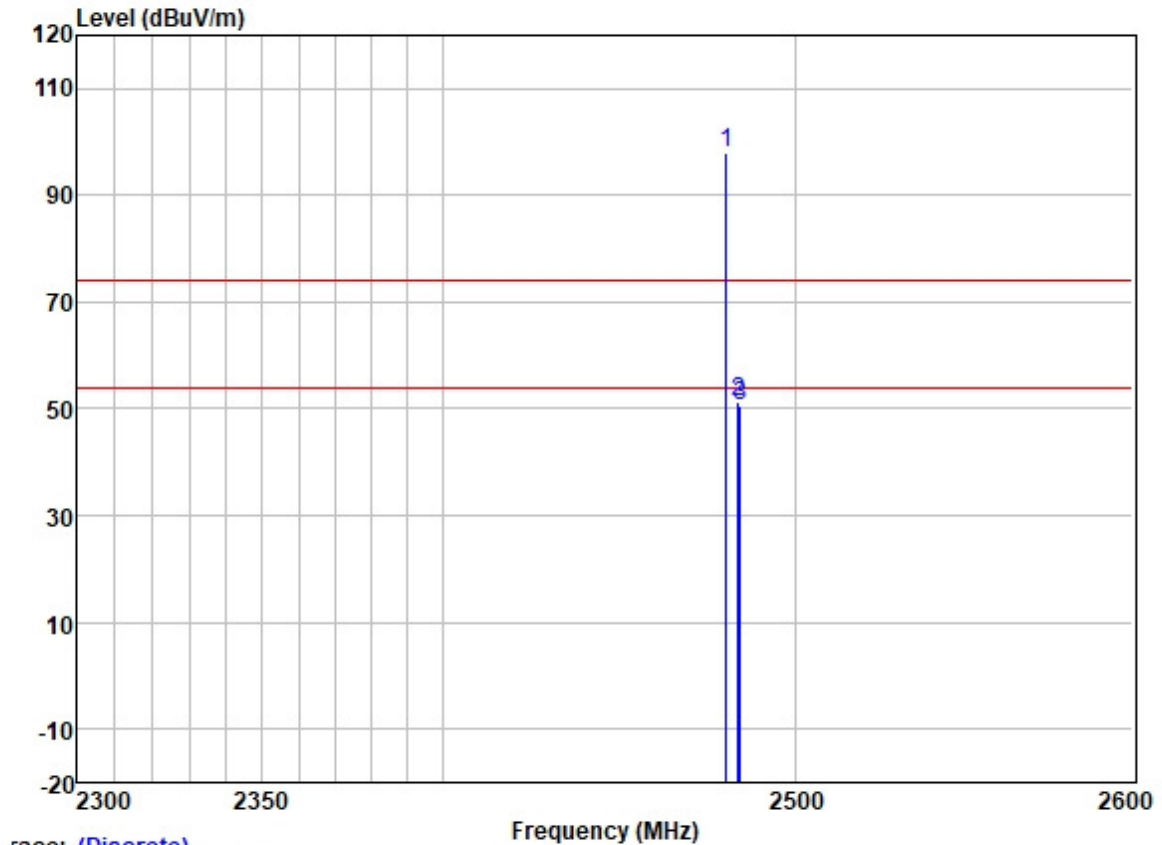
Test Mode: 00; Polarity: Vertical; Modulation:GFSK; ; Channel:Low



Trace: (Discrete)

	Freq	ReadAntenna	Cable	Preamp		Limit	Over			
		Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2388.748	54.73	27.33	3.48	37.59	47.95	74.00	-26.05	VERTICAL	Peak
2	2390.000	52.49	27.33	3.48	37.59	45.71	74.00	-28.29	VERTICAL	Peak
3 *	2402.000	93.32	27.35	3.50	37.59	86.58	74.00	12.58	VERTICAL	Peak

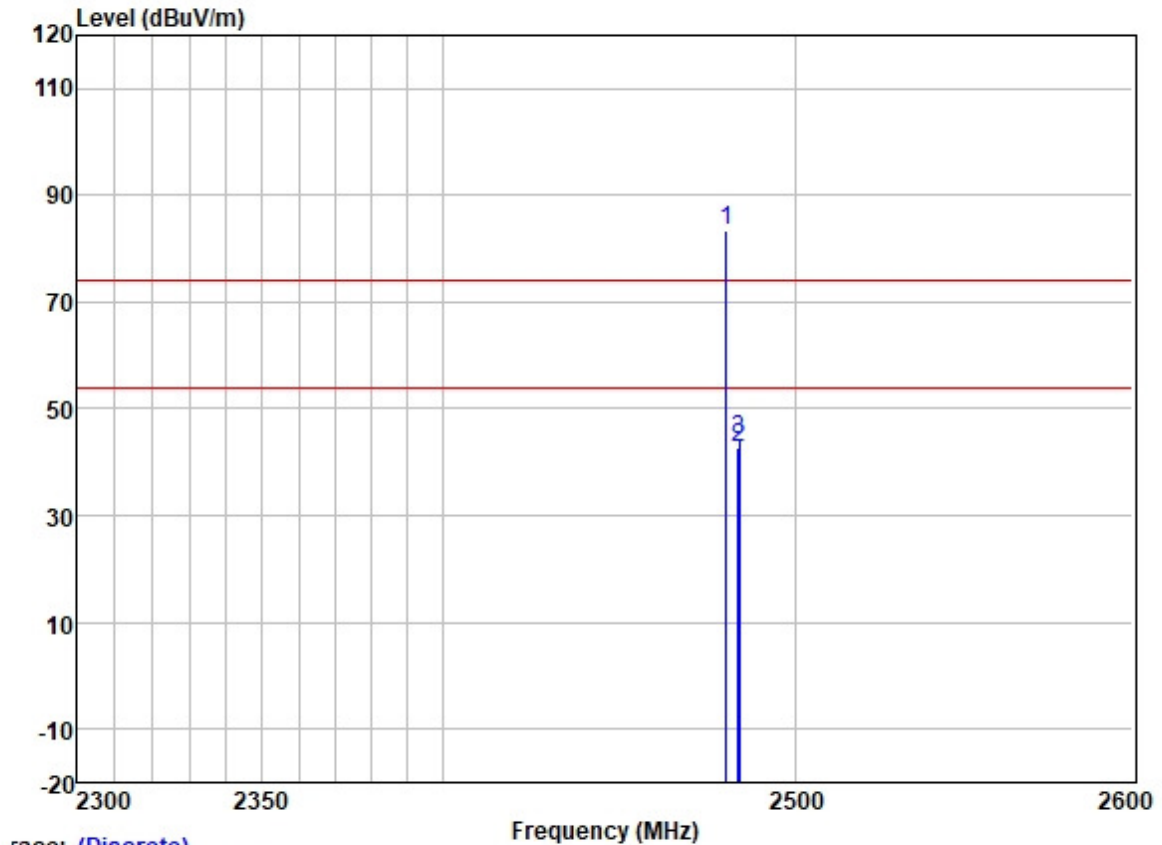
Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; ; Channel:High



Trace: (Discrete)

		ReadAntenna		Cable	Preamp		Limit	Over		
	Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1 *	2480.000	104.30	27.47	3.60	37.57	97.80	74.00	23.80	HORIZONTAL	Peak
2	2483.500	57.73	27.48	3.53	37.57	51.17	74.00	-22.83	HORIZONTAL	Peak
3	2483.896	57.07	27.48	3.53	37.57	50.51	74.00	-23.49	HORIZONTAL	Peak

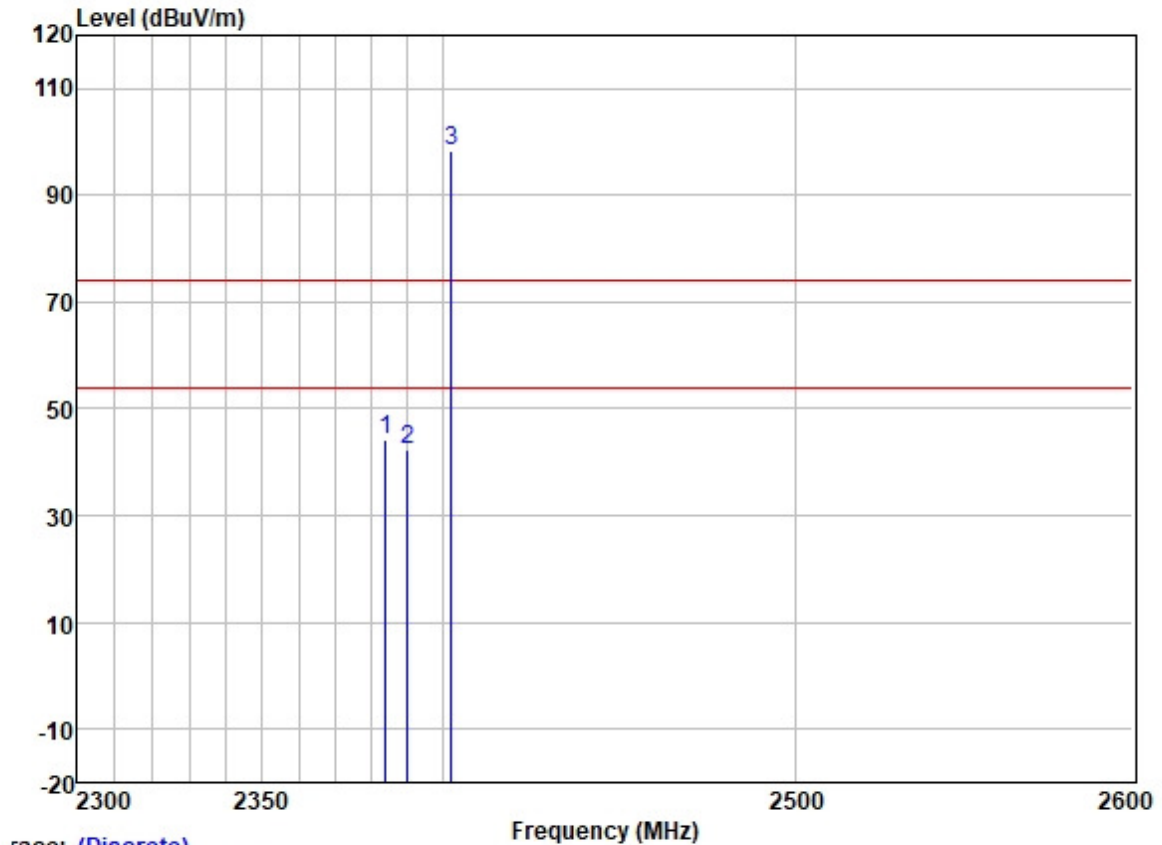
Test Mode: 00; Polarity: Vertical; Modulation:GFSK; ; Channel:High



Trace: (Discrete)

	Freq	ReadAntenna Level	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	90.00	27.47	3.60	37.57	83.50	74.00	9.50	VERTICAL	Peak
2	2483.500	49.20	27.48	3.53	37.57	42.64	74.00	-31.36	VERTICAL	Peak
3	2483.821	50.79	27.48	3.53	37.57	44.23	74.00	-29.77	VERTICAL	Peak

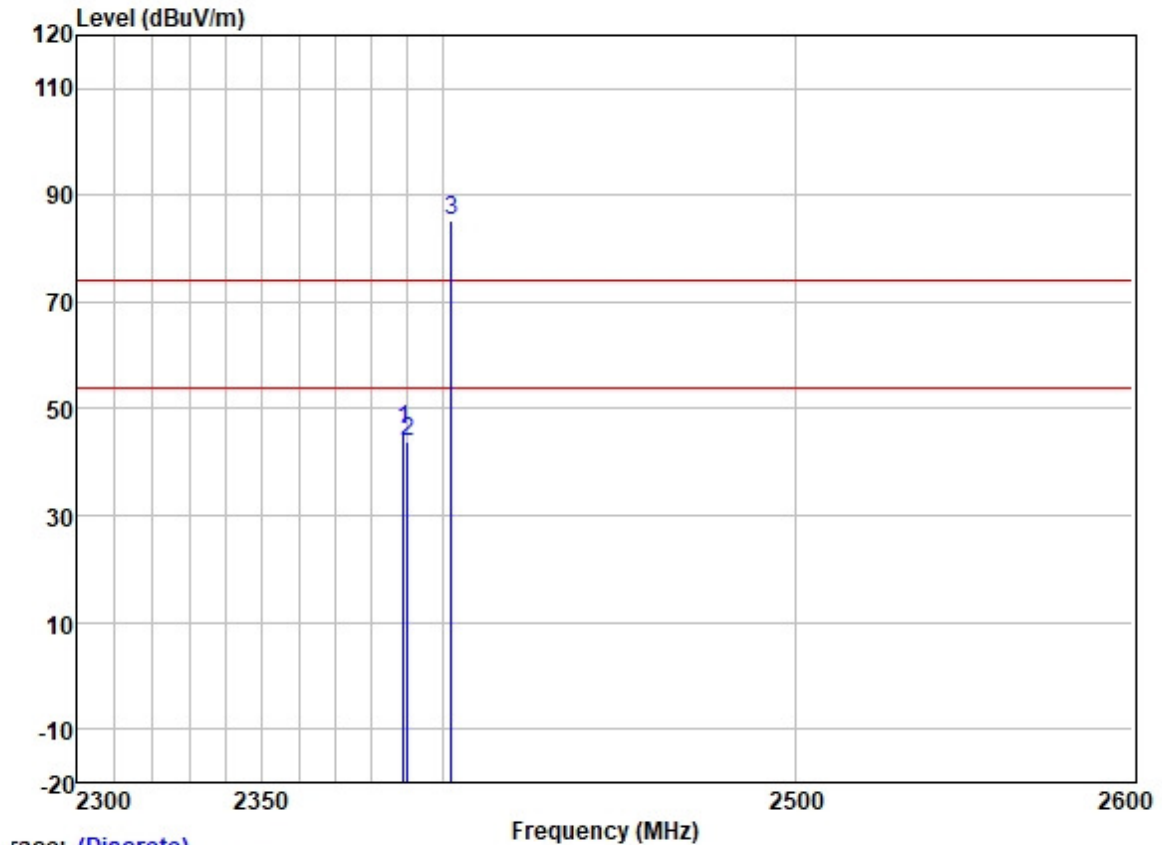
Test Mode: 01; Polarity: Horizontal; Modulation:GFSK; ; Channel:Low



race: (Discrete)

	Freq	ReadAntenna	Cable	Preamp		Limit	Over			
		Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2383.692	50.95	27.33	3.48	37.60	44.16	74.00	-29.84	HORIZONTAL	Peak
2	2390.000	48.97	27.33	3.48	37.59	42.19	74.00	-31.81	HORIZONTAL	Peak
3 *	2402.000	105.16	27.35	3.50	37.59	98.42	74.00	24.42	HORIZONTAL	Peak

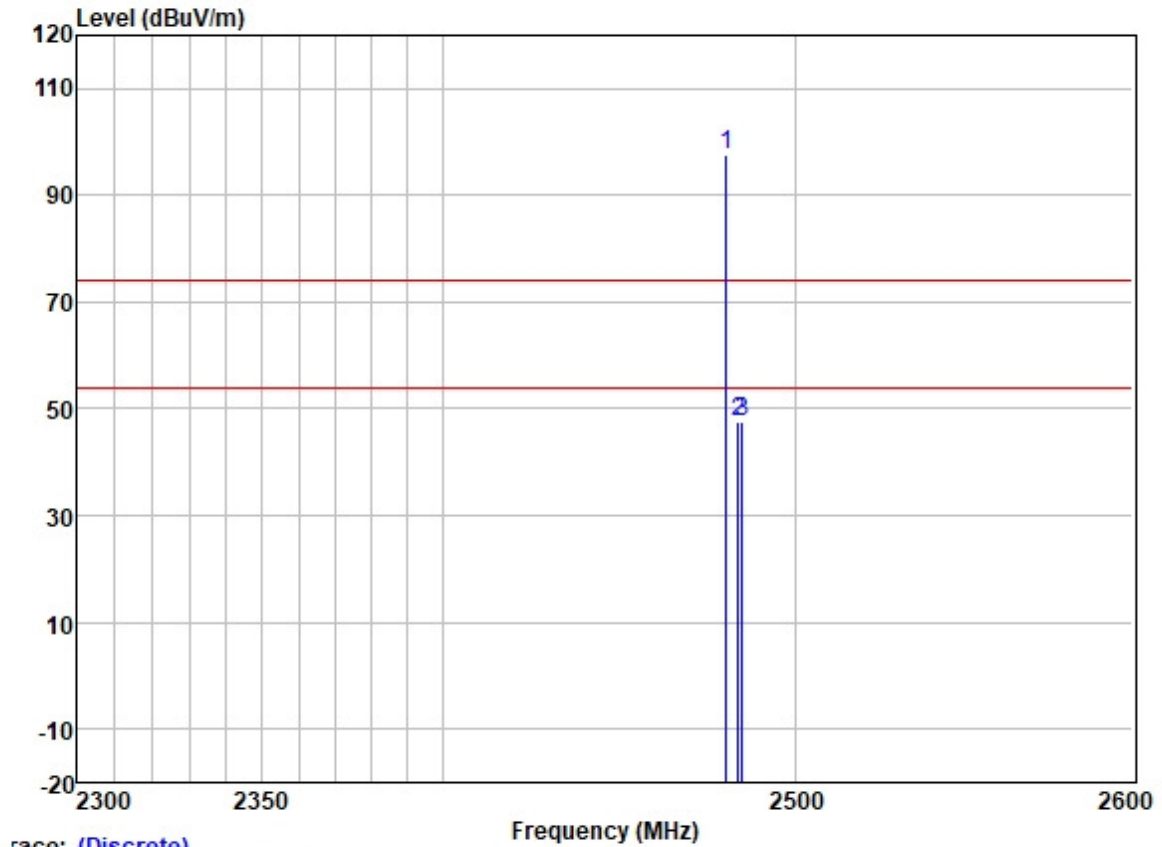
Test Mode: 01; Polarity: Vertical; Modulation:GFSK; ; Channel:Low



race: (Discrete)

	Freq	ReadAntenna	Cable	Preamp		Limit	Over			
	MHz	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2388.748	53.03	27.33	3.48	37.59	46.25	74.00	-27.75	VERTICAL	Peak
2	2390.000	50.68	27.33	3.48	37.59	43.90	74.00	-30.10	VERTICAL	Peak
3 *	2402.000	91.96	27.35	3.50	37.59	85.22	74.00	11.22	VERTICAL	Peak

