

TEST REPORT

Application No.: SHCR2308001590AT
FCC ID: VPYLB2AB
IC: 772C-LB2AB
Applicant: Murata Manufacturing Co., Ltd.
Address of Applicant: 10-1, Higashikotari 1-chome, Nagaokakyo-shi Kyoto 617-8555 Japan
Manufacturer: Murata Manufacturing Co., Ltd.
Address of Manufacturer: 10-1, Higashikotari 1-chome, Nagaokakyo-shi Kyoto 617-8555 Japan
Factory: Shenzhen Murata Technology Co., Ltd.
Address of Factory: 15 Cuijing Road, Shenzhen Grand Industrial Zone, Pingshan District, Shenzhen 518118 China

Equipment Under Test (EUT):

EUT Name: UWB+BLE Combo Module plus 1055 ANT
Model No.: LBUA5QJ2AB
Trade Mark: Murata
Standard(s) : 47 CFR Part 15, Subpart C 15.247
RSS-247 Issue 2, February 2017
RSS-Gen Issue 5 Amendment 2 (February 2021)
Date of Receipt: 2022-09-23
Date of Test: 2023-08-17 to 2023-08-23
Date of Issue: 2023-08-24

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

Parlam Zhan

Parlam Zhan
Laboratory Manager



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EEC EMC Lab

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Revision Record			
Version	Description	Date	Remark
00	Updated product name; Updated BLE Antenna	2023-08-24	Based on KSCR211000018401

Authorized for issue by:			
			
		<hr/> Micheal Niu /Project Engineer	
			
		<hr/> Parlam Zhan /Reviewer	



2 Test Summary

Radio Spectrum Technical Requirement				
Item	FCC Requirement	IC Requirement	Method	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	RSS-Gen Clause 6.8	N/A	Customer Declaration

N/A: Not applicable

Radio Spectrum Matter Part				
Item	FCC Requirement	IC Requirement	Method	Result
Minimum 6dB Bandwidth	47 CFR Part 15, Subpart C 15.247a(2)	RSS-247 Clause 5.2(a)	ANSI C63.10 (2013) Section 11.8.1	Pass
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247(b)(3)	RSS-247 Clause 5.4(d)	ANSI C63.10 (2013) Section 11.9.1	Pass
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	RSS-247 Section 3.3 & RSS-Gen Section 8.9	ANSI C63.10 (2013) Section 6.10.5	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	RSS-247 Section 3.3 & RSS-Gen Section 8.9	ANSI C63.10 (2013) Section 6.4,6.5,6.6	Pass

Note: Updated the BLE antenna, only EIRP and Minimum 6dB Bandwidth, Conducted Peak Output Power, Radiated Emissions which fall in the restricted bands and Radiated Spurious Emissions were retested in this new report, other test data refer to original report KSCR211000018401.



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4 General Information

4.1 Details of E.U.T.

Power supply:	DC 2.5V~3.6V Test Voltage: DC 3V
Operation Frequency:	2402MHz to 2480MHz
Bluetooth Version:	V5.2 LE
Modulation Type:	GFSK
Number of Channels:	40
Channel Spacing:	2MHz
Antenna Type:	PCB Antenna
Antenna Gain:	-3.8dBi(Provided by manufacturer)
Serial Number:	4A309935
Firmware Version:	V0.6.0

4.2 Power level setting using in test:

Channel	BLE 1M	BLE 2M
0	8	8
19	8	8
39	8	8

4.3 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
DC Power Supply	Agilent	E3632A	/
Notebook	LENOVO	E40	/
SSCOM	/	/	/



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4.4 Measurement Uncertainty

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

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



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4.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. E&E Lab

588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China

Tel: +86 21 6191 5666

Fax: +86 21 6191 5678

No tests were sub-contracted.

Note:

1. SGS is not responsible for wrong test results due to incorrect information (e.g. max. clock frequency, highest internal frequency, antenna gain, cable loss, etc) is provided by the applicant. (if applicable).

2. SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (if applicable).

4.6 Test Facility

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

• **A2LA (Certificate No. 6332.01)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the American Association for Laboratory Accreditation(A2LA).

• **FCC (Designation Number: CN1301)**

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

• **ISED (CAB Identifier: CN0020)**

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

Company Number: 8617A

• **VCCI (Member No.: 3061)**

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.

4.7 Deviation from Standards

None

4.8 Abnormalities from Standard Conditions

None



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5 Equipment List

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RF Conducted Test					
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2022-12-20	2023-12-19
Spectrum Analyzer	Keysight	N9020B	SHEM241-1	2022-12-20	2023-12-19
Spectrum Analyzer	Agilent	N9020A	SHEM181-1	2022-08-02	2023-08-01
Spectrum Analyzer	Agilent	N9020A	SHEM181-1	2023-08-02	2024-08-01
Signal Generator	R&S	SMR20	SHEM006-1	2022-08-02	2023-08-01
Signal Generator	R&S	SMR20	SHEM006-1	2023-08-02	2024-08-01
Signal Generator	Agilent	N5182A	SHEM182-1	2022-08-02	2023-08-01
Signal Generator	Agilent	N5182A	SHEM182-1	2023-08-02	2024-08-01
Communication Tester	R&S	CMW270	SHEM183-1	2023-06-01	2024-05-31
Communication Tester	R&S	CMW500	SHEM268-1	2023-06-01	2024-05-31
Power Sensor	Keysight	U2021XA * 4	SHEM184-1	2022-08-02	2023-08-01
Power Sensor	Keysight	U2021XA * 4	SHEM184-1	2023-08-02	2024-08-01
Splitter	Anritsu	MA1612A	SHEM185-1	/	/
Coupler	e-meca	803-S-1	SHEM186-1	/	/
High-low Temp Cabinet	Suzhou Zhihe	TL-40	SHEM087-1	2022-11-08	2024-11-07
AC Power Stabilizer	APC	KDF-31020T-V0-F0	SHEM216-1	2022-12-20	2023-12-19
DC Power Supply	MCH	MCH-303A	SHEM210-1	2022-12-20	2023-12-19
Conducted test Cable	/	RF01~RF04	/	2022-12-20	2023-12-19
Switcher	Tonscend	JS0806	SHEM184-1	2022-08-02	2023-08-01
Switcher	Tonscend	JS0806	SHEM184-1	2023-08-02	2024-08-01
Test software	Tonscend	JS Tonscend BT/WIFI System	Version: 2.6	/	/
Coaxial Cable	TST		SHEM263-1	2022-08-02	2023-08-01
Coaxial Cable	TST		SHEM263-1	2023-08-02	2024-08-01
Test software	TST	TST PASS	Version: 2.0	/	/
RF Radiated Test					
EMI test Receiver	R&S	ESU40	SHEM051-1	2022-12-20	2023-12-19
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2022-12-20	2023-12-19
Communication Tester	R&S	CMW500	SHEM268-1	2023-06-01	2024-05-31
Loop Antenna (9kHz-30MHz)	Schwarzbeck	FMZB1519	SHEM135-1	2022-12-20	2023-12-19
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM048-1	2021-09-11	2023-09-10
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM202-1	2022-05-07	2024-05-06
Horn Antenna (1-18GHz)	Schwarzbeck	HF906	SHEM009-1	2022-08-11	2024-08-10
Horn Antenna (1-18GHz)	Schwarzbeck	BBHA9120D	SHEM050-1	2021-09-18	2023-09-17
Horn Antenna (14-40GHz)	Schwarzbeck	BBHA 9170	SHEM049-1	2021-09-18	2023-09-17
Pre-Amplifier	HP	8447D	SHEM236-1	2022-08-02	2023-08-01
Pre-Amplifier	HP	8447D	SHEM236-1	2023-08-02	2024-08-01
High-amplifier (14-40GHz)	Schwarzbeck	10001	SHEM049-2	2022-12-20	2023-12-19
Band Filter	LORCH	9BRX-875/X150	SHEM156-1	/	/
Band Filter	LORCH	13BRX-1950/X500	SHEM083-2	/	/
Band Filter	LORCH	5BRX-2400/X200	SHEM155-1	/	/
Band Filter	LORCH	5BRX-5500/X1000	SHEM157-2	/	/
High pass Filter	Wainwright	WHK3.0/18G	SHEM157-1	/	/
High pass Filter	Wainwright	WHKS1700	SHEM157-3	/	/
Semi/Fully Anechoic	ST	11*6*6M	SHEM078-2	2021-05-25	2024-05-24
RE test Cable	/	RE01, RE02, RE06	/	2023-01-07	2024-01-06