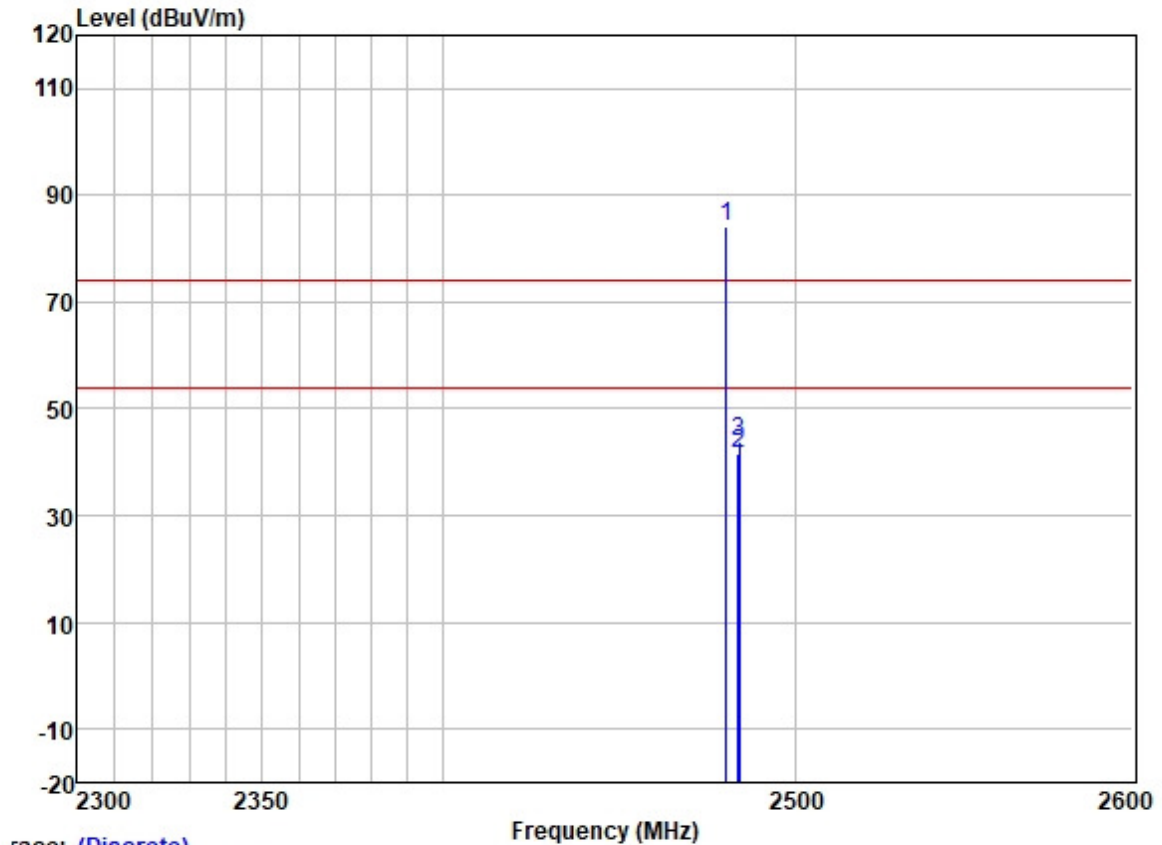
Test Mode: 01; Polarity: Horizontal; Modulation:GFSK; ; Channel:High



Trace: (Discrete)

	Read	Antenna	Cable	Preamp		Limit	Over		
Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1 *	2480.000	103.97	27.47	3.60	37.57	97.47	74.00	23.47	HORIZONTAL Peak
2	2483.500	53.99	27.48	3.53	37.57	47.43	74.00	-26.57	HORIZONTAL Peak
3	2484.745	53.97	27.48	3.53	37.57	47.41	74.00	-26.59	HORIZONTAL Peak

Test Mode: 01; Polarity: Vertical; Modulation:GFSK; ; Channel:High



Trace: (Discrete)

		ReadAntenna		Cable	Preamp		Limit	Over		
	Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	* 2480.000	90.79	27.47	3.60	37.57	84.29	74.00	10.29	VERTICAL	Peak
2	2483.500	48.34	27.48	3.53	37.57	41.78	74.00	-32.22	VERTICAL	Peak
3	2483.821	50.54	27.48	3.53	37.57	43.98	74.00	-30.02	VERTICAL	Peak

7.8 Radiated Spurious Emissions (Below 1GHz)

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

7.8.1 E.U.T. Operation

Operating Environment:

Temperature: 25.1 °C

Humidity: 48.2 % RH

Atmospheric Pressure: 1003 mbar

7.8.2 Test Mode Description

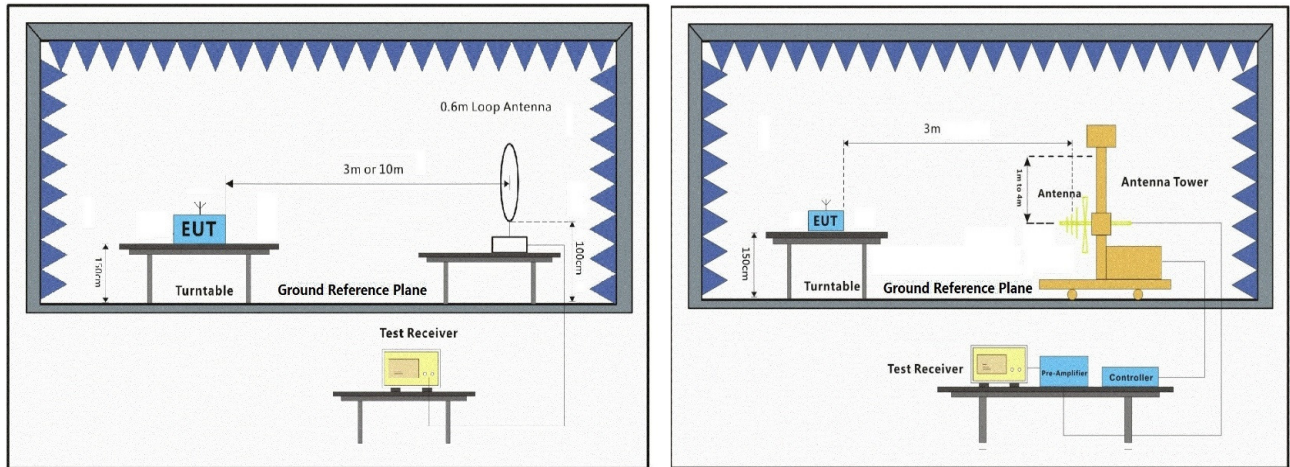
Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	01	TX mode(2Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.



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7.8.3 Test Setup Diagram



7.8.4 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 peak, quasi-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:

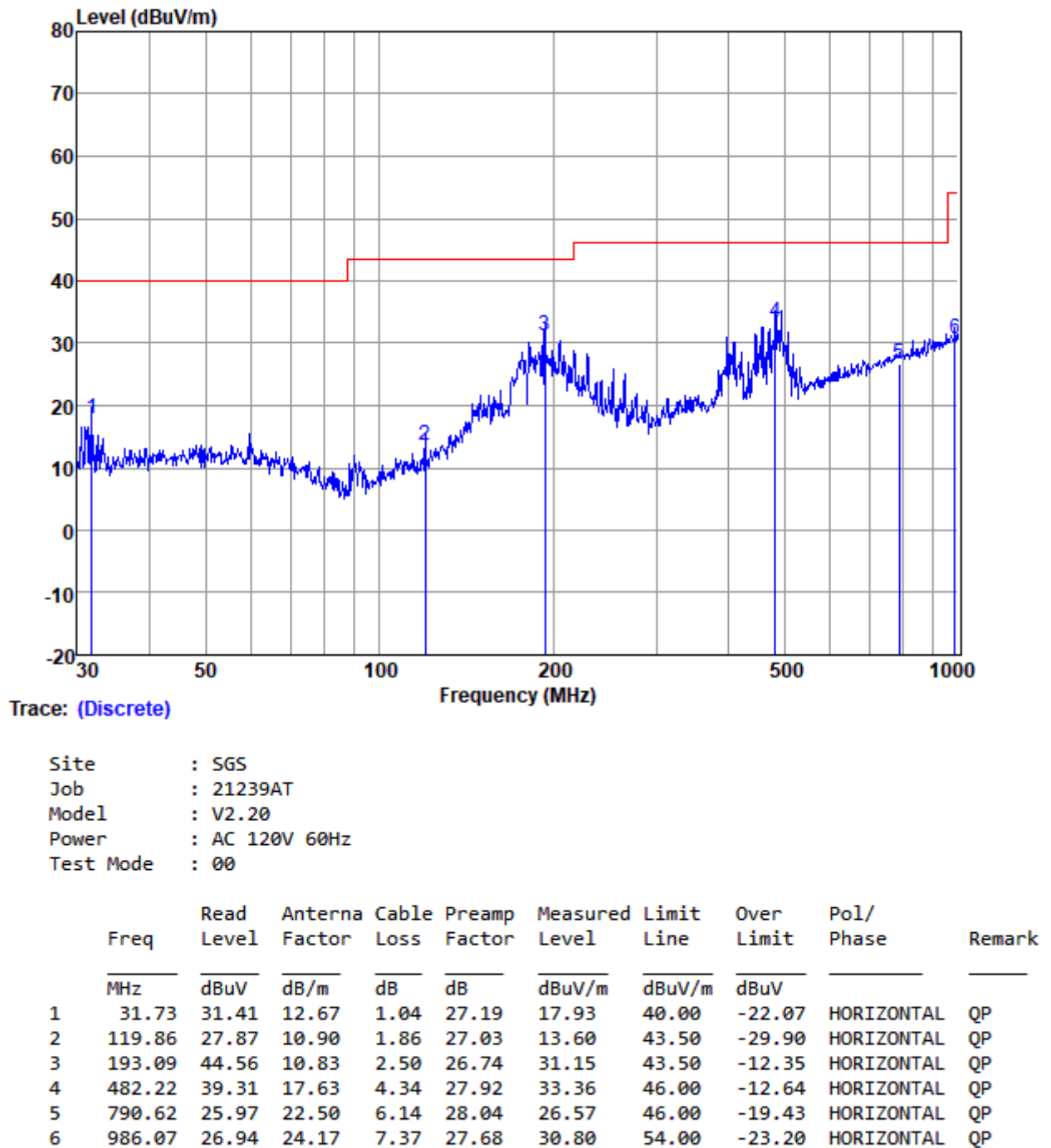
- 1) Through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level = Receiver Reading + Antenna Factor + Cable Factor - Preamplifier Factor

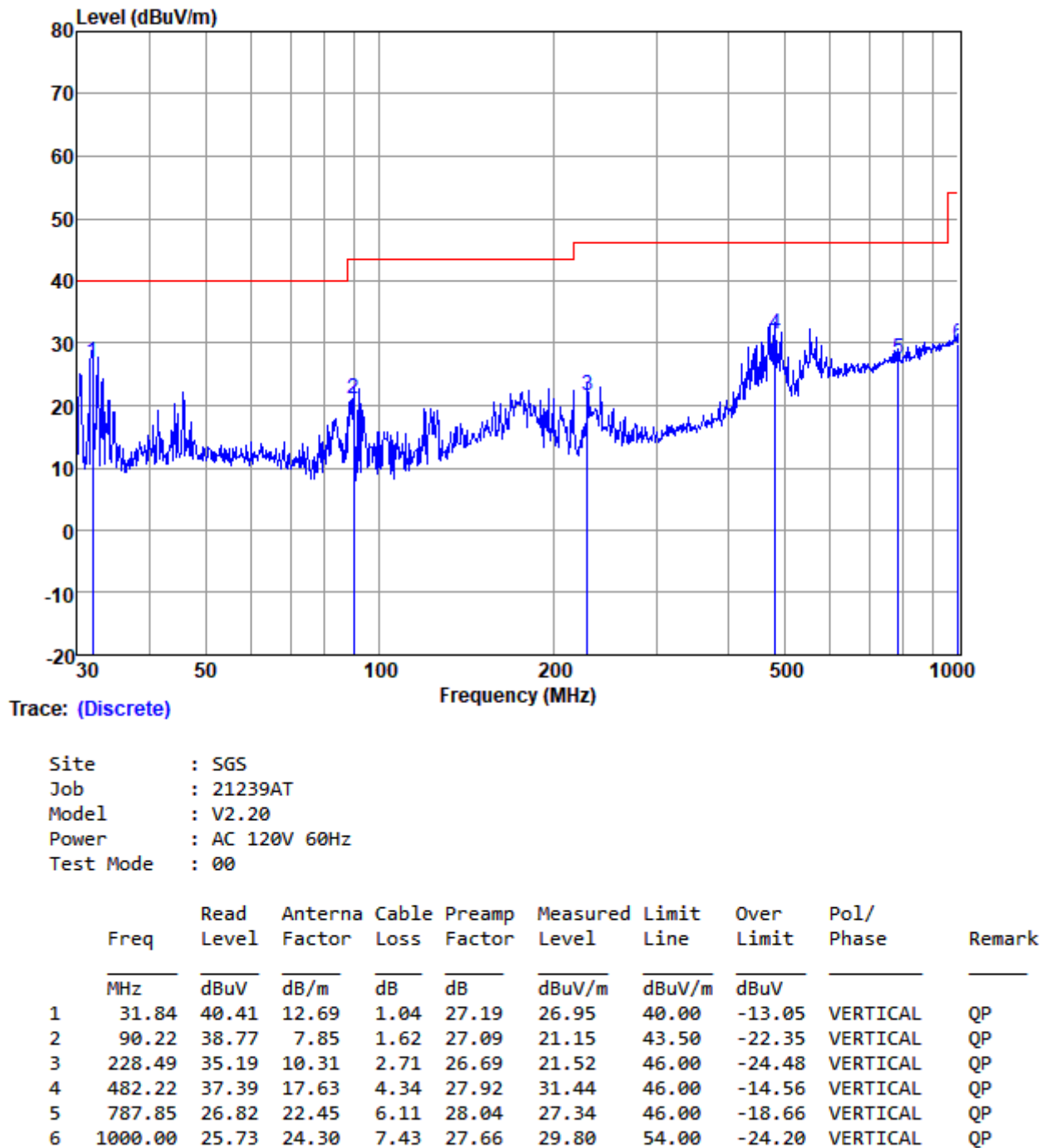
- 3) Scan from 9kHz to 1 GHz, the disturbance below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.



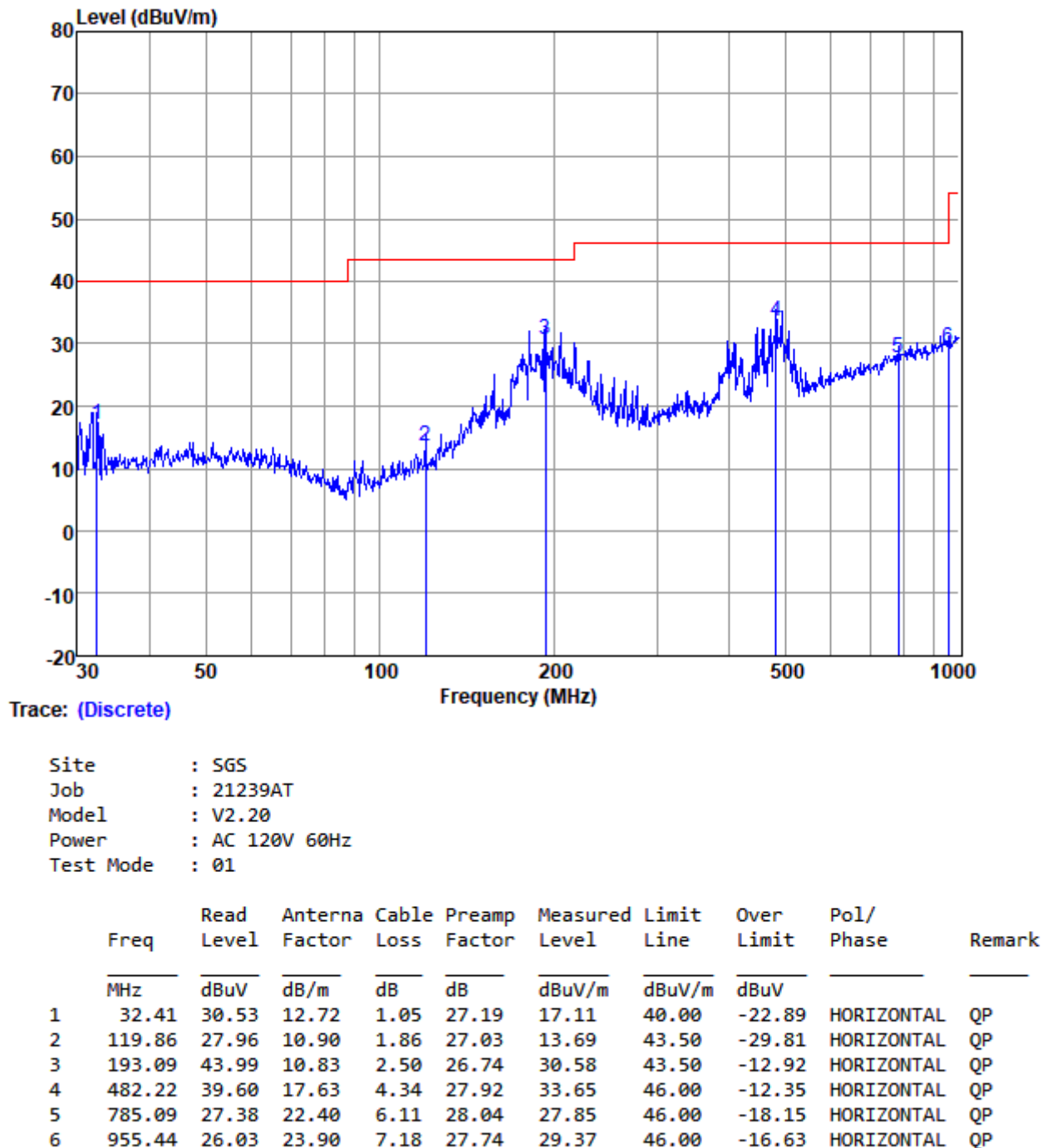
Test Mode: 00; Polarity: Horizontal; Modulation: GFSK; ; Channel: Low



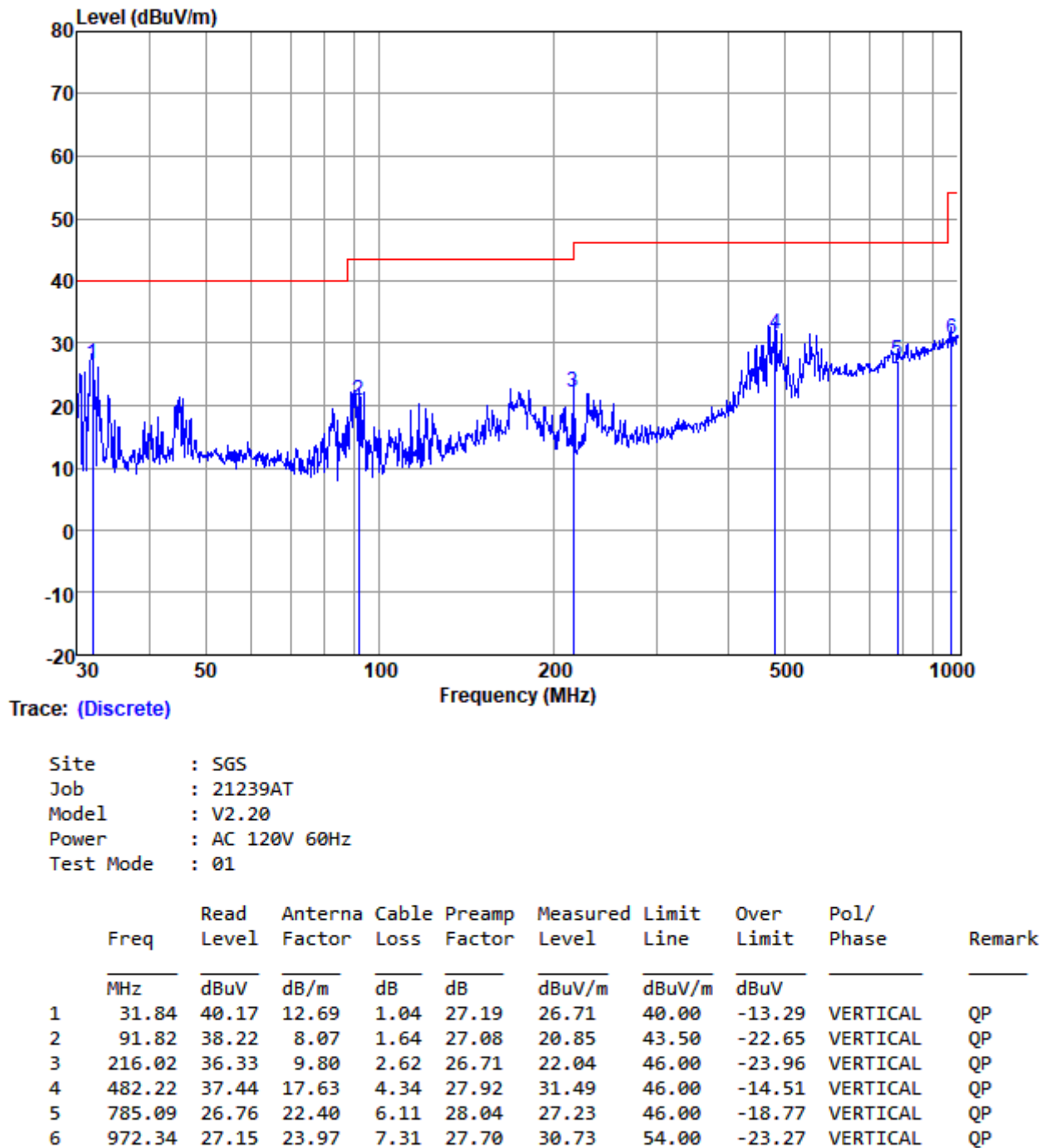
Test Mode: 00; Polarity: Vertical; Modulation: GFSK; ; Channel: Low



Test Mode: 01; Polarity: Horizontal; Modulation: GFSK; ; Channel: Low



Test Mode: 01; Polarity: Vertical; Modulation: GFSK; ; Channel: Low



7.9 Radiated Spurious Emissions (Above 1GHz)

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

7.9.1 E.U.T. Operation

Operating Environment:

Temperature: 24.5 °C

Humidity: 48.0 % RH

Atmospheric Pressure: 1003 mbar

7.9.2 Test Mode Description

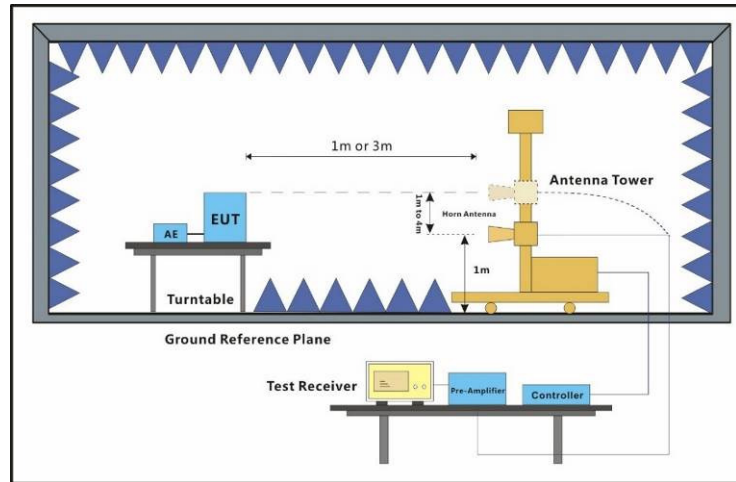
Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	01	TX mode(2Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.



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7.9.3 Test Setup Diagram



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

Final Test Level = Receiver Reading + Antenna Factor + Cable Factor - Preamplifier Factor

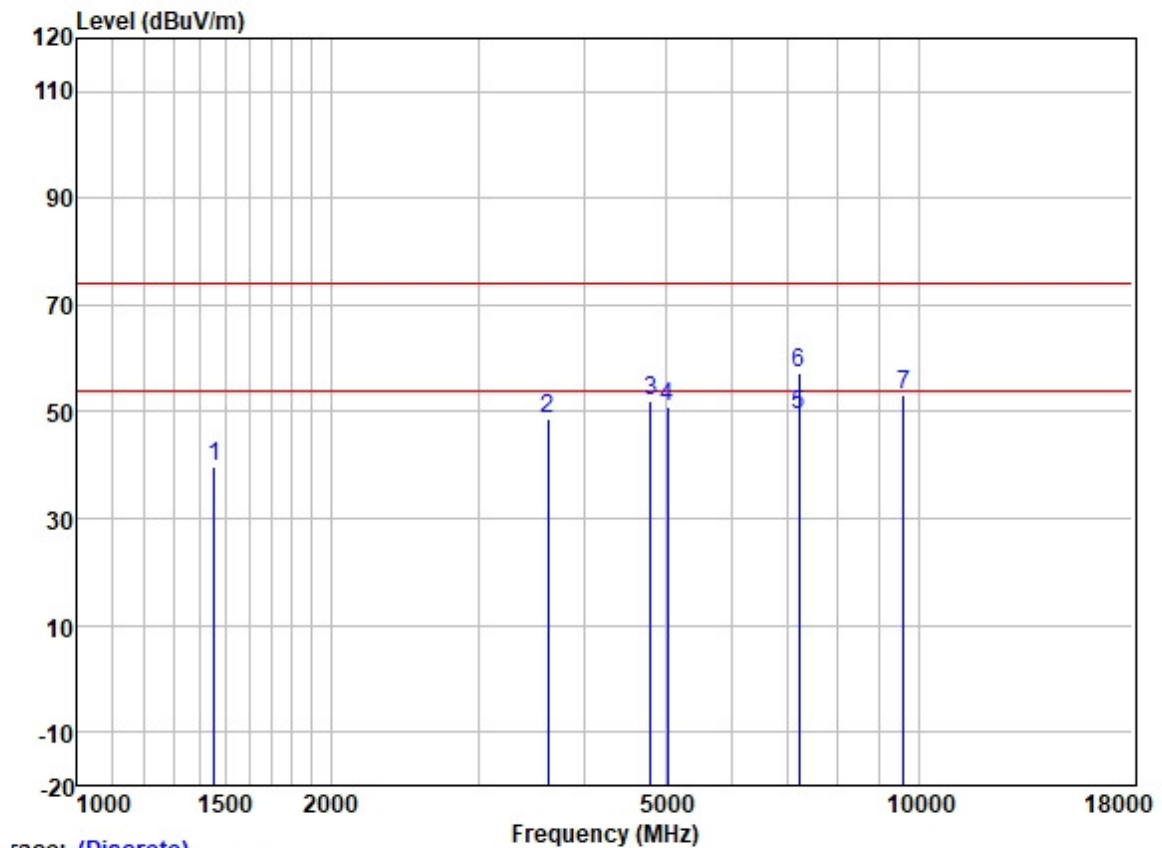
2) Scan from 1GHz to 25GHz, the disturbance above 18GHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

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



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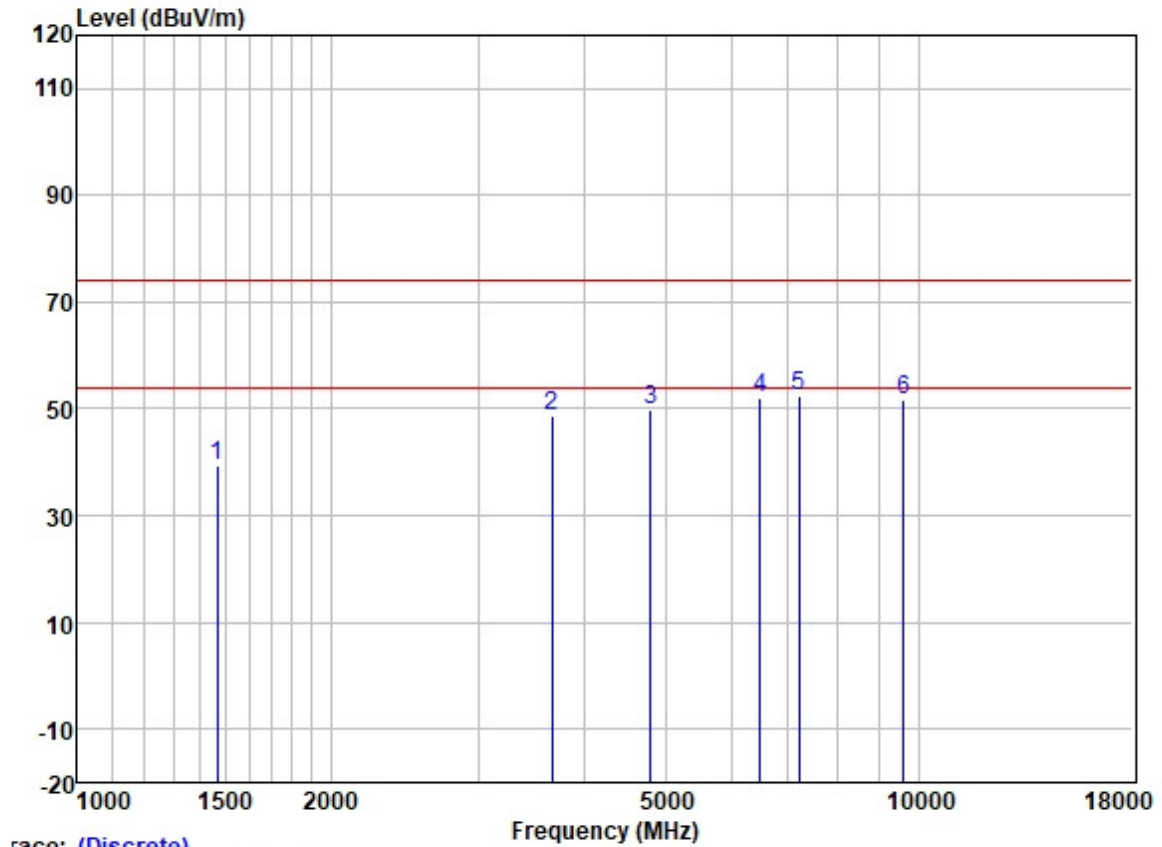
Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; ; Channel:Low



race: (Discrete)

	Freq	ReadAntenna	Cable	Preamp		Limit	Over			
	MHz	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1456.158	49.66	25.46	2.72	38.17	39.67	74.00	-34.33	HORIZONTAL	Peak
2	3624.017	51.83	29.07	4.51	36.90	48.51	74.00	-25.49	HORIZONTAL	Peak
3	4804.000	51.97	31.42	5.40	36.83	51.96	74.00	-22.04	HORIZONTAL	Peak
4	5027.706	50.53	31.70	5.69	36.85	51.07	74.00	-22.93	HORIZONTAL	Peak
5	7206.000	45.17	35.54	5.98	37.38	49.31	54.00	-4.69	HORIZONTAL	Average
6	7206.000	53.03	35.54	5.98	37.38	57.17	74.00	-16.83	HORIZONTAL	Peak
7	9608.000	45.13	38.37	7.07	37.42	53.15	74.00	-20.85	HORIZONTAL	Peak

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



race: (Discrete)

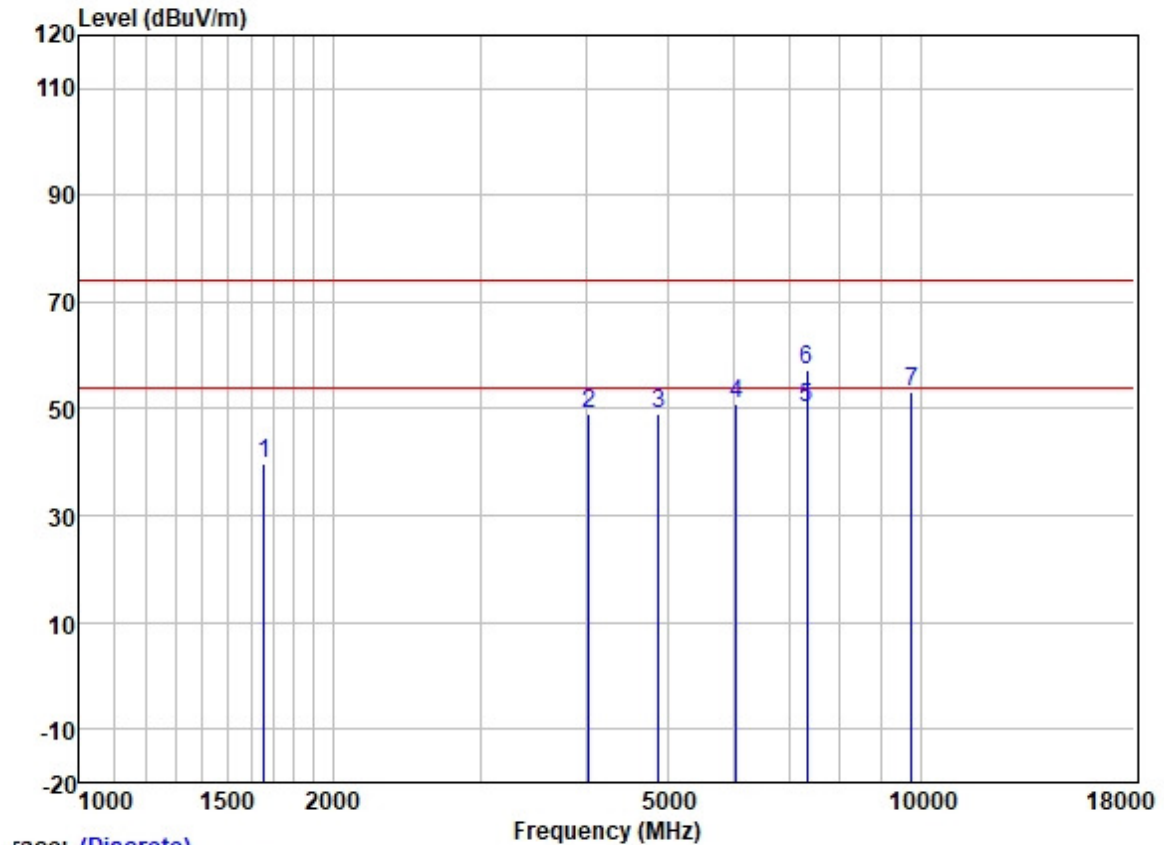
	Freq	ReadAntenna	Cable	Preamp		Limit	Over			
	MHz	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1465.340	49.26	25.47	2.74	38.13	39.34	74.00	-34.66	VERTICAL	Peak
2	3662.571	51.81	29.15	4.53	36.88	48.61	74.00	-25.39	VERTICAL	Peak
3	4804.000	49.82	31.42	5.40	36.83	49.81	74.00	-24.19	VERTICAL	Peak
4	6483.907	49.10	33.96	5.85	37.00	51.91	74.00	-22.09	VERTICAL	Peak
5	7206.000	48.17	35.54	5.98	37.38	52.31	74.00	-21.69	VERTICAL	Peak
6	9608.000	43.51	38.37	7.07	37.42	51.53	74.00	-22.47	VERTICAL	Peak



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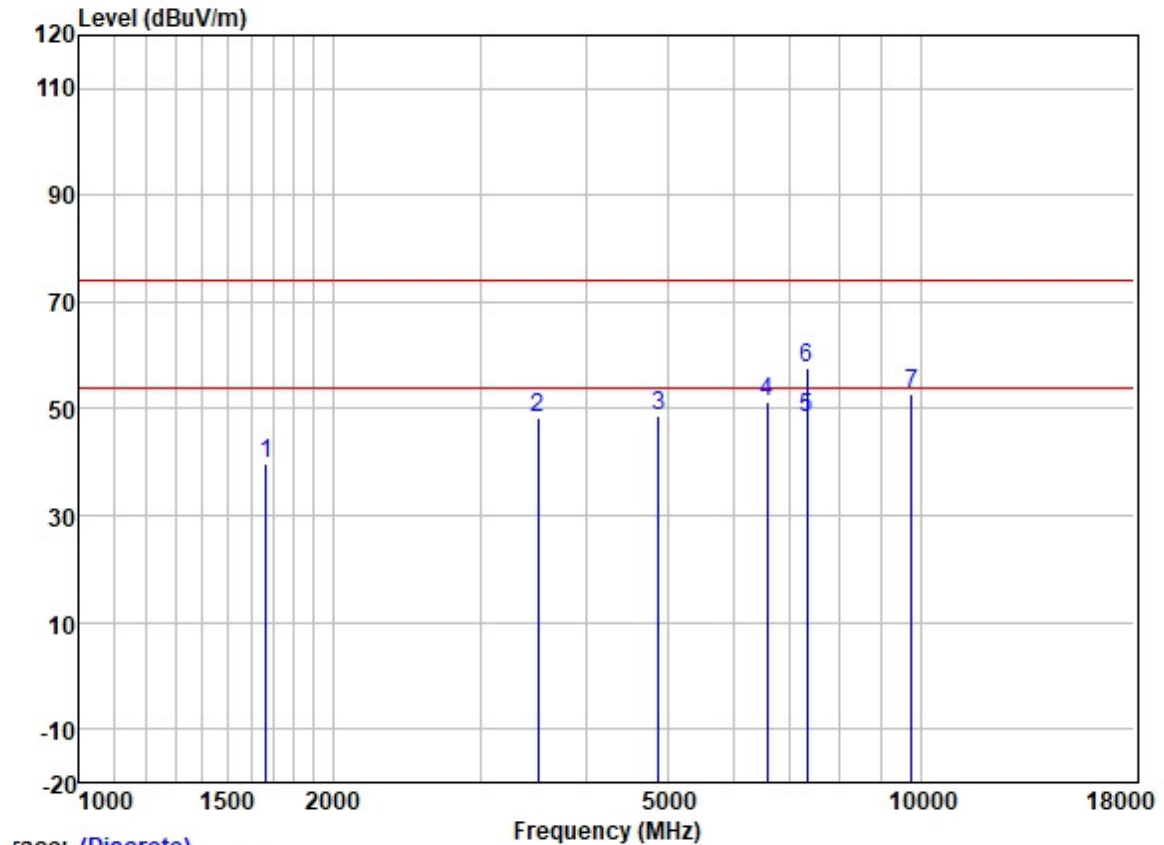
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Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; ; Channel:middle



		Read	Antenna	Cable	Preamp		Limit	Over		
	Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1656.506	49.29	25.65	2.80	37.93	39.81	74.00	-34.19	HORIZONTAL	Peak
2	4038.586	51.32	29.85	4.60	36.80	48.97	74.00	-25.03	HORIZONTAL	Peak
3	4880.000	48.70	31.54	5.50	36.84	48.90	74.00	-25.10	HORIZONTAL	Peak
4	6046.580	49.27	32.52	6.17	36.91	51.05	74.00	-22.95	HORIZONTAL	Peak
5	7320.000	45.54	36.00	6.13	37.43	50.24	54.00	-3.76	HORIZONTAL	Average
6	7320.000	52.60	36.00	6.13	37.43	57.30	74.00	-16.70	HORIZONTAL	Peak
7	9760.000	45.05	38.50	7.02	37.41	53.16	74.00	-20.84	HORIZONTAL	Peak

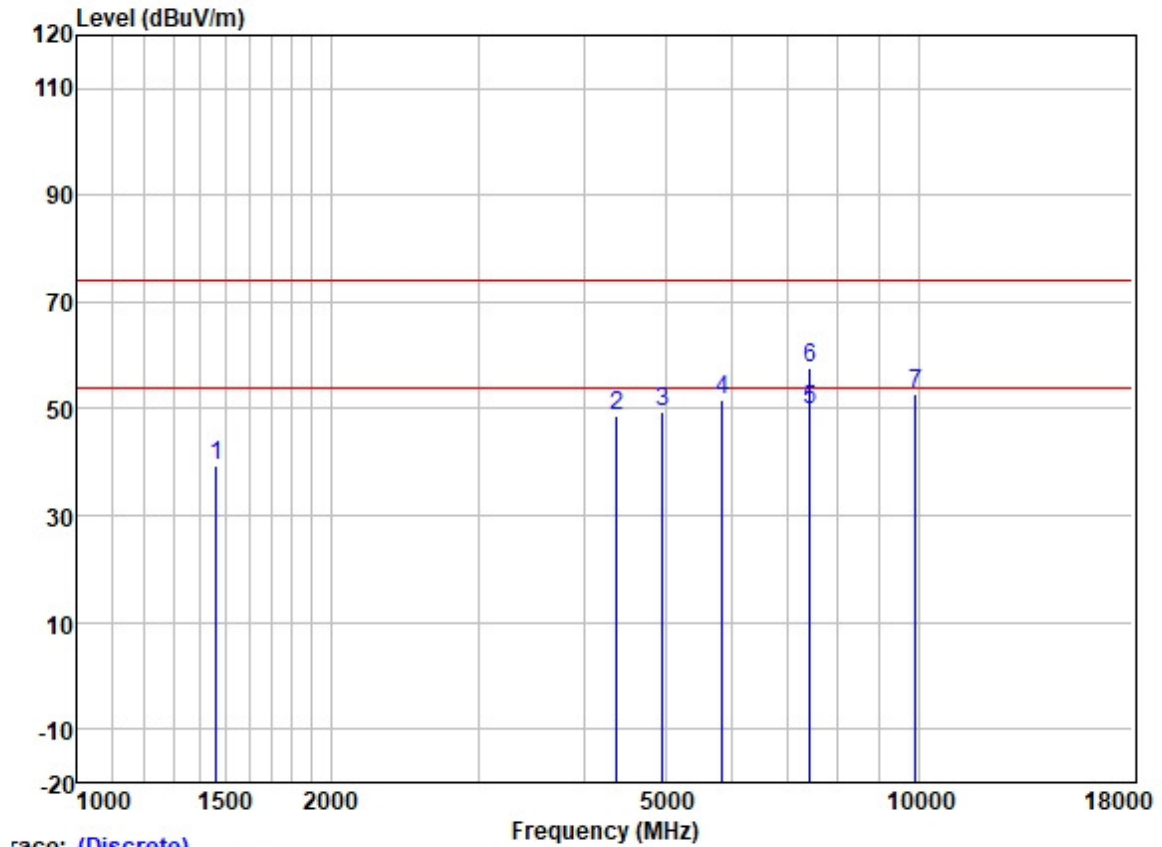
Test Mode: 00; Polarity: Vertical; Modulation:GFSK; ; Channel:middle



race: (Discrete)