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Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Test software	ESE	E3	Version: 6.111221a	/	/



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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 PCB Antenna and no consideration of replacement. The best case gain of the antenna is -3.8dBi.

Antenna location: Refer to internal photo.



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7 Radio Spectrum Matter Test Results

7.1 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

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

7.1.1 E.U.T. Operation

Operating Environment:

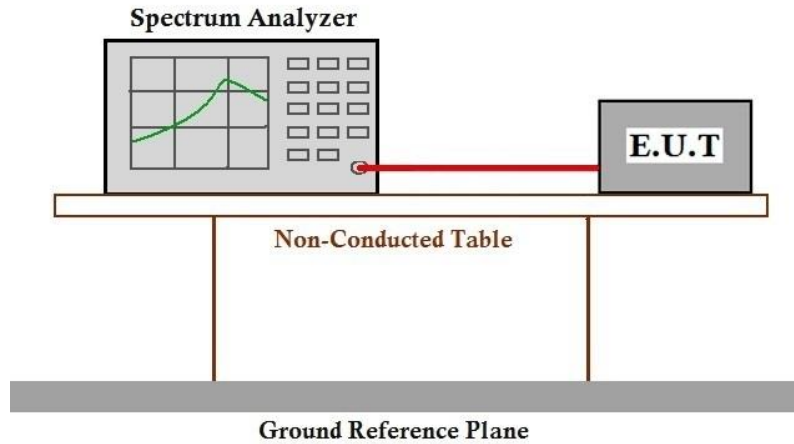
Temperature: 24.1 °C Humidity: 50.1 % RH Atmospheric Pressure: 1010 mbar

7.1.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	02	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	03	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

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

Please Refer to Appendix for Details



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7.2 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

7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 24.1 °C

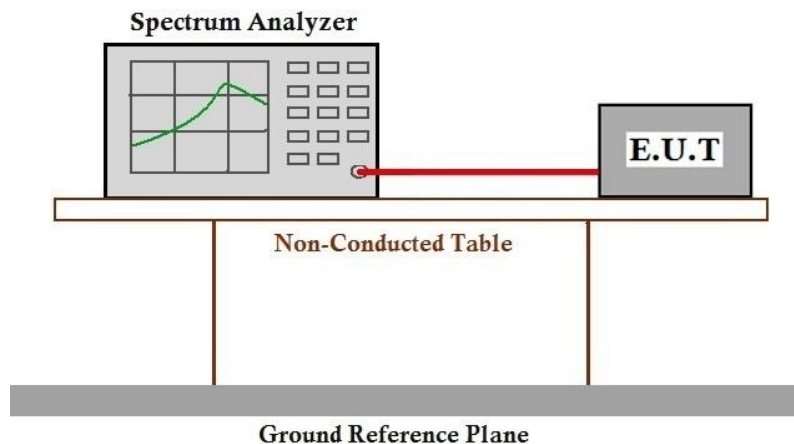
Humidity: 50.1 % RH

Atmospheric Pressure: 1010 mbar

7.2.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	02	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	03	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

Please Refer to Appendix for Details



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7.3 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.

7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 24.1 °C Humidity: 50.1 % RH Atmospheric Pressure: 1010 mbar

7.3.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	02	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	03	TX mode(2Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.


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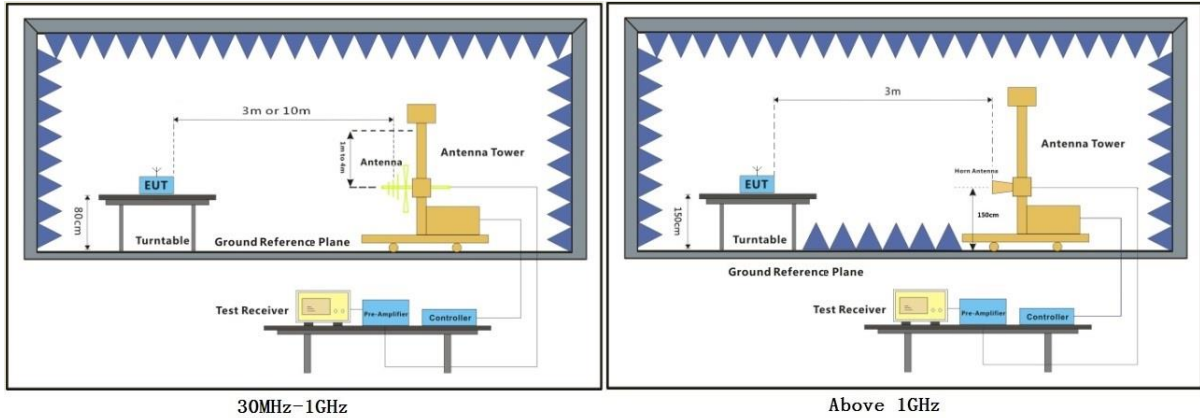
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7.3.3 Test Setup Diagram