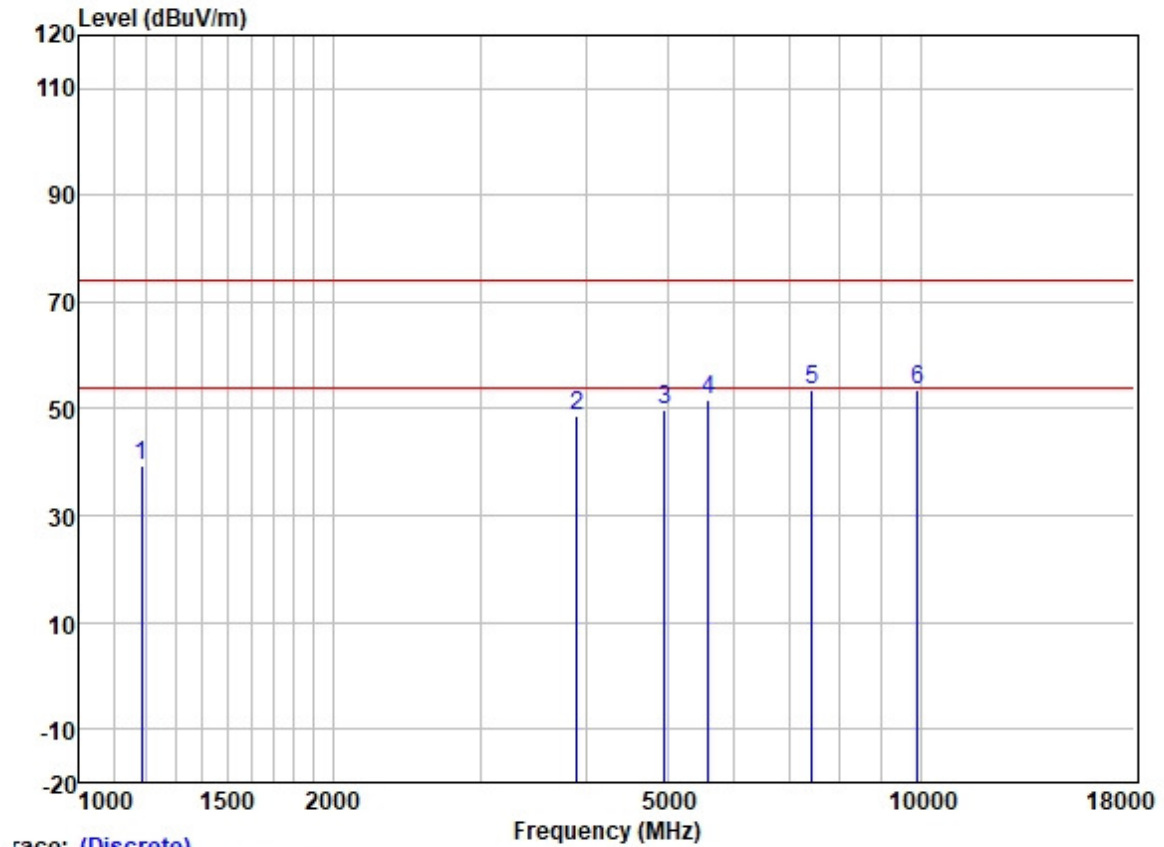
	Freq	ReadAntenna	Cable	Preamp		Limit	Over			
		Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1665.876	49.10	25.66	2.80	37.91	39.65	74.00	-34.35	VERTICAL	Peak
2	3512.309	51.81	28.92	4.35	36.94	48.14	74.00	-25.86	VERTICAL	Peak
3	4880.000	48.56	31.54	5.50	36.84	48.76	74.00	-25.24	VERTICAL	Peak
4	6564.068	48.32	34.09	5.84	37.03	51.22	74.00	-22.78	VERTICAL	Peak
5	7320.000	43.59	36.00	6.13	37.43	48.29	54.00	-5.71	VERTICAL	Average
6	7320.000	52.98	36.00	6.13	37.43	57.68	74.00	-16.32	VERTICAL	Peak
7	9760.000	44.83	38.50	7.02	37.41	52.94	74.00	-21.06	VERTICAL	Peak

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



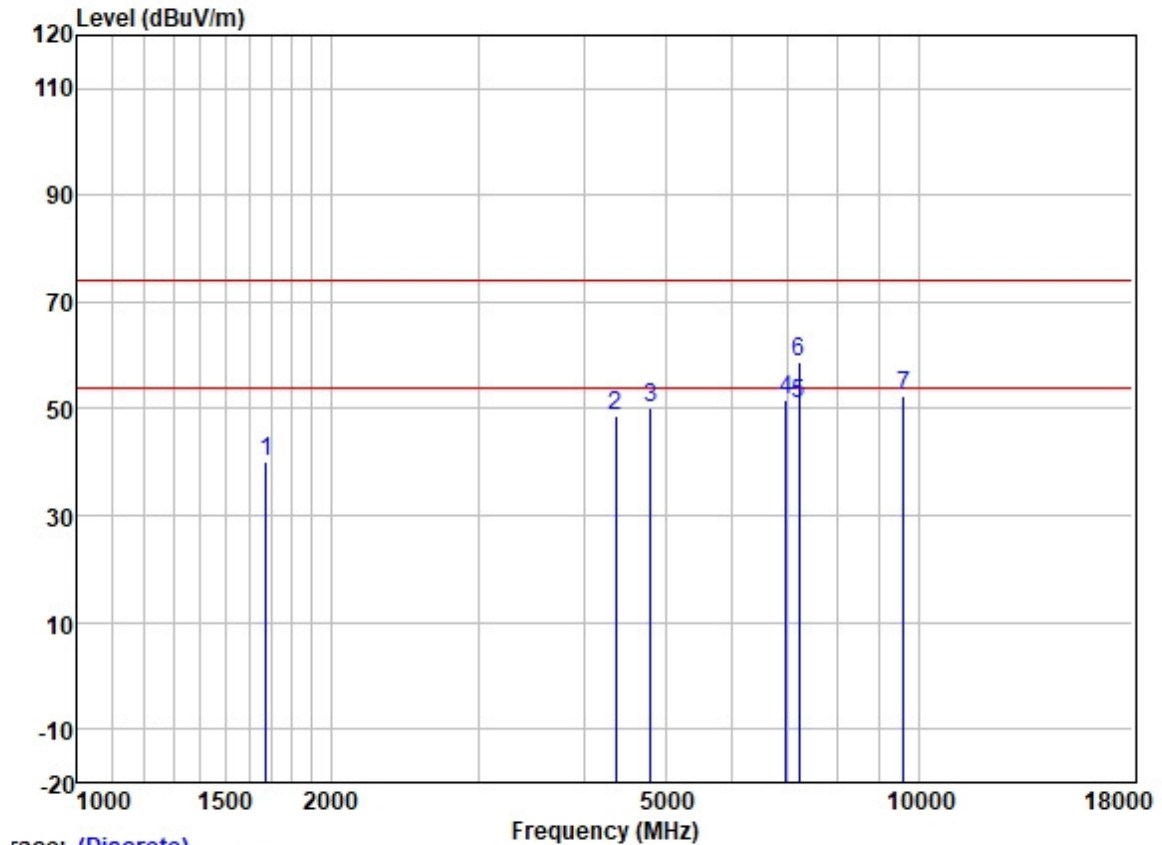
	Freq	ReadAntenna	Cable	Preamp		Limit	Over		
		Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	Remark
1	1463.067	49.17	25.47	2.74	38.13	39.25	74.00	-34.75	HORIZONTAL Peak
2	4372.626	50.19	30.62	4.68	36.81	48.68	74.00	-25.32	HORIZONTAL Peak
3	4960.000	48.91	31.65	5.65	36.84	49.37	74.00	-24.63	HORIZONTAL Peak
4	5845.755	50.47	32.25	6.00	36.90	51.82	74.00	-22.18	HORIZONTAL Peak
5	7440.000	44.69	36.27	6.22	37.47	49.71	54.00	-4.29	HORIZONTAL Average
6	7440.000	52.81	36.27	6.22	37.47	57.83	74.00	-16.17	HORIZONTAL Peak
7	9920.000	44.48	38.65	6.96	37.40	52.69	74.00	-21.31	HORIZONTAL Peak

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



	Freq	ReadAntenna	Cable	Preamp		Limit	Over			
	MHz	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1184.025	50.88	24.60	2.37	38.40	39.45	74.00	-34.55	VERTICAL	Peak
2	3899.446	51.21	29.69	4.60	36.82	48.68	74.00	-25.32	VERTICAL	Peak
3	4960.000	49.21	31.65	5.65	36.84	49.67	74.00	-24.33	VERTICAL	Peak
4	5590.355	50.52	31.87	6.32	36.89	51.82	74.00	-22.18	VERTICAL	Peak
5	7440.000	48.41	36.27	6.22	37.47	53.43	74.00	-20.57	VERTICAL	Peak
6	9920.000	45.29	38.65	6.96	37.40	53.50	74.00	-20.50	VERTICAL	Peak

Test Mode: 01; Polarity: Horizontal; Modulation:GFSK; ; Channel:Low



race: (Discrete)

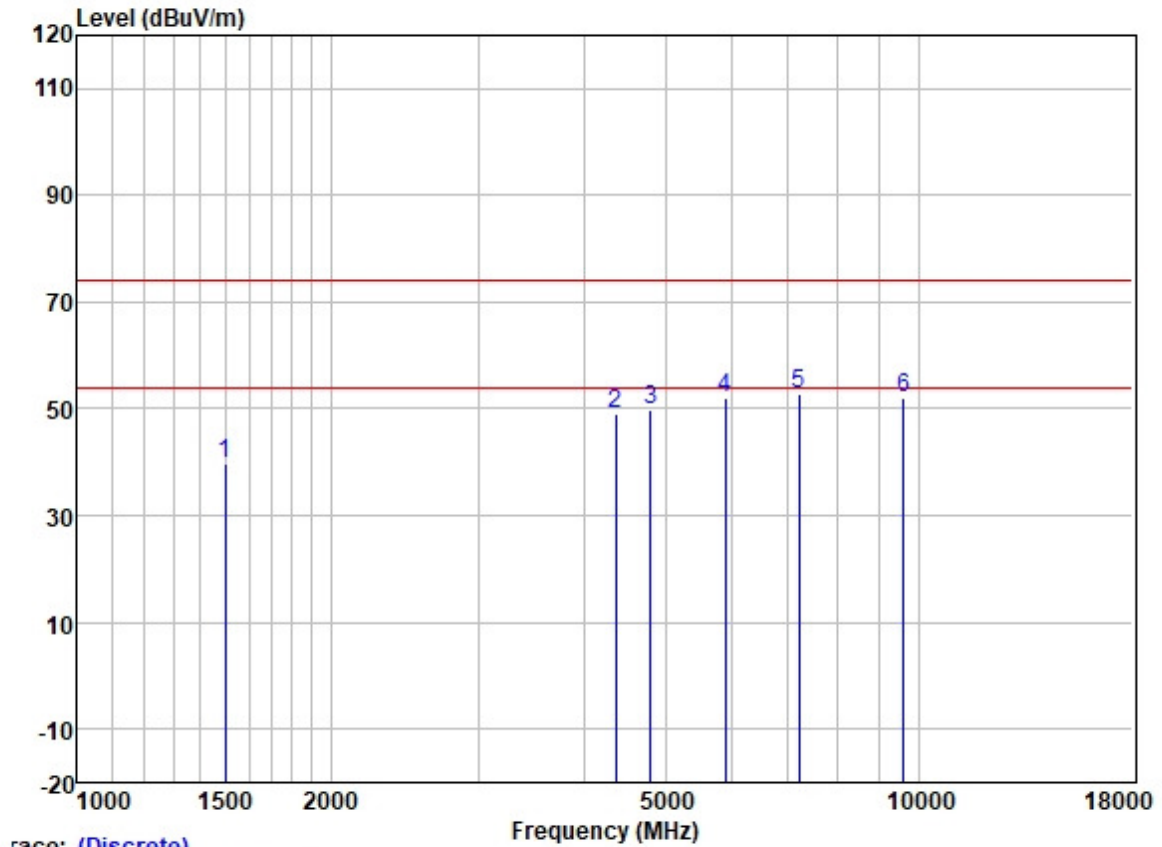
	Freq	ReadAntenna	Cable	Preamp		Limit	Over			
	MHz	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1677.621	49.63	25.68	2.80	37.91	40.20	74.00	-33.80	HORIZONTAL	Peak
2	4367.058	50.31	30.62	4.68	36.81	48.80	74.00	-25.20	HORIZONTAL	Peak
3	4804.000	50.24	31.42	5.40	36.83	50.23	74.00	-23.77	HORIZONTAL	Peak
4	6954.852	48.12	34.95	5.81	37.21	51.67	74.00	-22.33	HORIZONTAL	Peak
5	7206.000	46.74	35.54	5.98	37.38	50.88	54.00	-3.12	HORIZONTAL	Average
6	7206.000	54.59	35.54	5.98	37.38	58.73	74.00	-15.27	HORIZONTAL	Peak
7	9608.000	44.37	38.37	7.07	37.42	52.39	74.00	-21.61	HORIZONTAL	Peak



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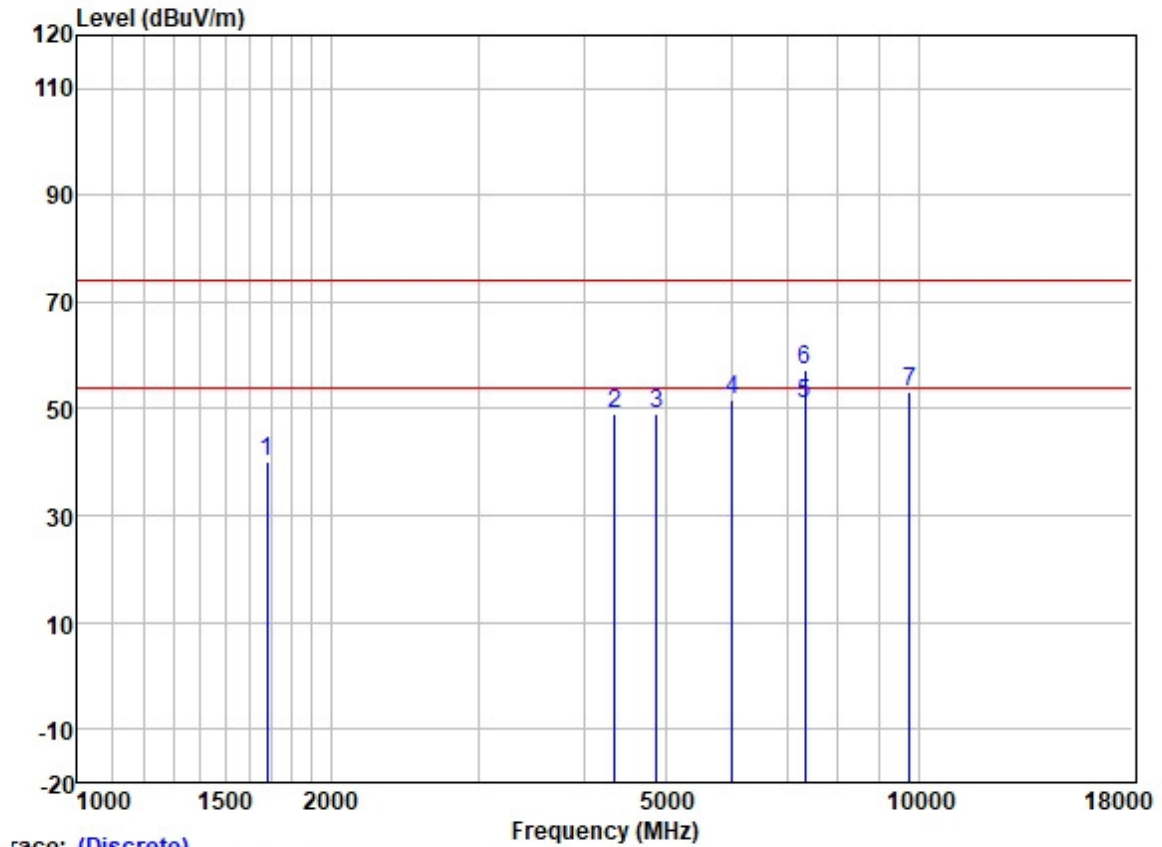
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Test Mode: 01; Polarity: Vertical; Modulation:GFSK; ; Channel:Low



	Freq	ReadAntenna	Cable	Preamp		Limit	Over			
		Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1498.781	49.64	25.50	2.80	38.10	39.84	74.00	-34.16	VERTICAL	Peak
2	4367.058	50.49	30.62	4.68	36.81	48.98	74.00	-25.02	VERTICAL	Peak
3	4804.000	49.99	31.42	5.40	36.83	49.98	74.00	-24.02	VERTICAL	Peak
4	5898.442	50.71	32.31	5.90	36.90	52.02	74.00	-21.98	VERTICAL	Peak
5	7206.000	48.52	35.54	5.98	37.38	52.66	74.00	-21.34	VERTICAL	Peak
6	9608.000	44.04	38.37	7.07	37.42	52.06	74.00	-21.94	VERTICAL	Peak

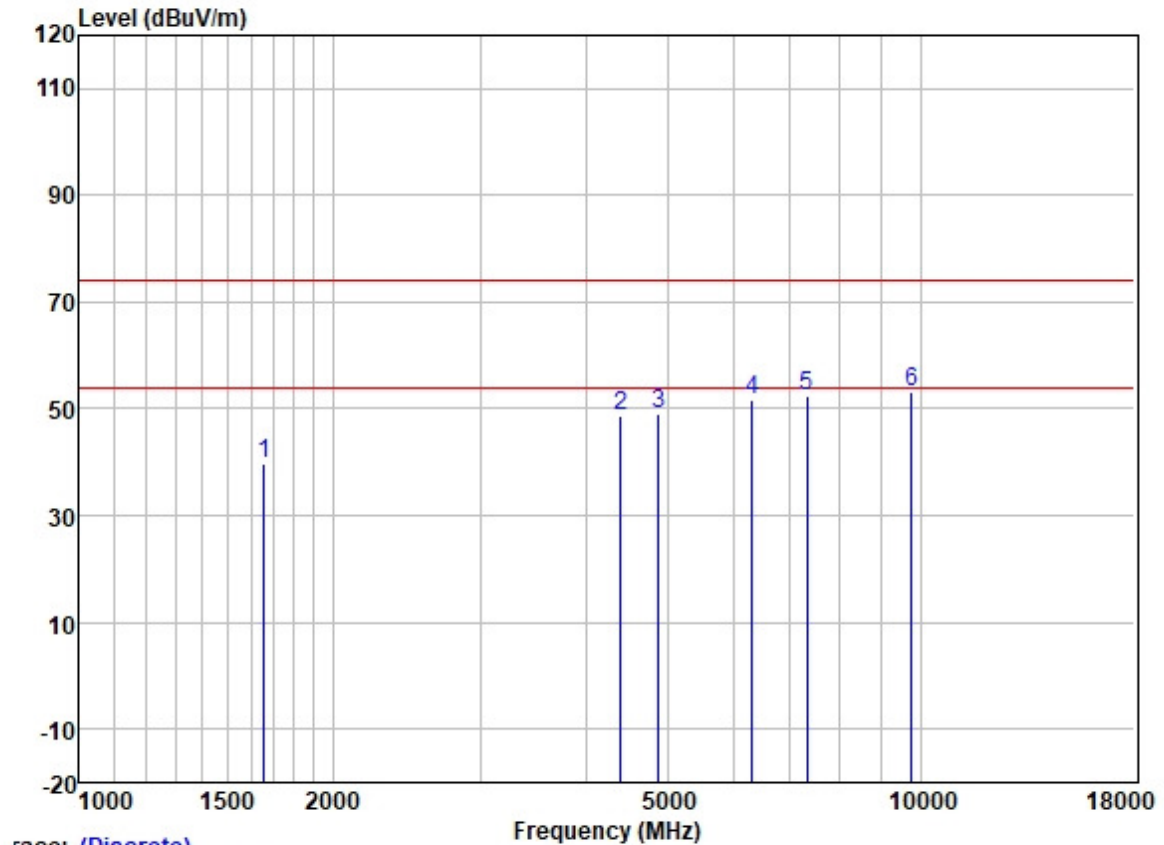
Test Mode: 01; Polarity: Horizontal; Modulation:GFSK; ; Channel:middle



race: (Discrete)