7.3.4 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

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

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



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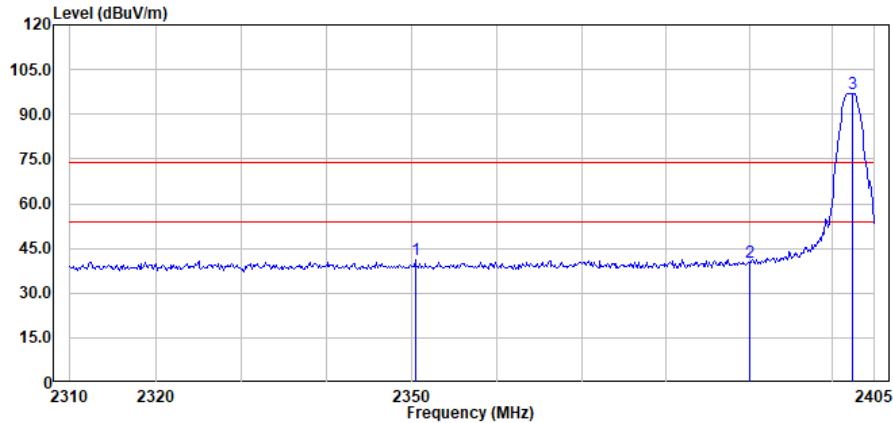
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Test Mode: 02; Polarity: Horizontal; Modulation:GFSK; Channel:Low



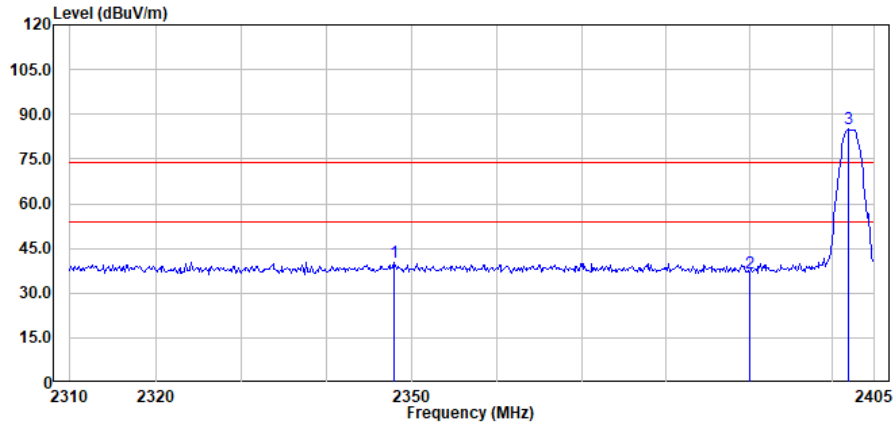
Antenna Polarity :Horizontal

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2350.34		61.14	27.53	2.63	50.18	41.12	74.00	-32.88	Peak
2390.00		60.32	27.55	2.66	50.13	40.40	74.00	-33.60	Peak
2402.38		116.94	27.56	2.67	50.11	97.06	74.00	23.06	Peak

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



Test Mode: 02; Polarity: Vertical; Modulation: GFSK; Channel: Low



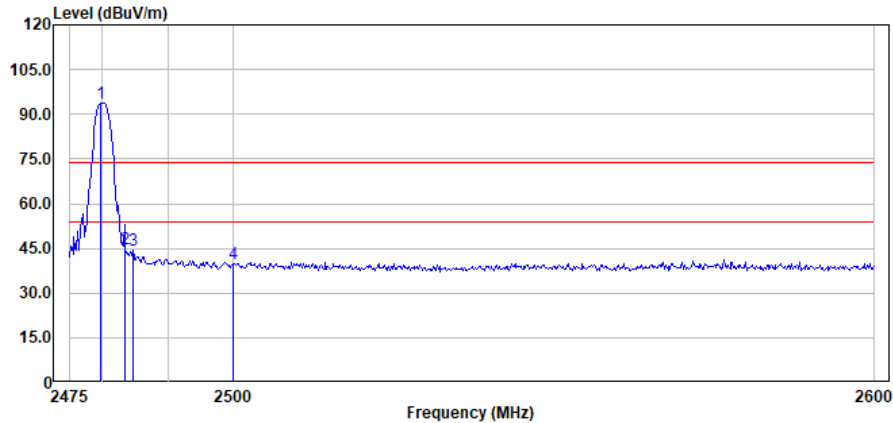
Antenna Polarity :Vertical

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2347.86		60.37	27.53	2.63	50.18	40.35	74.00	-33.65	Peak
2390.00		56.72	27.55	2.66	50.13	36.80	74.00	-37.20	Peak
2401.97		104.80	27.55	2.67	50.11	84.91	74.00	10.91	Peak

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



Test Mode: 02; Polarity: Horizontal; Modulation:GFSK; Channel:High



Antenna Polarity :Horizontal

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamplifier Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2479.71		113.20	27.58	2.73	49.90	93.61	74.00	19.61	Peak
2483.50		64.51	27.58	2.73	49.90	44.92	74.00	-29.08	Peak
2484.60		64.06	27.58	2.73	49.91	44.46	74.00	-29.54	Peak
2500.00		59.37	27.59	2.74	49.94	39.76	74.00	-34.24	Peak

Notes: Emission Level=Read Level+Antenna Factor+Cable loss-Preamplifier Factor



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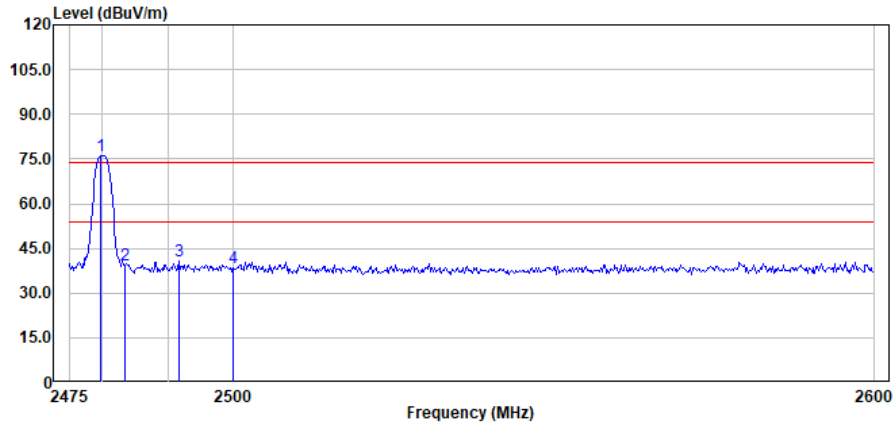
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Test Mode: 02; Polarity: Vertical; Modulation: GFSK; Channel: High



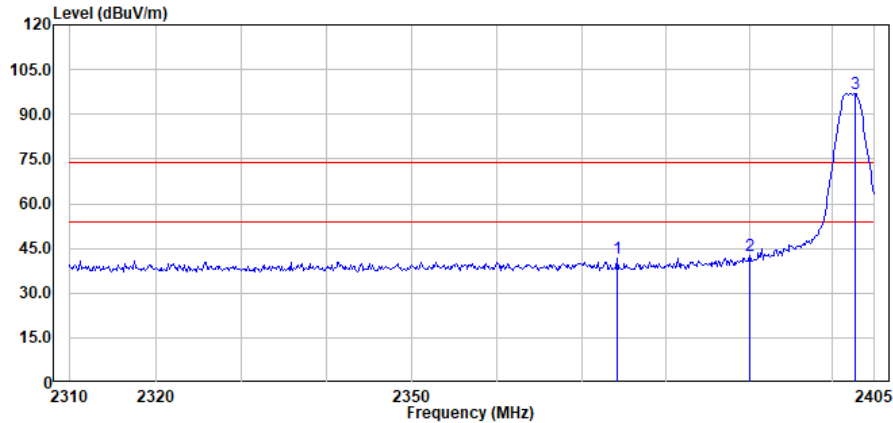
Antenna Polarity :Vertical

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamplifier Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2479.71	2479.71	95.71	27.58	2.73	49.90	76.12	74.00	2.12	Peak
2483.50	2483.50	58.81	27.58	2.73	49.90	39.22	74.00	-34.78	Peak
2491.67	2491.67	60.17	27.59	2.74	49.92	40.58	74.00	-33.42	Peak
2500.00	2500.00	58.06	27.59	2.74	49.94	38.45	74.00	-35.55	Peak

Notes: Emission Level=Read Level+Antenna Factor+Cable loss-Preamplifier Factor



Test Mode: 03; Polarity: Horizontal; Modulation:GFSK; Channel:Low



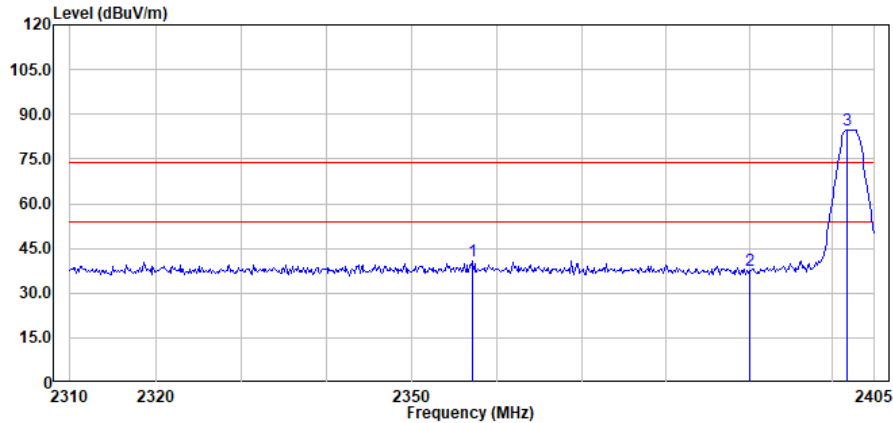
Antenna Polarity :Horizontal

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
	2374.30	61.69	27.55	2.64	50.15	41.73	74.00	-32.27	Peak
	2390.00	62.66	27.55	2.66	50.13	42.74	74.00	-31.26	Peak
	2402.66	116.66	27.56	2.67	50.10	96.79	74.00	22.79	Peak

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



Test Mode: 03; Polarity: Vertical; Modulation: GFSK; Channel: Low



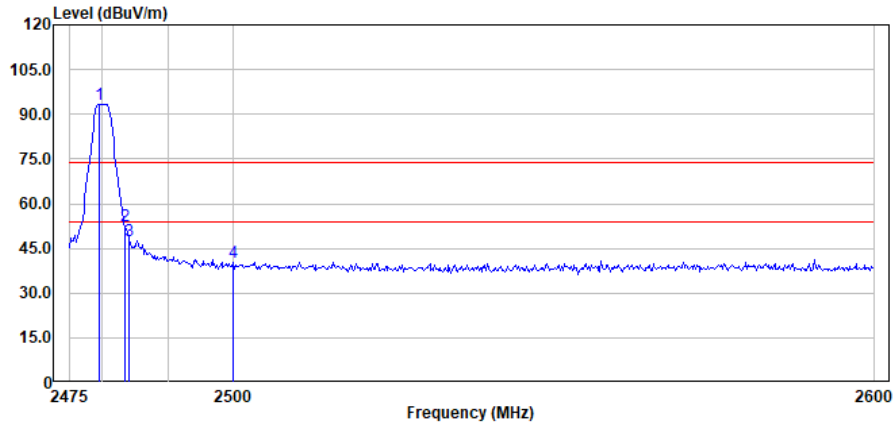
Antenna Polarity :Vertical

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
	2357.09	60.87	27.54	2.63	50.17	40.87	74.00	-33.13	Peak
	2390.00	57.56	27.55	2.66	50.13	37.64	74.00	-36.36	Peak
	2401.70	104.53	27.55	2.67	50.11	84.64	74.00	10.64	Peak

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



Test Mode: 03; Polarity: Horizontal; Modulation:GFSK; Channel:High



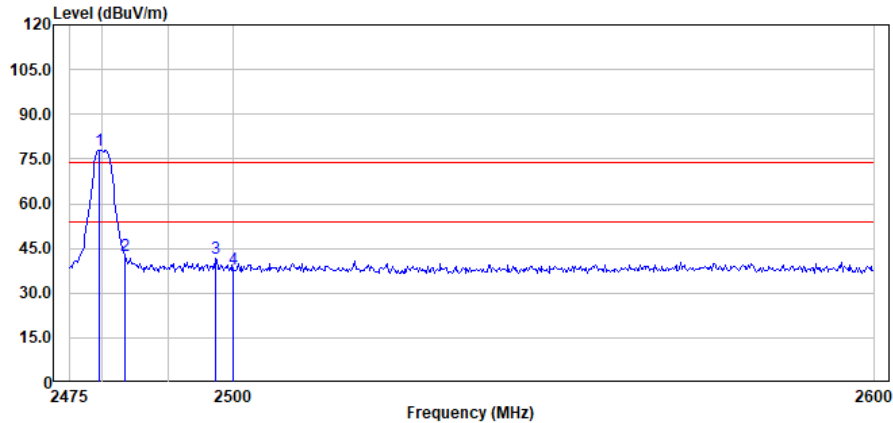
Antenna Polarity :Horizontal

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2479.53	113.01	27.58	2.73	49.89	93.43	74.00	19.43	Peak	
2483.50	72.07	27.58	2.73	49.90	52.48	74.00	-21.52	Peak	
2484.06	67.28	27.58	2.73	49.90	47.69	74.00	-26.31	Peak	
2500.00	59.69	27.59	2.74	49.94	40.08	74.00	-33.92	Peak	

Notes: Emission Level=Read Level+Antenna Factor+Cable loss-Preamplifier Factor



Test Mode: 03; Polarity: Vertical; Modulation:GFSK; Channel:High



Antenna Polarity :Vertical

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamplifier Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
	2479.53	97.54	27.58	2.73	49.89	77.96	74.00	3.96	Peak
	2483.50	62.04	27.58	2.73	49.90	42.45	74.00	-31.55	Peak
	2497.28	61.04	27.59	2.74	49.93	41.44	74.00	-32.56	Peak
	2500.00	57.85	27.59	2.74	49.94	38.24	74.00	-35.76	Peak

Notes: Emission Level=Read Level+Antenna Factor+Cable loss-Preamplifier Factor



7.4 Radiated Spurious Emissions Below 1GHz

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

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

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
960-1000	500	3

7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 24.0 °C Humidity: 50.1 % RH Atmospheric Pressure: 1010 mbar

7.4.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	02	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	03	TX mode(2Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.