	ReadAntenna	Cable	Preamp		Limit	Over			
Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1682.477	49.38	25.68	2.80	37.91	39.95	74.00	-34.05	HORIZONTAL Peak
2	4354.454	50.70	30.59	4.68	36.81	49.16	74.00	-24.84	HORIZONTAL Peak
3	4880.000	48.99	31.54	5.50	36.84	49.19	74.00	-24.81	HORIZONTAL Peak
4	6001.626	49.85	32.40	6.20	36.90	51.55	74.00	-22.45	HORIZONTAL Peak
5	7320.000	46.05	36.00	6.13	37.43	50.75	54.00	-3.25	HORIZONTAL Average
6	7320.000	52.60	36.00	6.13	37.43	57.30	74.00	-16.70	HORIZONTAL Peak
7	9760.000	45.24	38.50	7.02	37.41	53.35	74.00	-20.65	HORIZONTAL Peak

Test Mode: 01; Polarity: Vertical; Modulation:GFSK; ; Channel:middle



race: (Discrete)

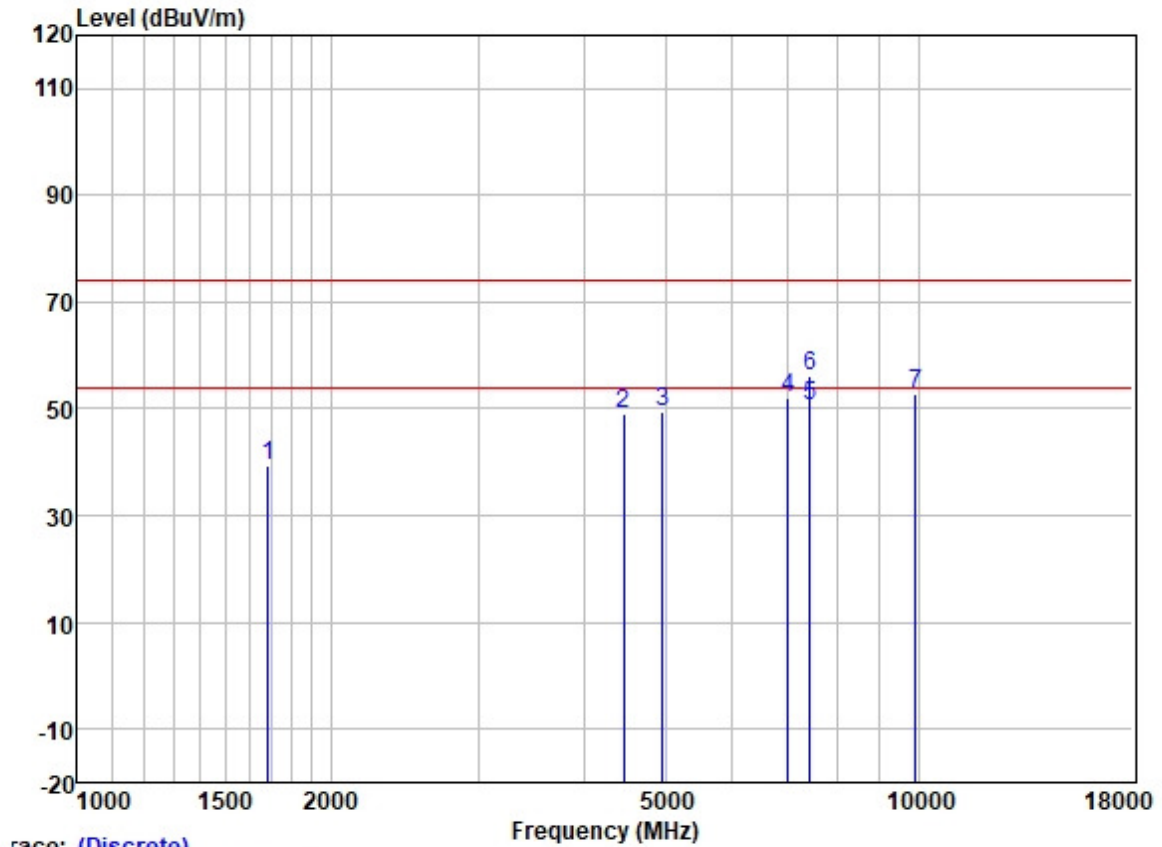
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	MHz	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1658.337	49.38	25.65	2.80	37.93	39.90	74.00	-34.10	VERTICAL	Peak
2	4405.090	50.11	30.68	4.70	36.81	48.68	74.00	-25.32	VERTICAL	Peak
3	4880.000	48.71	31.54	5.50	36.84	48.91	74.00	-25.09	VERTICAL	Peak
4	6303.890	49.34	33.44	5.97	36.96	51.79	74.00	-22.21	VERTICAL	Peak
5	7320.000	47.62	36.00	6.13	37.43	52.32	74.00	-21.68	VERTICAL	Peak
6	9760.000	45.21	38.50	7.02	37.41	53.32	74.00	-20.68	VERTICAL	Peak



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Test Mode: 01; Polarity: Horizontal; Modulation:GFSK; ; Channel:High



race: (Discrete)

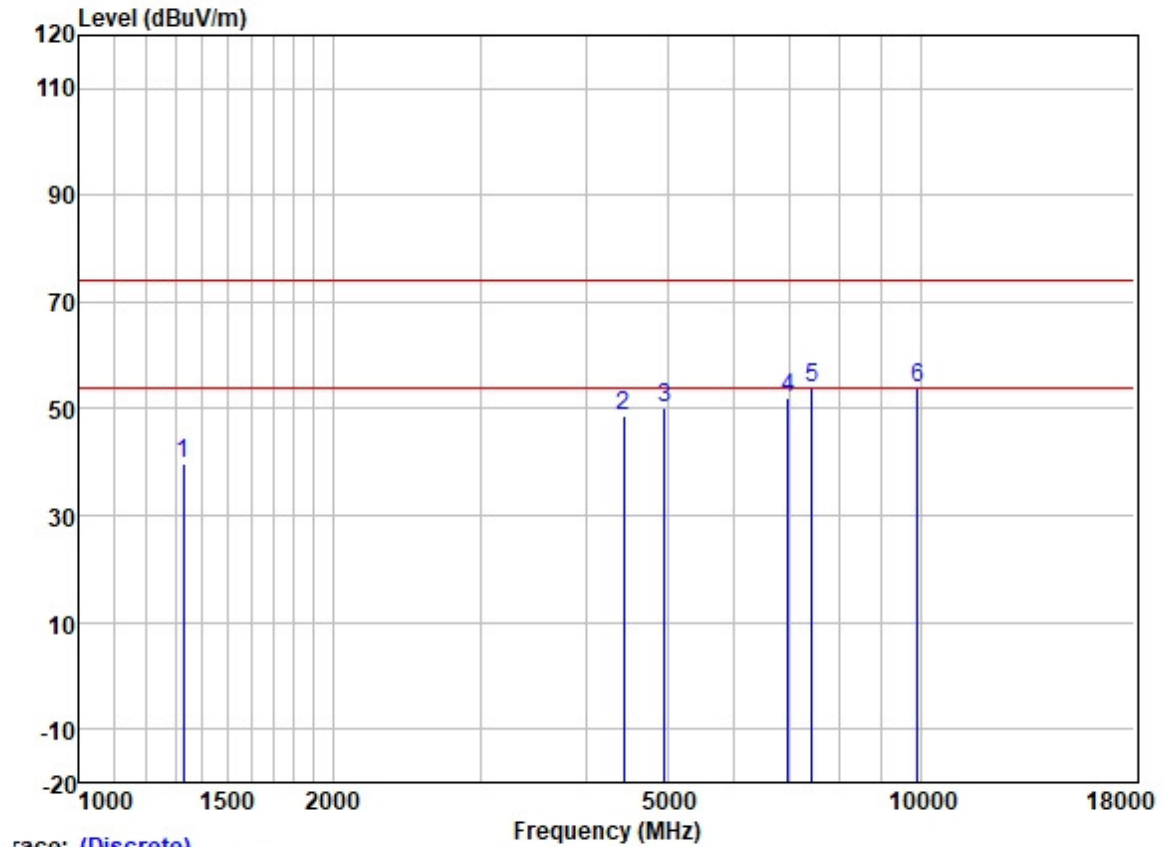
	ReadAntenna	Cable	Preamp		Limit	Over			
Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1687.347	48.86	25.69	2.80	37.91	39.44	74.00	-34.56	HORIZONTAL Peak
2	4456.315	50.14	30.75	4.88	36.81	48.96	74.00	-25.04	HORIZONTAL Peak
3	4960.000	49.07	31.65	5.65	36.84	49.53	74.00	-24.47	HORIZONTAL Peak
4	6995.172	48.39	35.00	5.81	37.25	51.95	74.00	-22.05	HORIZONTAL Peak
5	7440.000	45.43	36.27	6.22	37.47	50.45	54.00	-3.55	HORIZONTAL Average
6	7440.000	51.18	36.27	6.22	37.47	56.20	74.00	-17.80	HORIZONTAL Peak
7	9920.000	44.74	38.65	6.96	37.40	52.95	74.00	-21.05	HORIZONTAL Peak



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Test Mode: 01; Polarity: Vertical; Modulation:GFSK; ; Channel:High



race: (Discrete)

	ReadAntenna	Cable	Preamp		Limit	Over			
Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1331.288	50.17	25.28	2.60	38.29	39.76	74.00	-34.24	VERTICAL Peak
2	4443.453	50.04	30.73	4.83	36.81	48.79	74.00	-25.21	VERTICAL Peak
3	4960.000	49.77	31.65	5.65	36.84	50.23	74.00	-23.77	VERTICAL Peak
4	6954.852	48.39	34.95	5.81	37.21	51.94	74.00	-22.06	VERTICAL Peak
5	7440.000	48.91	36.27	6.22	37.47	53.93	74.00	-20.07	VERTICAL Peak
6	9920.000	45.57	38.65	6.96	37.40	53.78	74.00	-20.22	VERTICAL Peak



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8 Test Setup Photo

Refer to Appendix_SetupPhoto for GZCR2110021239AT.

9 EUT Constructional Details (EUT Photos)

Refer to Appendix – External and Internal Photos for GZCR2110021239AT.



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10 Appendix

1. Duty Cycle

1.1 Ant1

1.1.1 Test Result

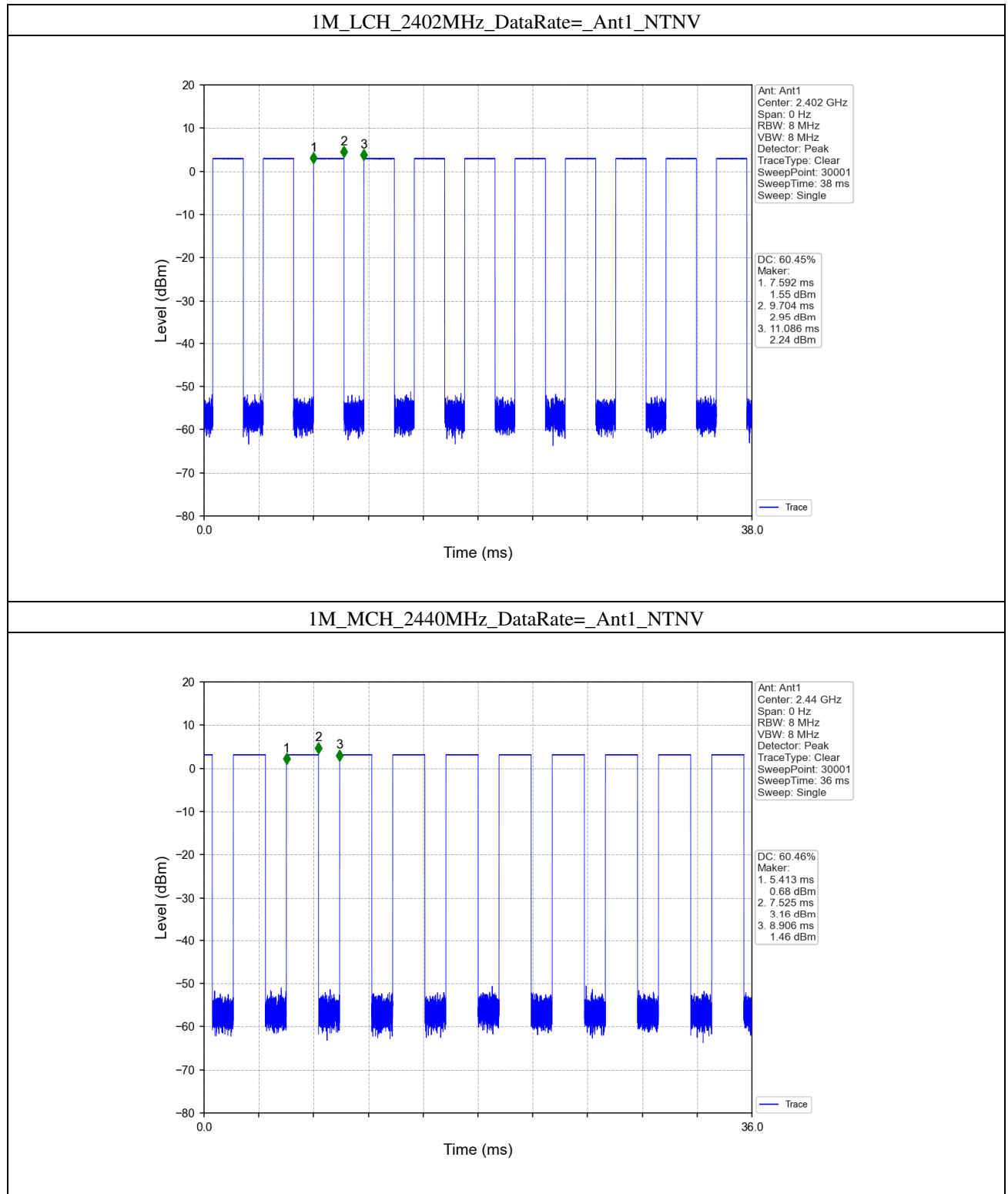
Ant1							
Mode	TX Type	Frequency (MHz)	T_on (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	Max. DC Variation (%)
1M	SISO	2402	2.112	3.494	60.45	2.19	0.04
		2440	2.112	3.493	60.46	2.19	0.02
		2480	2.112	3.493	60.46	2.19	0.02
2M	SISO	2402	1.065	1.746	61.00	2.15	0.03
		2440	1.065	1.746	61.00	2.15	0.03
		2480	1.066	1.746	61.05	2.14	0.00



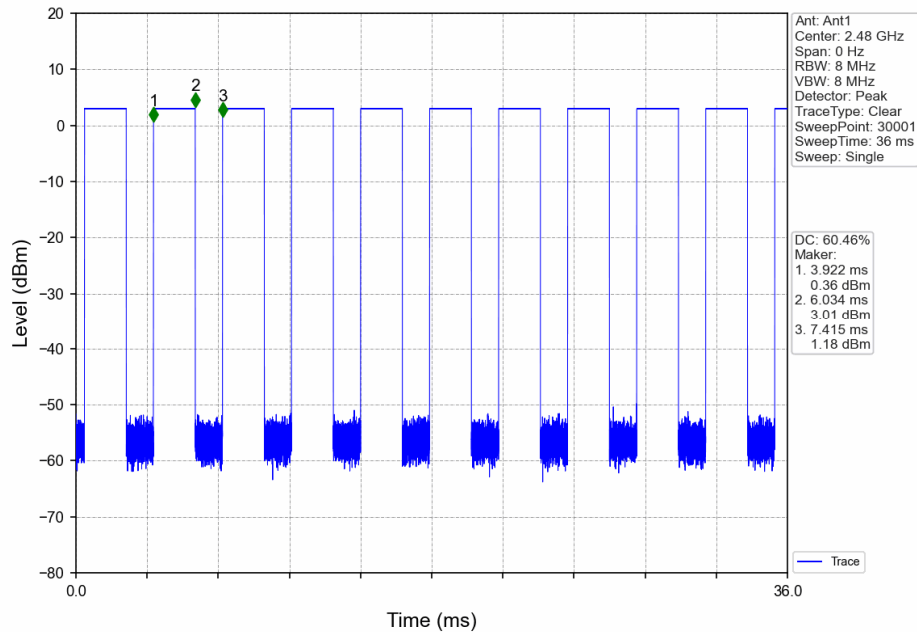
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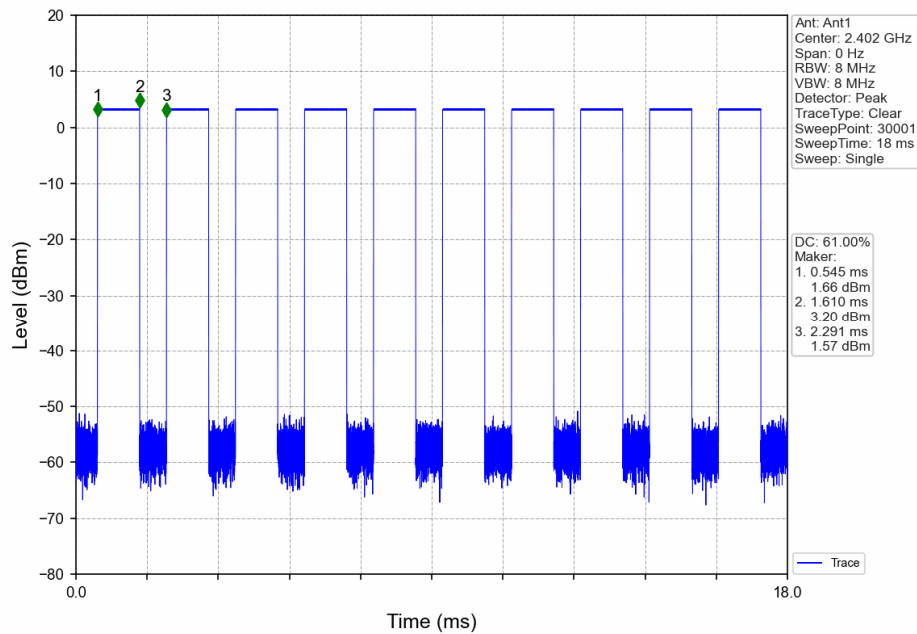
1.1.2 Test Graph