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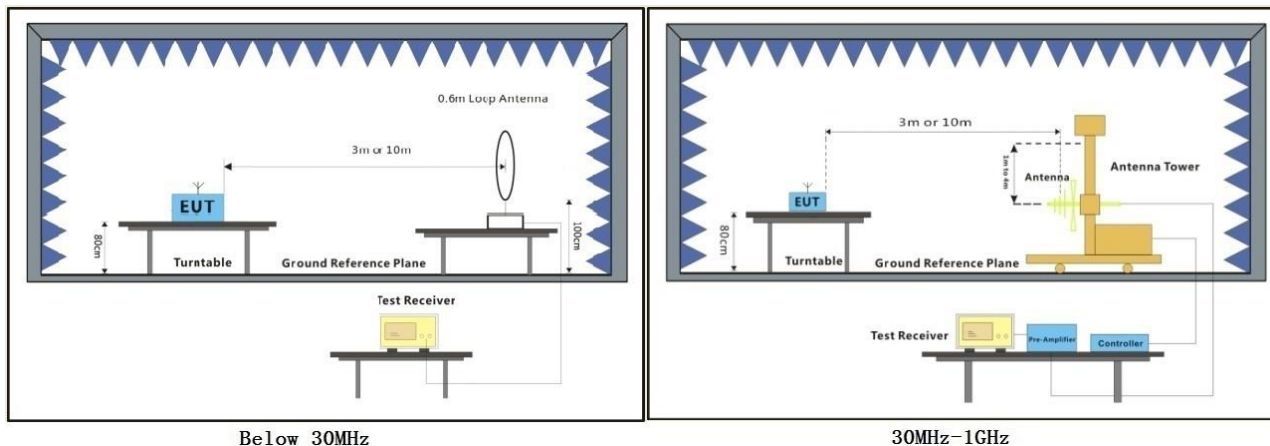
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7.4.3 Test Setup Diagram



7.4.4 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.
- 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 quasi-peak method as specified and then reported in a data sheet.
- Test the EUT in the lowest channel, the middle 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:

- Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor
- 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.
- 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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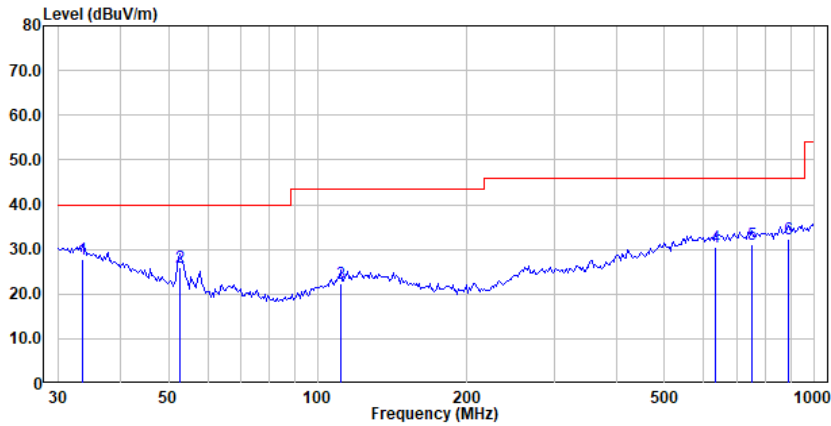
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Test Mode: 02; Polarity: Horizontal



Antenna Polarity :HORIZONTAL

No.	Freq (MHz)	Read level (dBuV)	LISN Factor (dB)	Cable Loss (dB)	Emission Level (dBuV)	Limit (dBuV)	Over Limit (dB)	Remark
1	33.56	2.71	24.68	0.32	27.71	40.00	-12.29	QP
2	52.58	9.20	16.48	0.42	26.10	40.00	-13.90	QP
3	111.35	3.57	17.80	0.89	22.26	43.50	-21.24	QP
4	633.91	2.74	25.34	2.40	30.48	46.00	-15.52	QP
5	750.11	2.77	25.79	2.41	30.97	46.00	-15.03	QP
6	887.61	2.98	27.02	2.41	32.41	46.00	-13.59	QP

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



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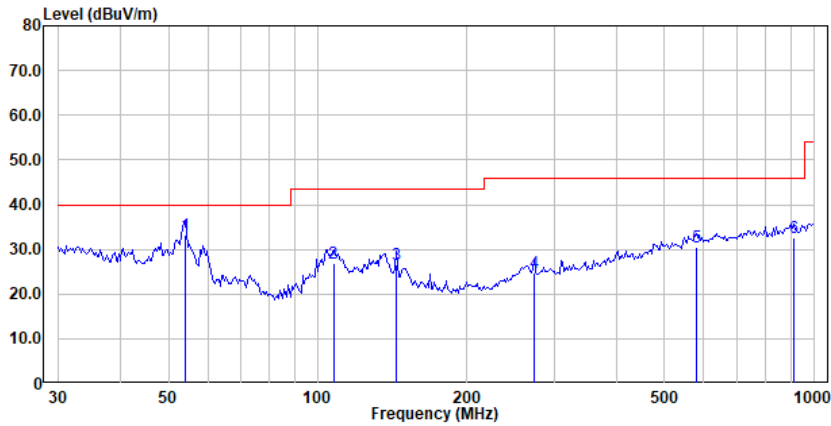
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Test Mode: 02; Polarity: Vertical



Antenna Polarity :VERTICAL

No.	Freq (MHz)	Read level (dBuV)	LISN Factor (dB)	Cable Loss (dB)	Emission Level (dBuV)	Limit (dBuV)	Over Limit (dB)	Remark
1	54.07	16.77	15.93	0.49	33.19	40.00	-6.81	QP
2	107.51	8.70	17.33	0.87	26.90	43.50	-16.60	QP
3	144.33	8.39	17.04	1.11	26.54	43.50	-16.96	QP
4	273.23	4.64	18.98	1.24	24.86	46.00	-21.14	QP
5	578.67	3.40	24.72	2.34	30.46	46.00	-15.54	QP
6	912.86	3.47	26.67	2.52	32.66	46.00	-13.34	QP

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



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7.5 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

7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 24.1 °C

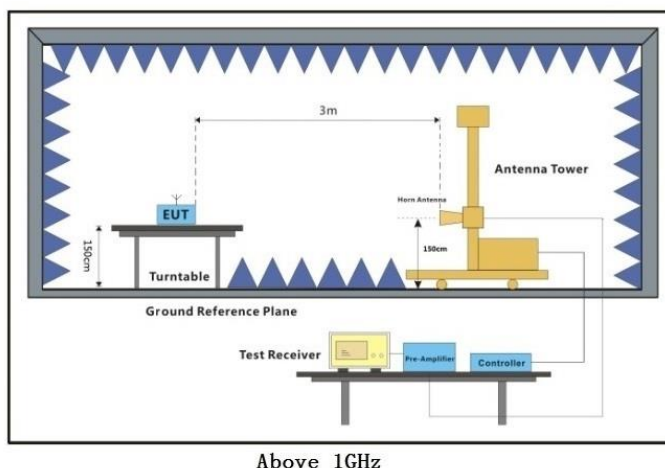
Humidity: 50.1 % RH

Atmospheric Pressure: 1010 mbar

7.5.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	02	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.
Final test	03	TX mode(2Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.5.3 Test Setup Diagram