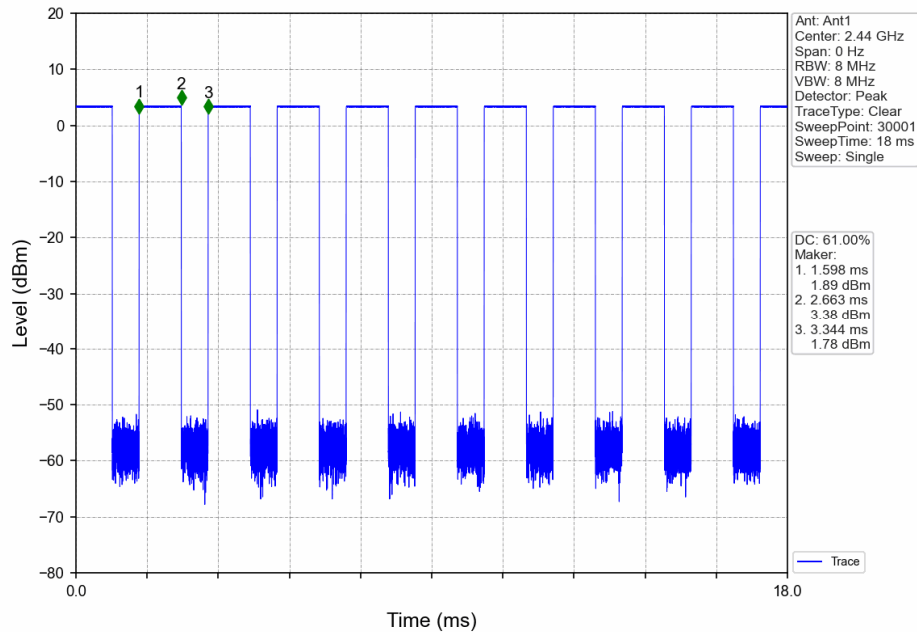
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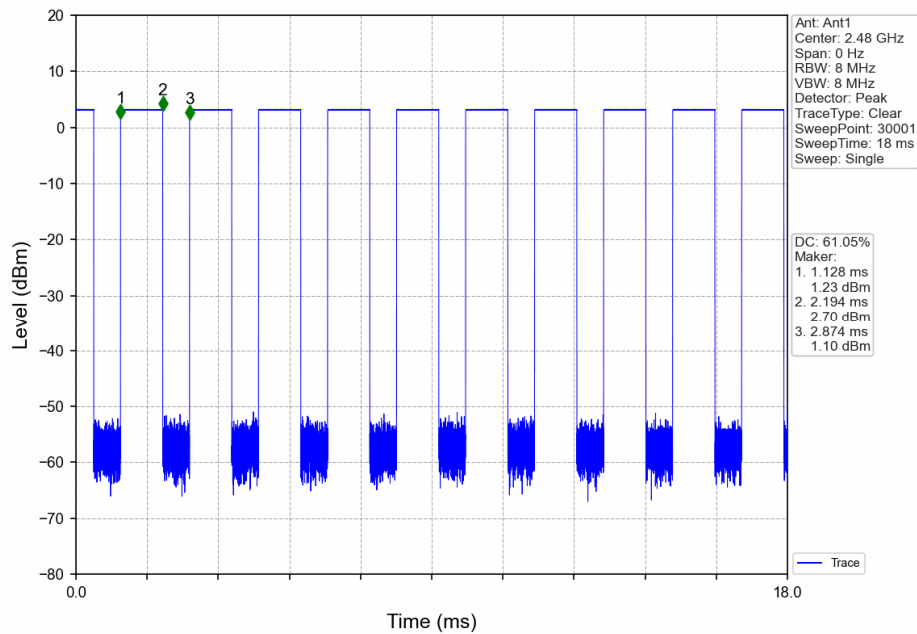
2M_LCH_2402MHz_DataRate=_Ant1_NTNV



2M_MCH_2440MHz_DataRate=_Ant1_NTNV



2M_HCH_2480MHz_DataRate=_Ant1_NTNV



2. Bandwidth

2.1 6dB BW

2.1.1 Test Result

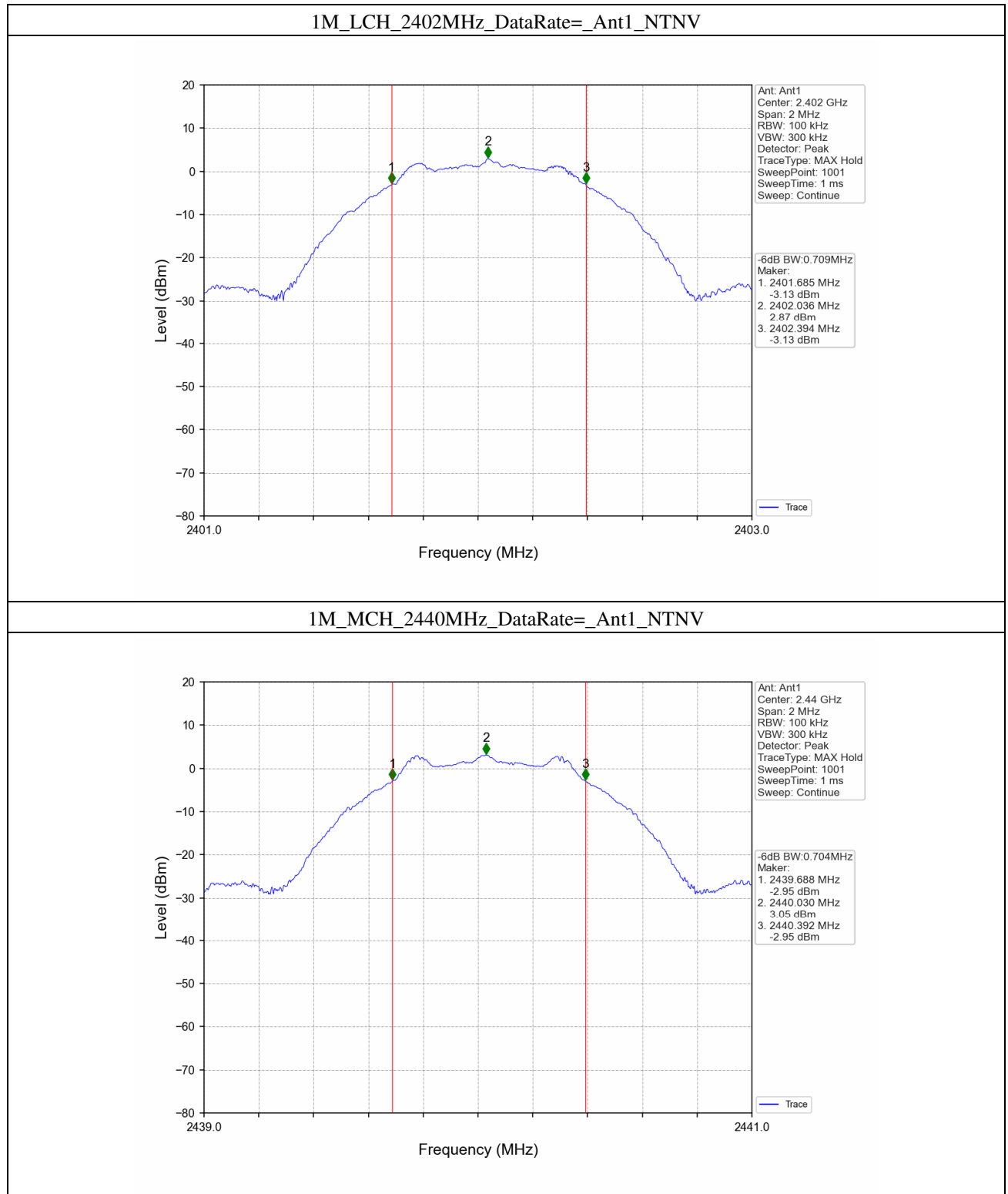
Mode	TX Type	Frequency (MHz)	Ant	6dB Bandwidth (MHz)		Verdict
				Result	Limit	
1M	SISO	2402	1	0.709	≥ 0.5	Pass
		2440	1	0.704	≥ 0.5	Pass
		2480	1	0.708	≥ 0.5	Pass
2M	SISO	2402	1	1.155	≥ 0.5	Pass
		2440	1	1.139	≥ 0.5	Pass
		2480	1	1.148	≥ 0.5	Pass



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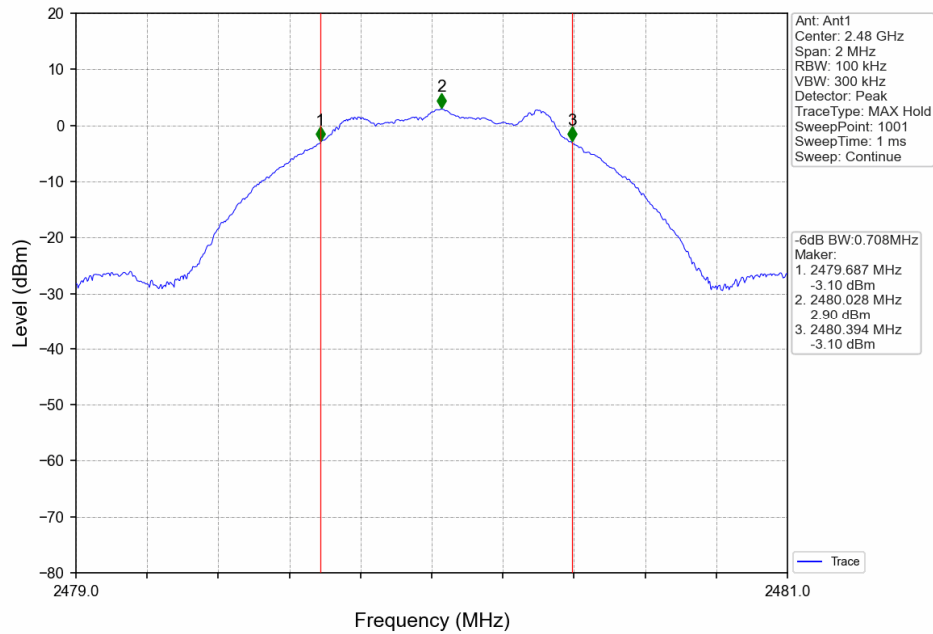
2.2.2 Test Graph



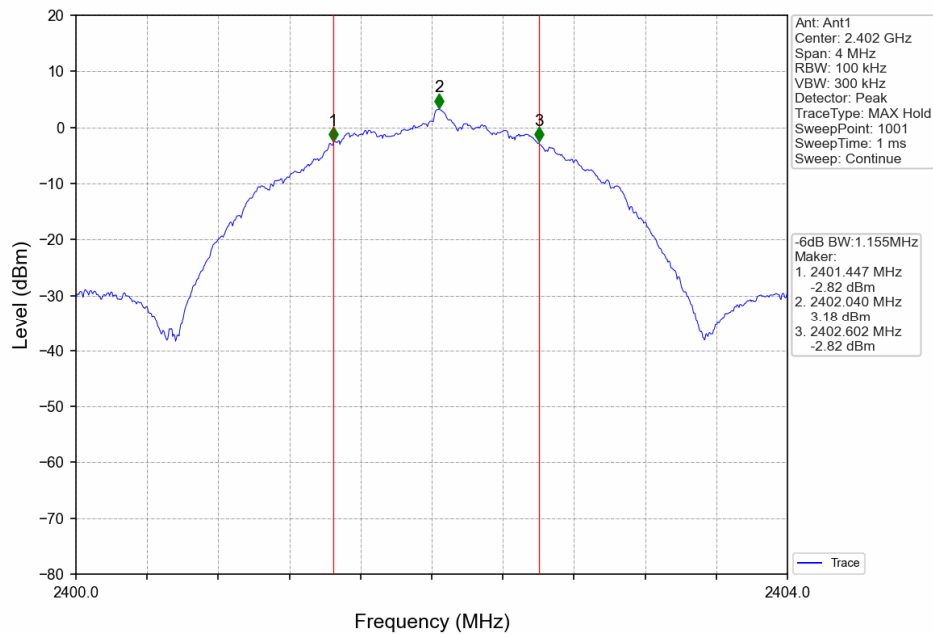
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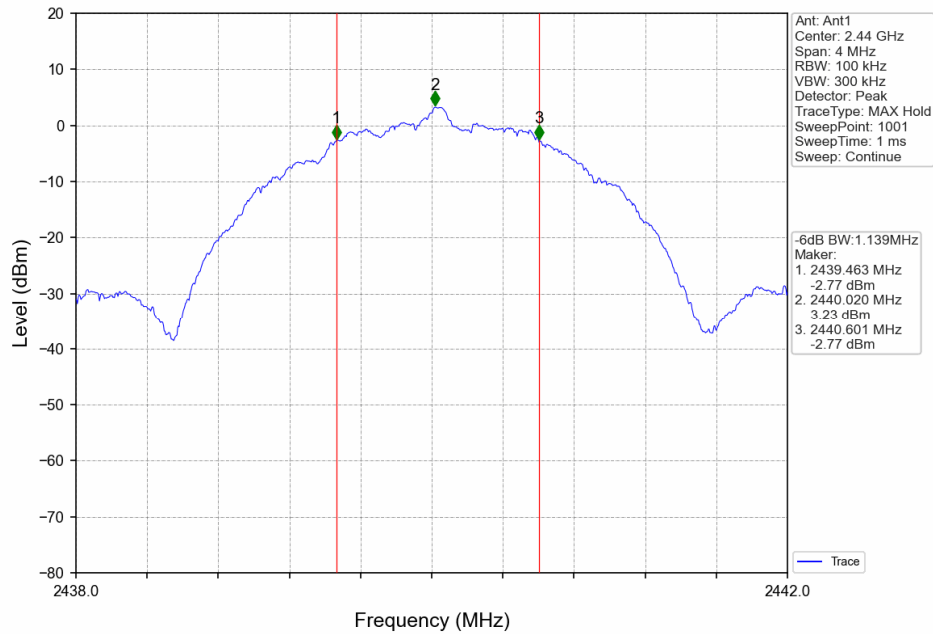
1M_HCH_2480MHz_DataRate=_Ant1_NTNV



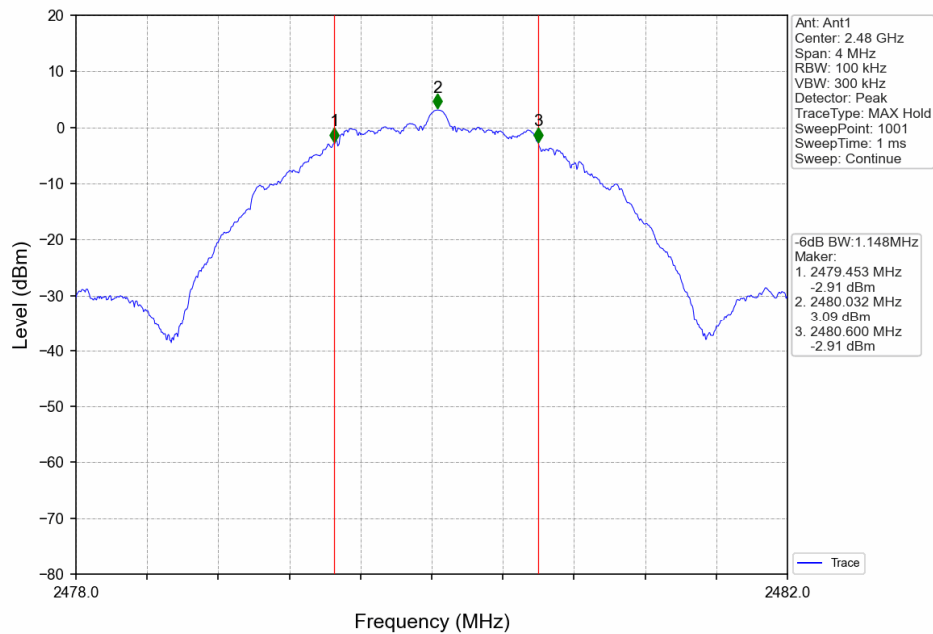
2M_LCH_2402MHz_DataRate=_Ant1_NTNV



2M_MCH_2440MHz_DataRate=_Ant1_NTNV



2M_HCH_2480MHz_DataRate=_Ant1_NTNV



3. Maximum Conducted Output Power

3.1 Power

3.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)		Verdict
			Ant1	Limit	
1M	SISO	2402	2.92	<=30	Pass
		2440	3.14	<=30	Pass
		2480	2.98	<=30	Pass
2M	SISO	2402	3.19	<=30	Pass
		2440	3.36	<=30	Pass
		2480	3.13	<=30	Pass

Note1: Antenna Gain: Ant1: -0.1dBi;

4. Maximum Power Spectral Density

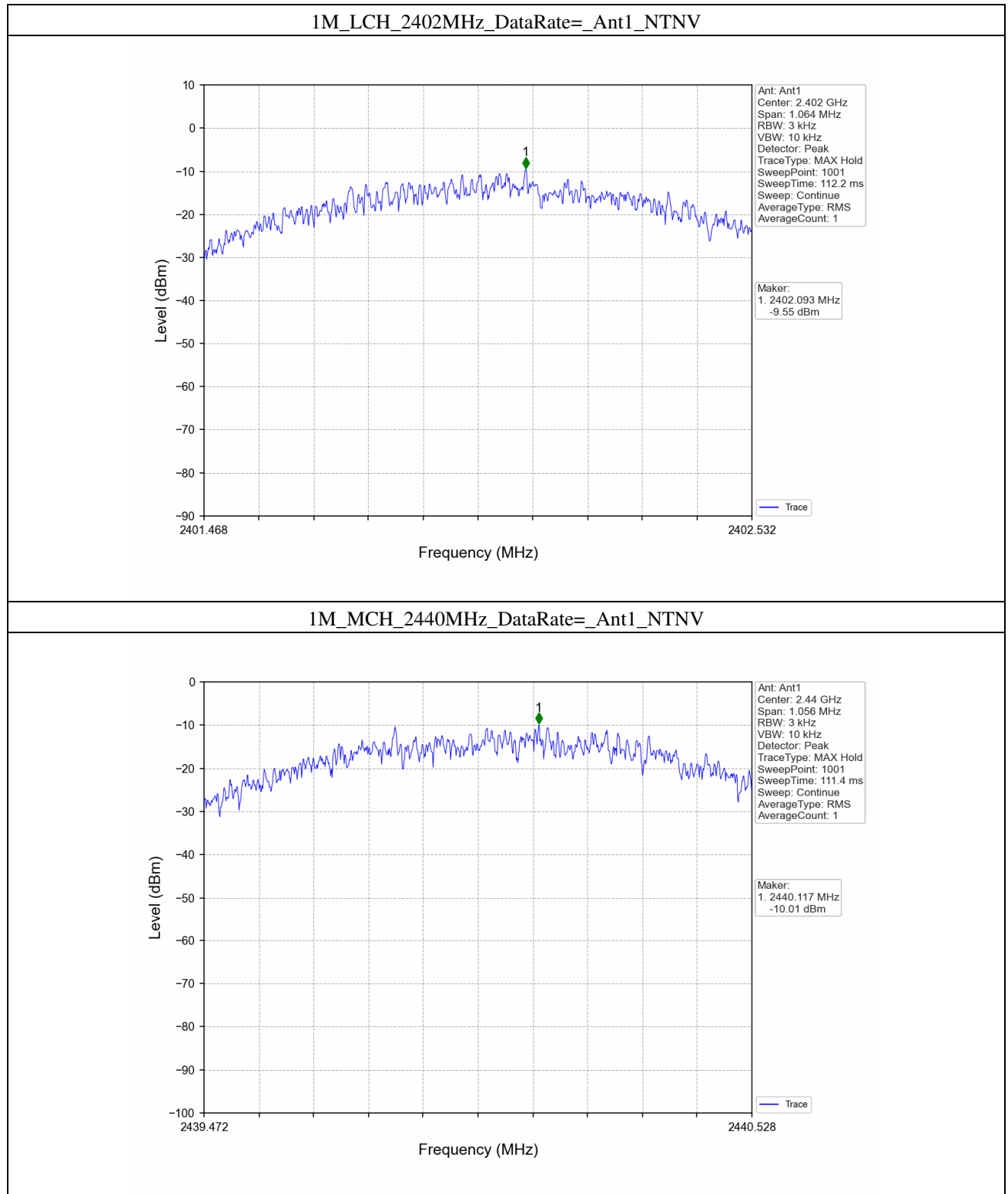
4.1 PSD

4.1.1 Test Result

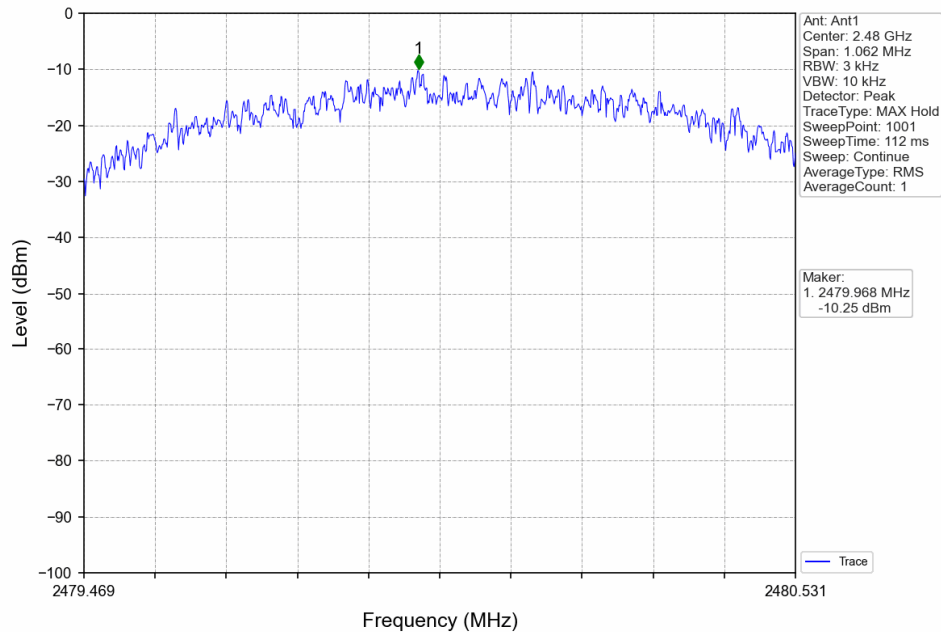
Mode	TX Type	Frequency (MHz)	Maximum PSD (dBm/3kHz)		Verdict
			Ant1	Limit	
1M	SISO	2402	-9.55	<=8	Pass
		2440	-10.01	<=8	Pass
		2480	-10.25	<=8	Pass
2M	SISO	2402	-12.70	<=8	Pass
		2440	-12.59	<=8	Pass
		2480	-12.77	<=8	Pass