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7.5.4 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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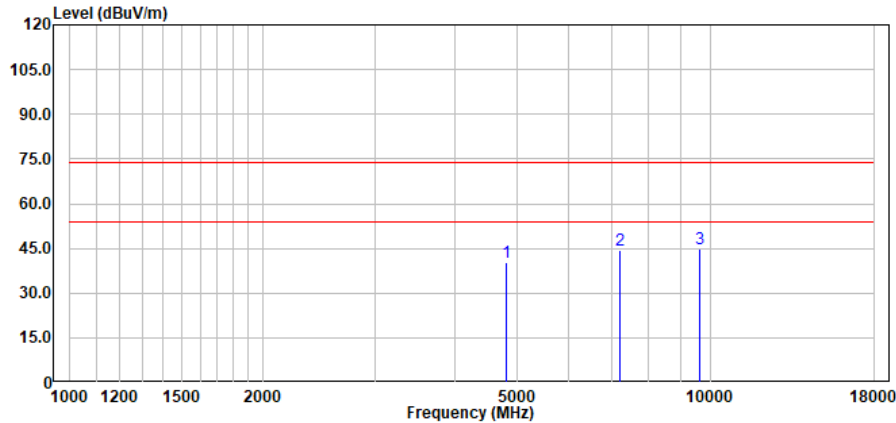
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Test Mode: 02; Polarity: Horizontal; Modulation:GFSK; Channel:Low



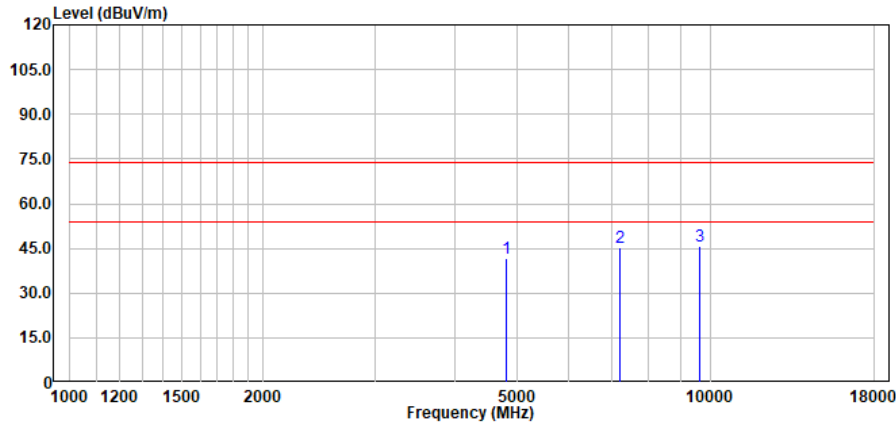
Antenna Polarity :Horizontal

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00		52.77	31.26	4.14	47.81	40.36	74.00	-33.64	Peak
7206.00		49.92	35.74	5.33	46.59	44.40	74.00	-29.60	Peak
9608.00		47.30	38.20	5.71	46.17	45.04	74.00	-28.96	Peak

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



Test Mode: 02; Polarity: Vertical; Modulation: GFSK; Channel: Low



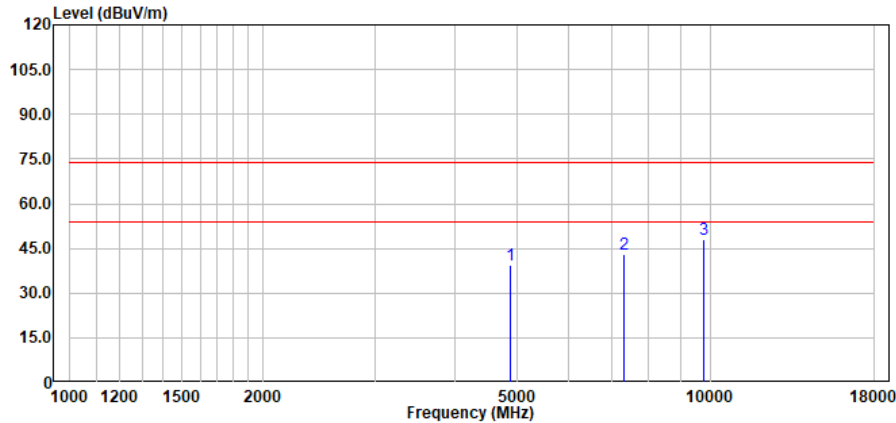
Antenna Polarity :Vertical

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00		53.89	31.26	4.14	47.81	41.48	74.00	-32.52	Peak
7206.00		50.61	35.74	5.33	46.59	45.09	74.00	-28.91	Peak
9608.00		48.11	38.20	5.71	46.17	45.85	74.00	-28.15	Peak

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



Test Mode: 02; Polarity: Horizontal; Modulation: GFSK; Channel: middle



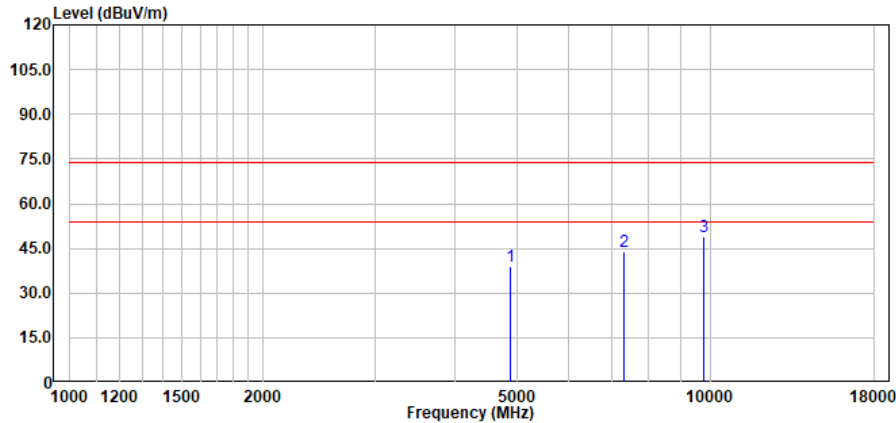
Antenna Polarity :Horizontal

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
	4880.00	51.38	31.42	4.17	47.77	39.20	74.00	-34.80	Peak
	7320.00	48.33	36.08	5.43	46.71	43.13	74.00	-30.87	Peak
	9760.00	50.20	38.35	5.75	46.10	48.20	74.00	-25.80	Peak