Note1: Antenna Gain: Ant1:-0.1dBi;

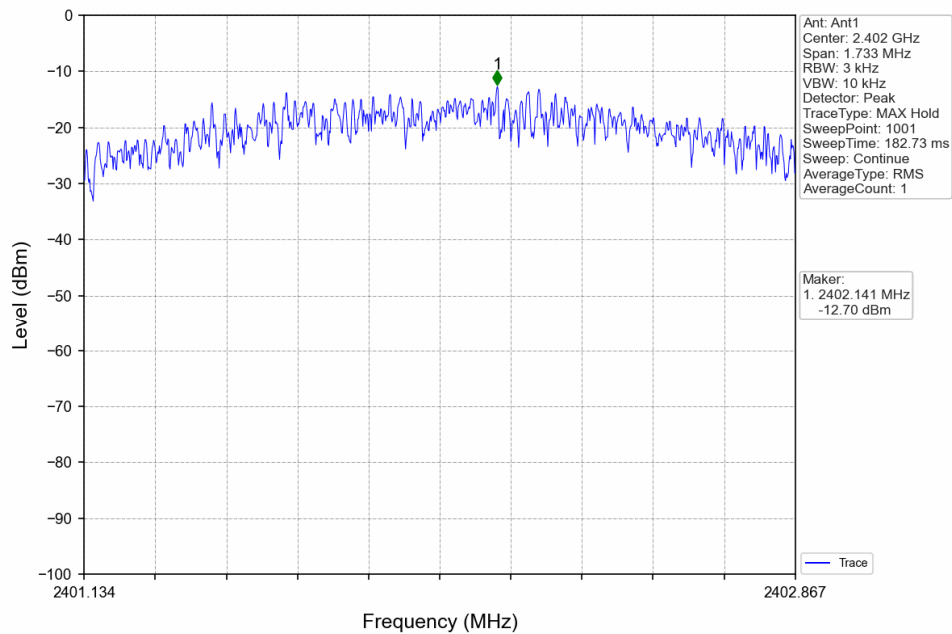
4.1.2 Test Graph



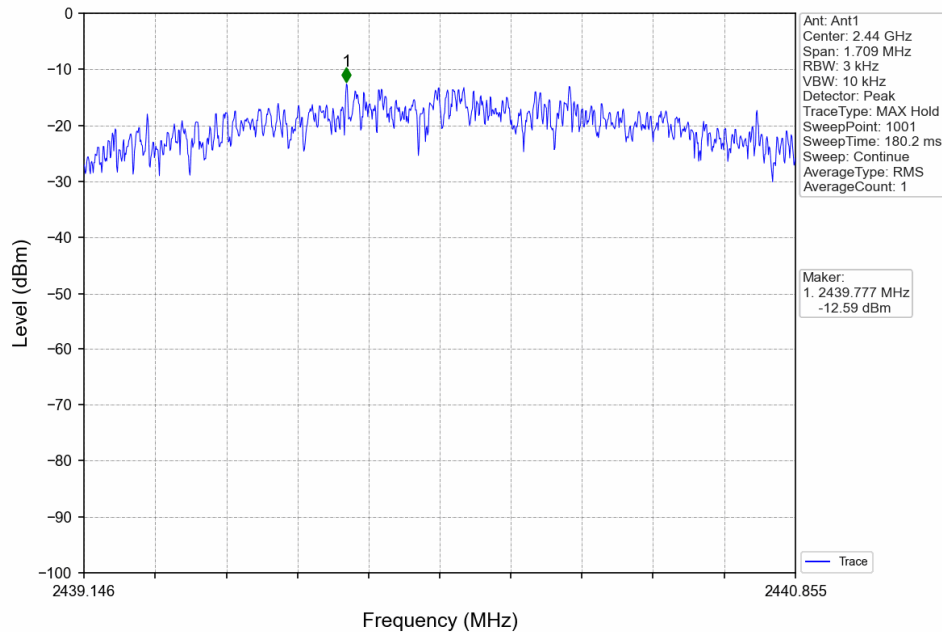
1M_HCH_2480MHz_DataRate=_Ant1_NTNV



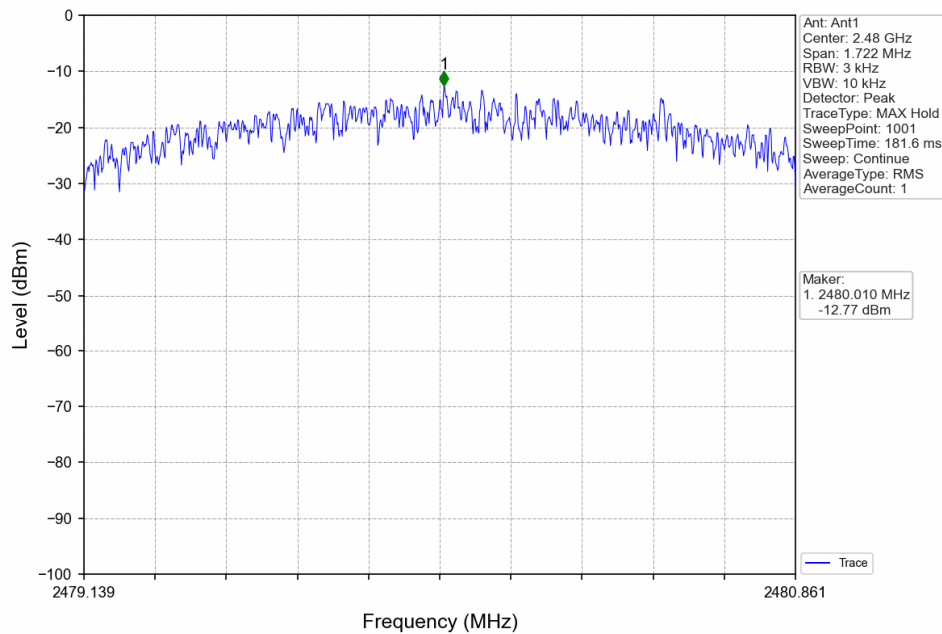
2M_LCH_2402MHz_DataRate=_Ant1_NTNV



2M_MCH_2440MHz_DataRate=_Ant1_NTNV



2M_HCH_2480MHz_DataRate=_Ant1_NTNV



5. Unwanted Emissions In Non-restricted Frequency Bands

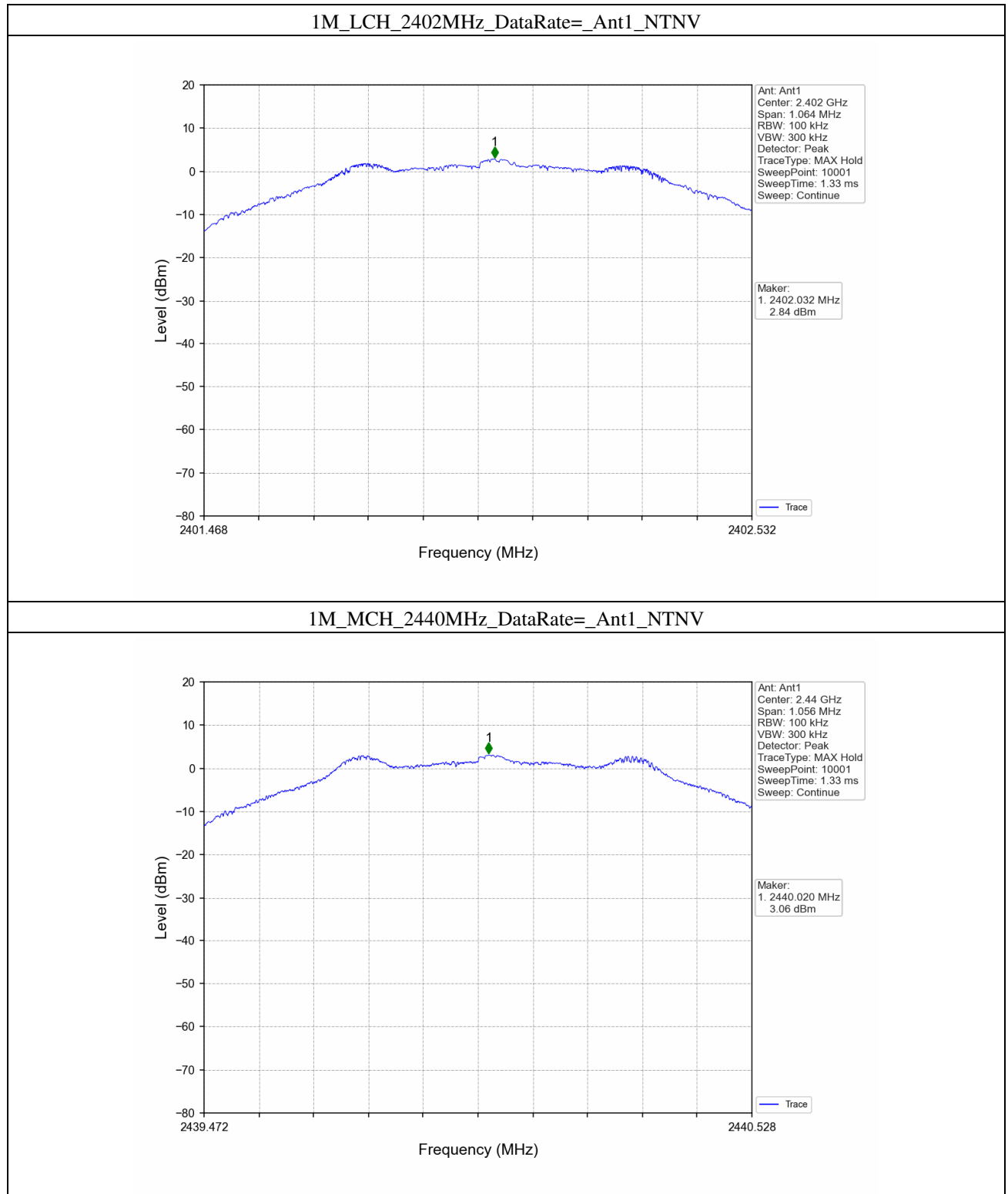
5.1 Ref

5.1.1 Test Result

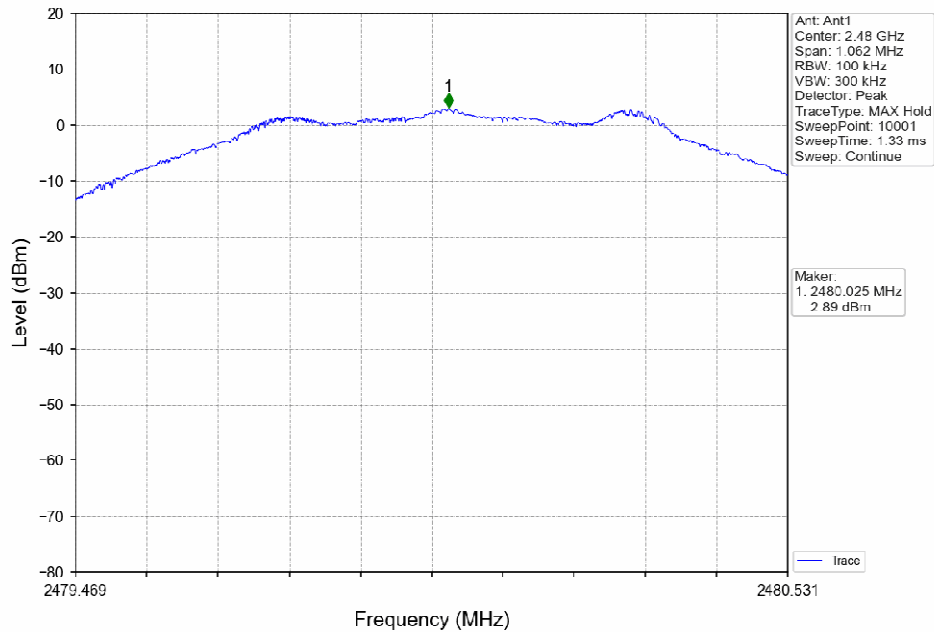
Mode	TX Type	Frequency (MHz)	Ant	Level of Reference (dBm)
1M	SISO	2402	1	2.84
		2440	1	3.06
		2480	1	2.89
2M	SISO	2402	1	3.10
		2440	1	3.23
		2480	1	2.95

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.