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



Test Mode: 02; Polarity: Vertical; Modulation:GFSK; Channel:middle



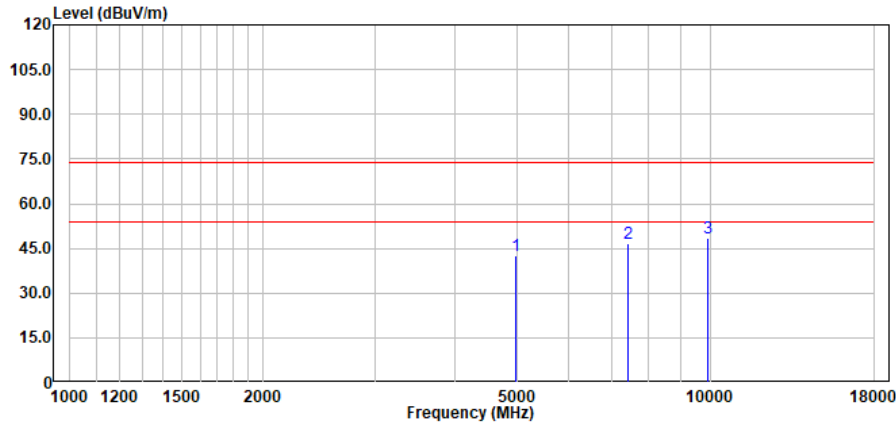
Antenna Polarity :Vertical

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
	4880.00	51.04	31.42	4.17	47.77	38.86	74.00	-35.14	Peak
	7320.00	49.22	36.08	5.43	46.71	44.02	74.00	-29.98	Peak
	9760.00	50.79	38.35	5.75	46.10	48.79	74.00	-25.21	Peak

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



Test Mode: 02; Polarity: Horizontal; Modulation:GFSK; Channel:High



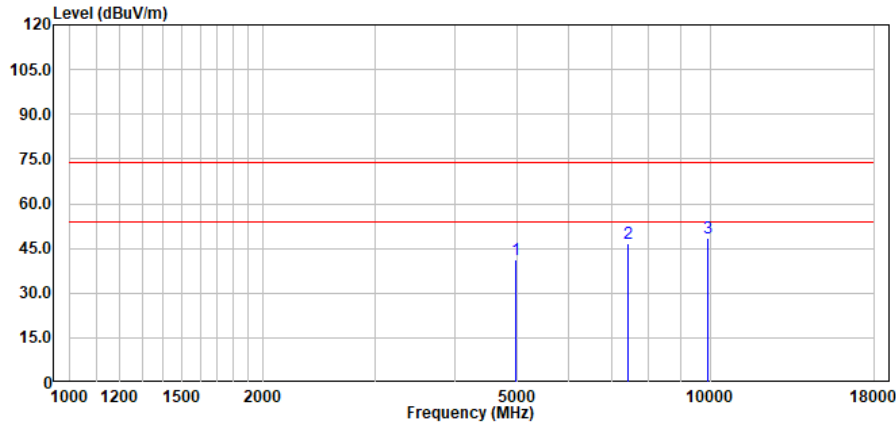
Antenna Polarity :Horizontal

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
	4960.00	54.55	31.58	4.21	47.72	42.62	74.00	-31.38	Peak
	7440.00	51.50	36.35	5.48	46.84	46.49	74.00	-27.51	Peak
	9920.00	50.34	38.51	5.81	46.03	48.63	74.00	-25.37	Peak

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



Test Mode: 02; Polarity: Vertical; Modulation:GFSK; Channel:High



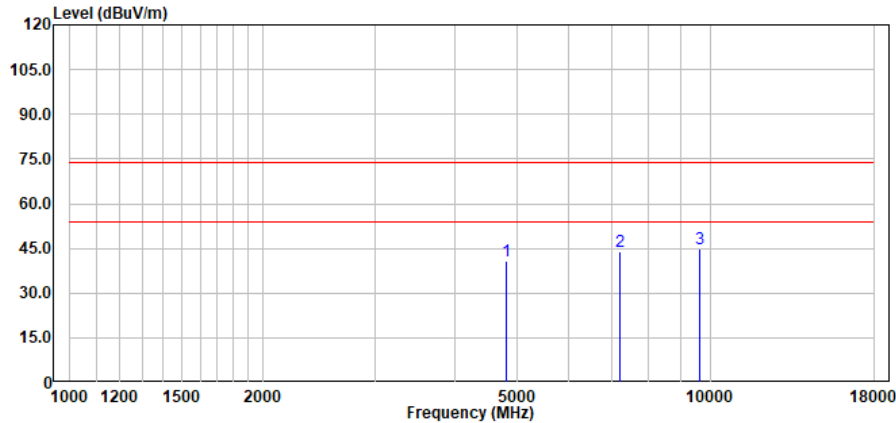
Antenna Polarity :Vertical

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
	4960.00	53.29	31.58	4.21	47.72	41.36	74.00	-32.64	Peak
	7440.00	51.77	36.35	5.48	46.84	46.76	74.00	-27.24	Peak
	9920.00	50.17	38.51	5.81	46.03	48.46	74.00	-25.54	Peak

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



Test Mode: 03; Polarity: Horizontal; Modulation:GFSK; Channel:Low



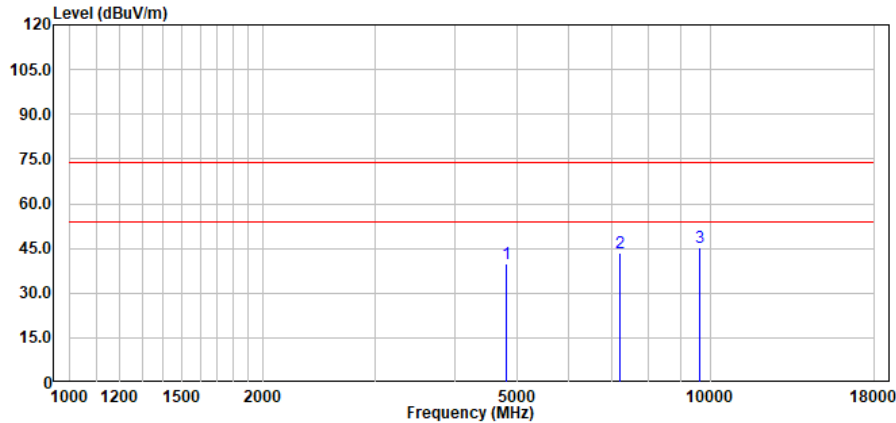
Antenna Polarity :Horizontal

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.00		53.36	31.26	4.14	47.81	40.95	74.00	-33.05	Peak
7206.00		49.37	35.74	5.33	46.59	43.85	74.00	-30.15	Peak
9608.00		47.01	38.20	5.71	46.17	44.75	74.00	-29.25	Peak