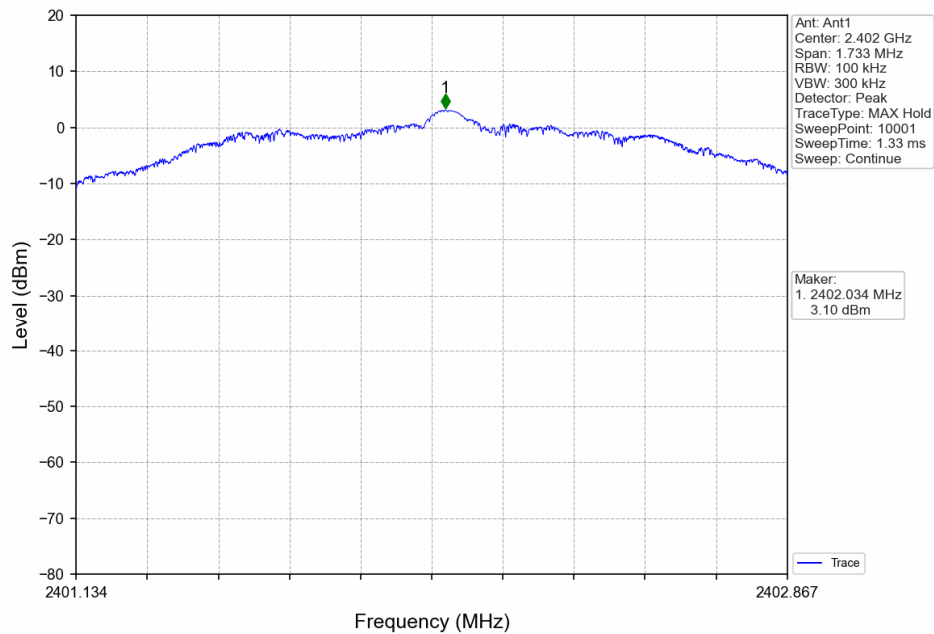
5.1.2 Test Graph



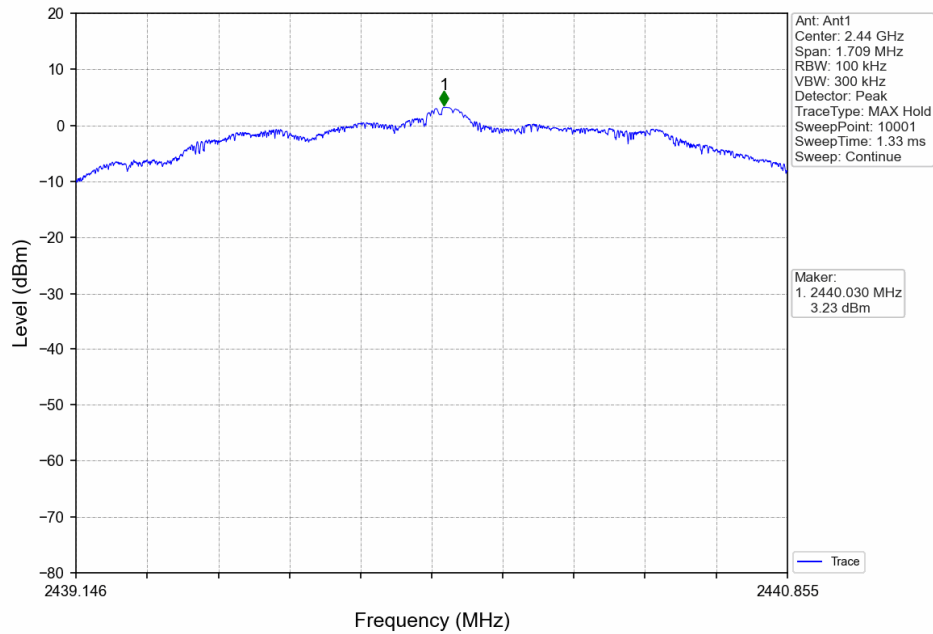
1M_HCH_2480MHz_DataRate=_Ant1_NTNV



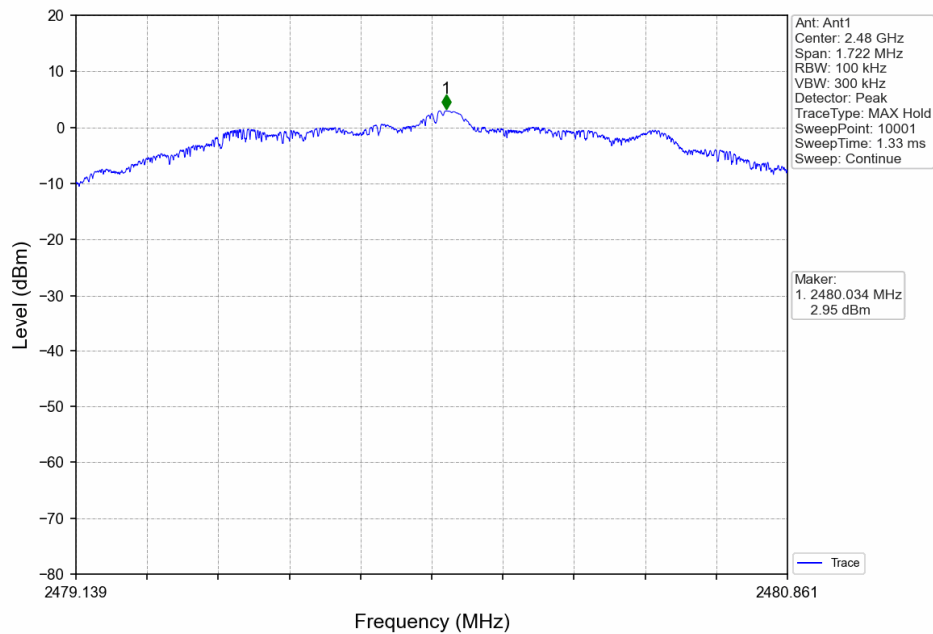
2M_LCH_2402MHz_DataRate=_Ant1_NTNV



2M_MCH_2440MHz_DataRate=_Ant1_NTNV



2M_HCH_2480MHz_DataRate=_Ant1_NTNV



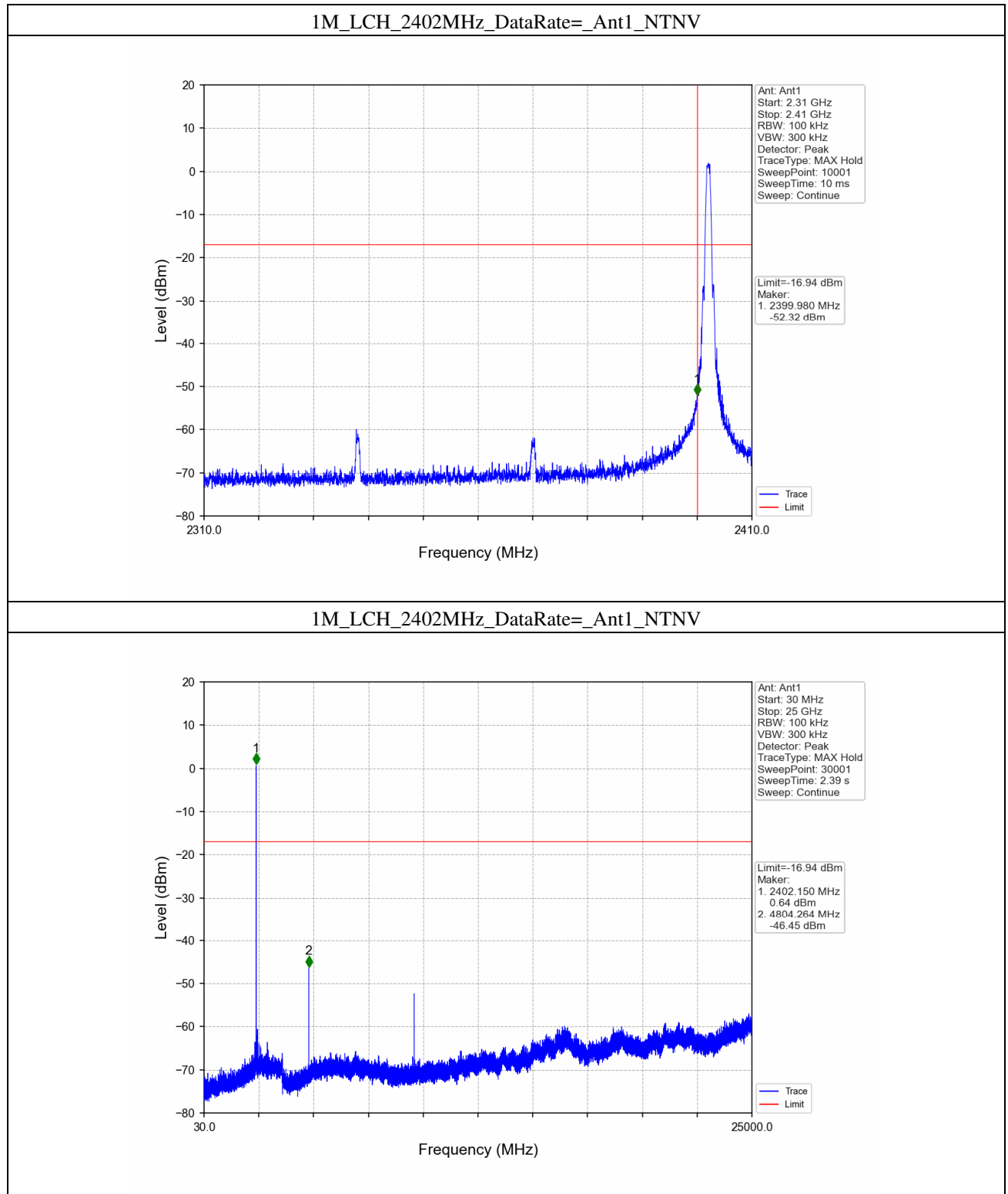
5.2 CSE

5.2.1 Test Result

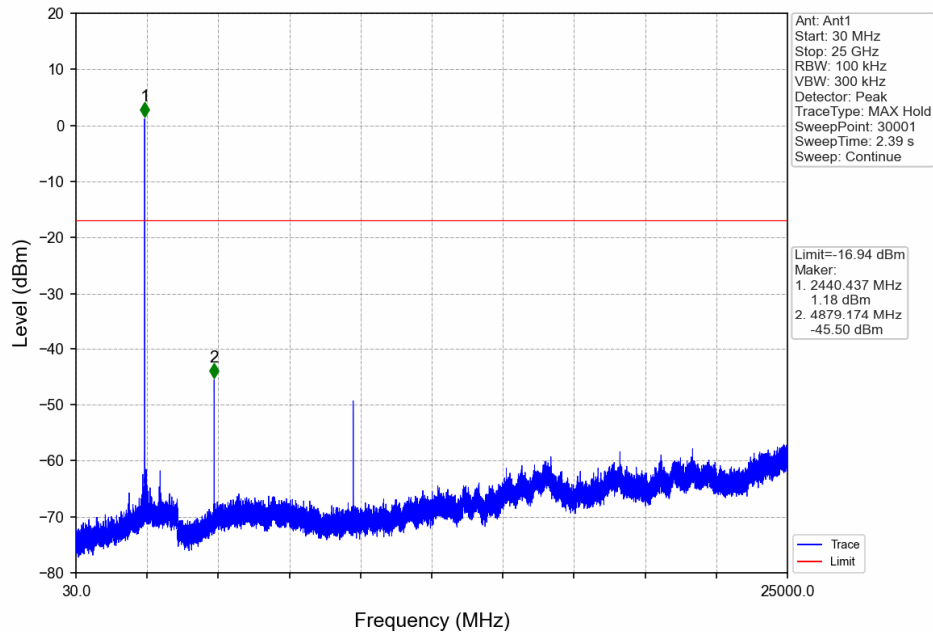
Mode	TX Type	Frequency (MHz)	Ant	Level of Reference (dBm)	Limit (dBm)	Verdict
1M	SISO	2402	1	3.06	-16.94	Pass
		2440	1	3.06	-16.94	Pass
		2480	1	3.06	-16.94	Pass
2M	SISO	2402	1	3.23	-16.77	Pass
		2440	1	3.23	-16.77	Pass
		2480	1	3.23	-16.77	Pass

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.

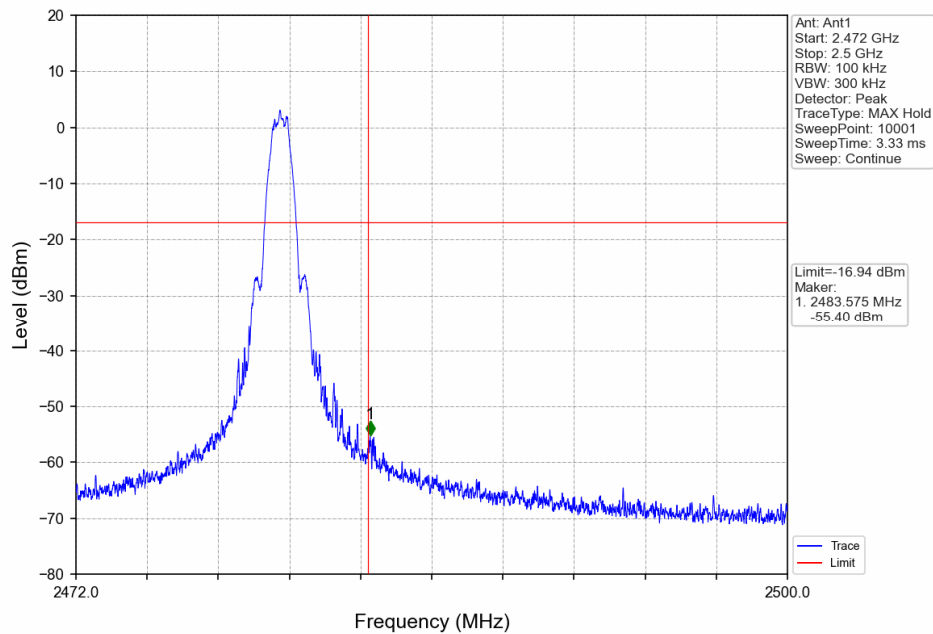
5.2.2 Test Graph



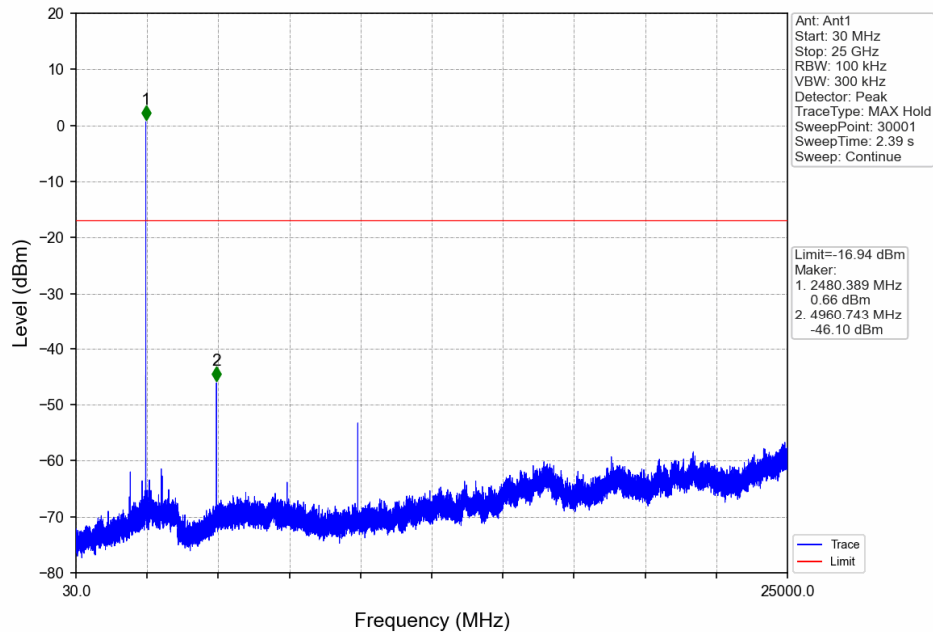
1M_MCH_2440MHz_DataRate=_Ant1_NTNV



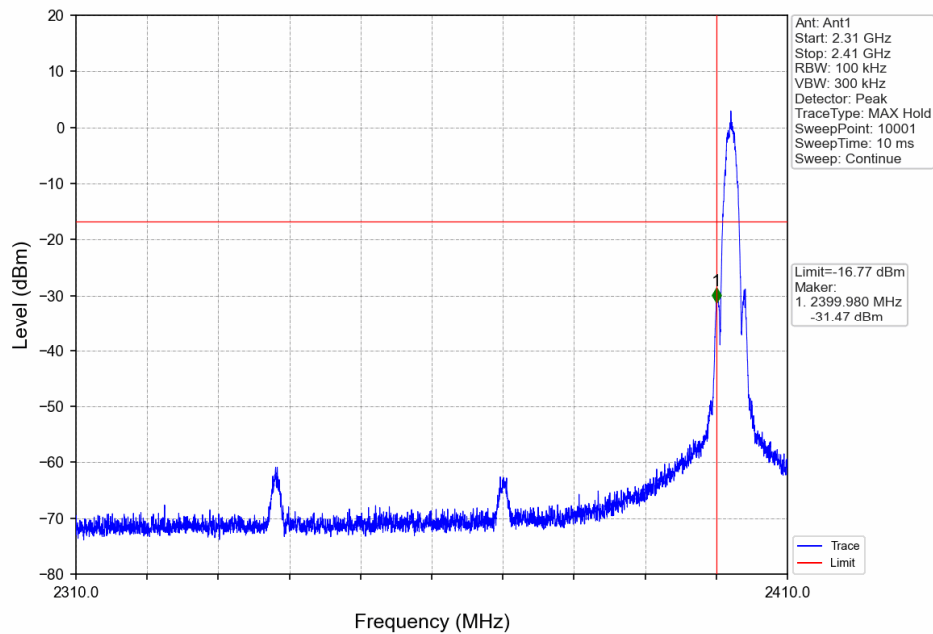
1M_HCH_2480MHz_DataRate=_Ant1_NTNV



1M_HCH_2480MHz_DataRate=_Ant1_NTNV



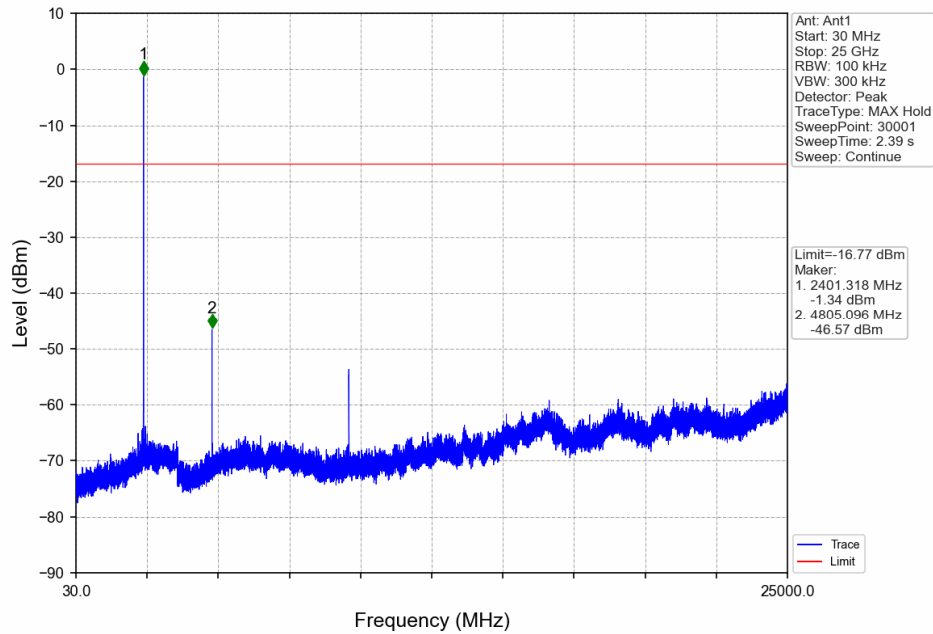
2M_LCH_2402MHz_DataRate=_Ant1_NTNV



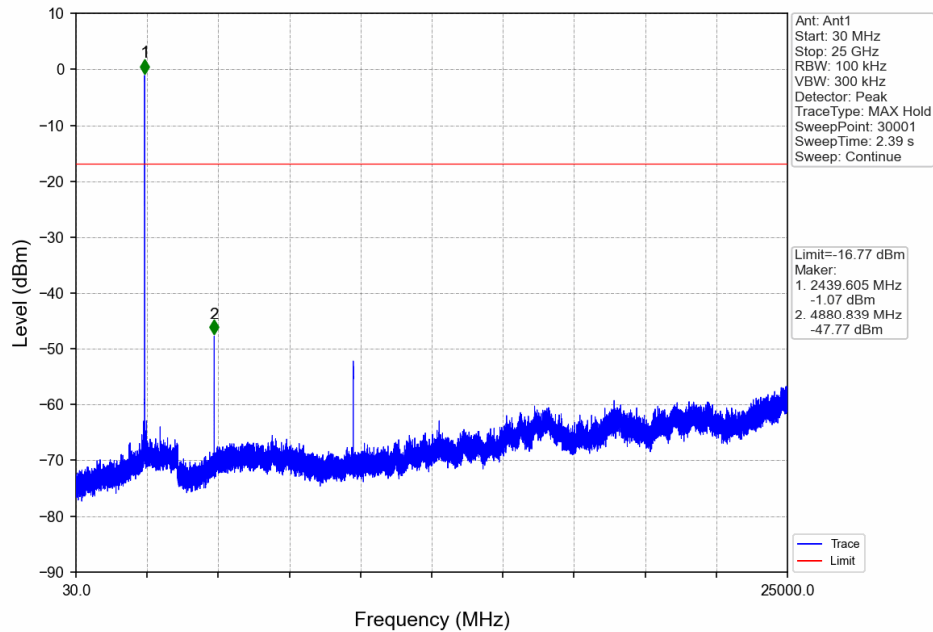
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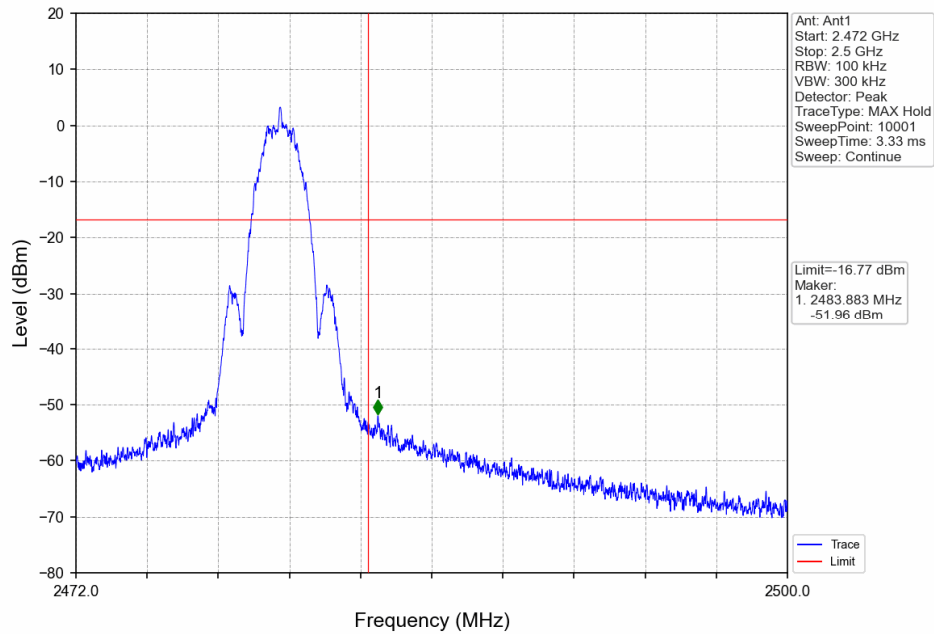
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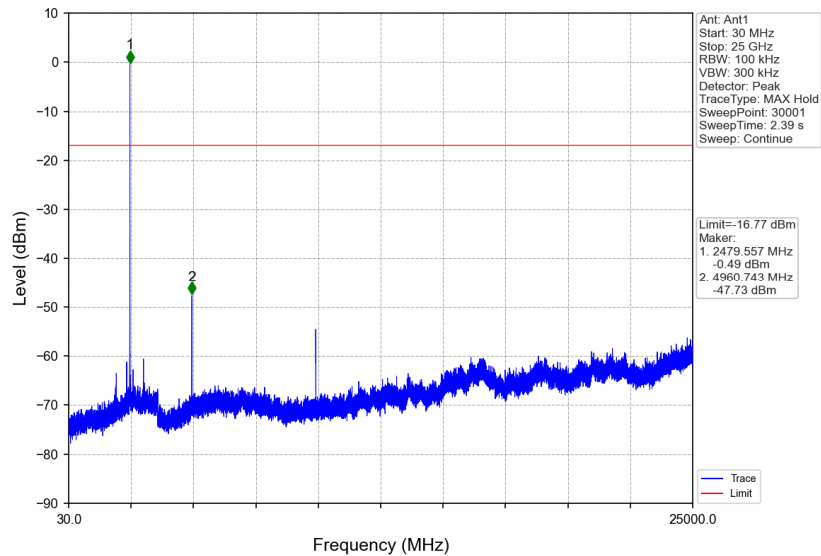
2M_MCH_2440MHz_DataRate=_Ant1_NTNV



2M_HCH_2480MHz_DataRate=_Ant1_NTNV



2M_HCH_2480MHz_DataRate=_Ant1_NTNV



- End of the Report -



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