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



Test Mode: 03; Polarity: Vertical; Modulation: GFSK; Channel: Low



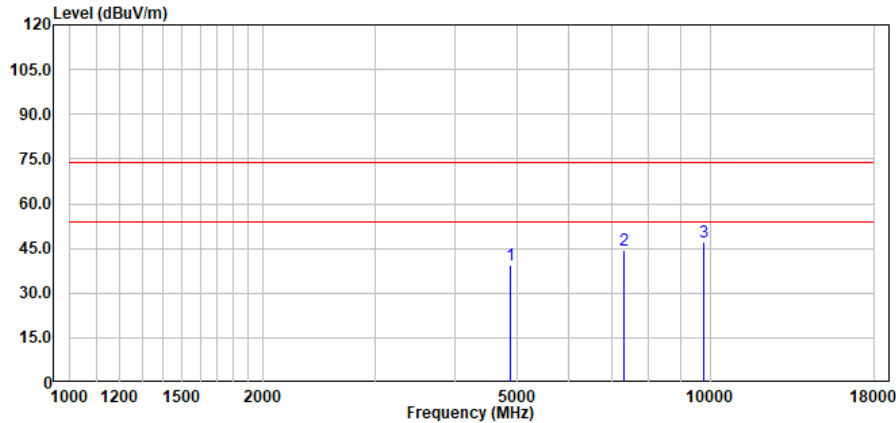
Antenna Polarity :Vertical

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
	4804.00	52.37	31.26	4.14	47.81	39.96	74.00	-34.04	Peak
	7206.00	48.94	35.74	5.33	46.59	43.42	74.00	-30.58	Peak
	9608.00	47.66	38.20	5.71	46.17	45.40	74.00	-28.60	Peak

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



Test Mode: 03; Polarity: Horizontal; Modulation: GFSK; Channel: middle



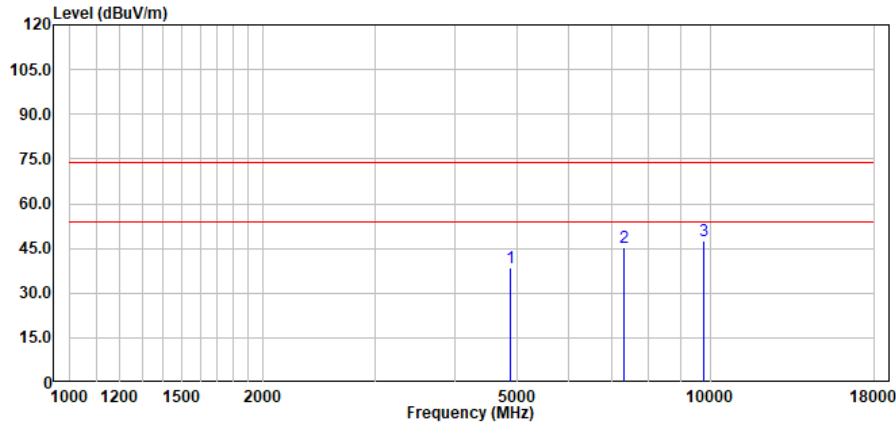
Antenna Polarity :Horizontal

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
	4880.00	51.67	31.42	4.17	47.77	39.49	74.00	-34.51	Peak
	7320.00	49.74	36.08	5.43	46.71	44.54	74.00	-29.46	Peak
	9760.00	49.16	38.35	5.75	46.10	47.16	74.00	-26.84	Peak

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



Test Mode: 03; Polarity: Vertical; Modulation:GFSK; Channel:middle



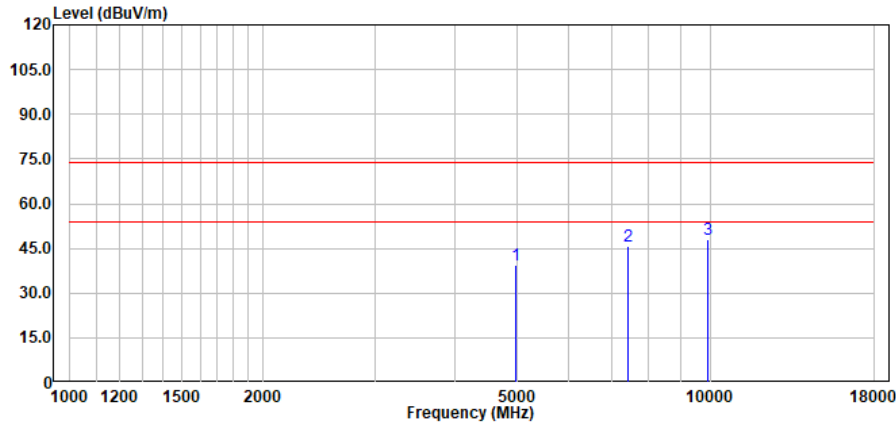
Antenna Polarity :Vertical

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
	4880.00	50.53	31.42	4.17	47.77	38.35	74.00	-35.65	Peak
	7320.00	50.46	36.08	5.43	46.71	45.26	74.00	-28.74	Peak
	9760.00	49.64	38.35	5.75	46.10	47.64	74.00	-26.36	Peak

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



Test Mode: 03; Polarity: Horizontal; Modulation:GFSK; Channel:High



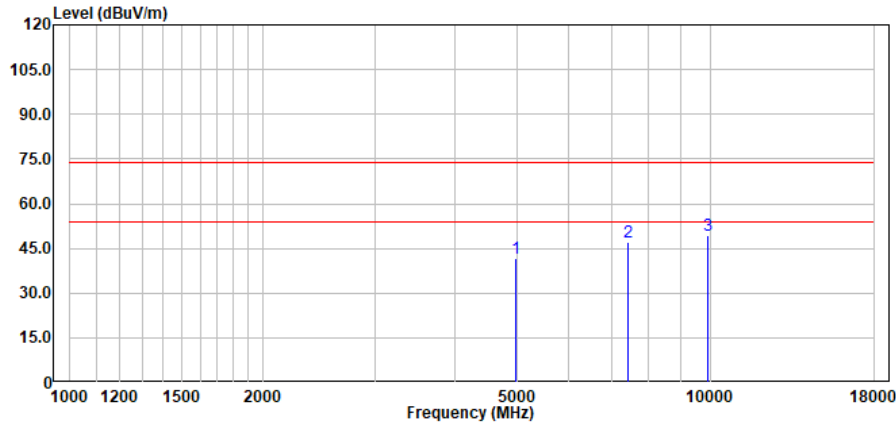
Antenna Polarity :Horizontal

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
	4960.00	51.36	31.58	4.21	47.72	39.43	74.00	-34.57	Peak
	7440.00	50.77	36.35	5.48	46.84	45.76	74.00	-28.24	Peak
	9920.00	49.89	38.51	5.81	46.03	48.18	74.00	-25.82	Peak

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



Test Mode: 03; Polarity: Vertical; Modulation: GFSK; Channel: High



Antenna Polarity :Vertical

No.	Freq	Read level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
	4960.00	53.37	31.58	4.21	47.72	41.44	74.00	-32.56	Peak
	7440.00	51.99	36.35	5.48	46.84	46.98	74.00	-27.02	Peak
	9920.00	50.89	38.51	5.81	46.03	49.18	74.00	-24.82	Peak

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



8 Test Setup Photo

Refer to Appendix - Test Setup Photo for SHCR2308001590AT

9 EUT Constructional Details (EUT Photos)

Refer to Appendix - Photographs of EUT Constructional Details for SHCR2308001590AT



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10 Appendix

1. Bandwidth

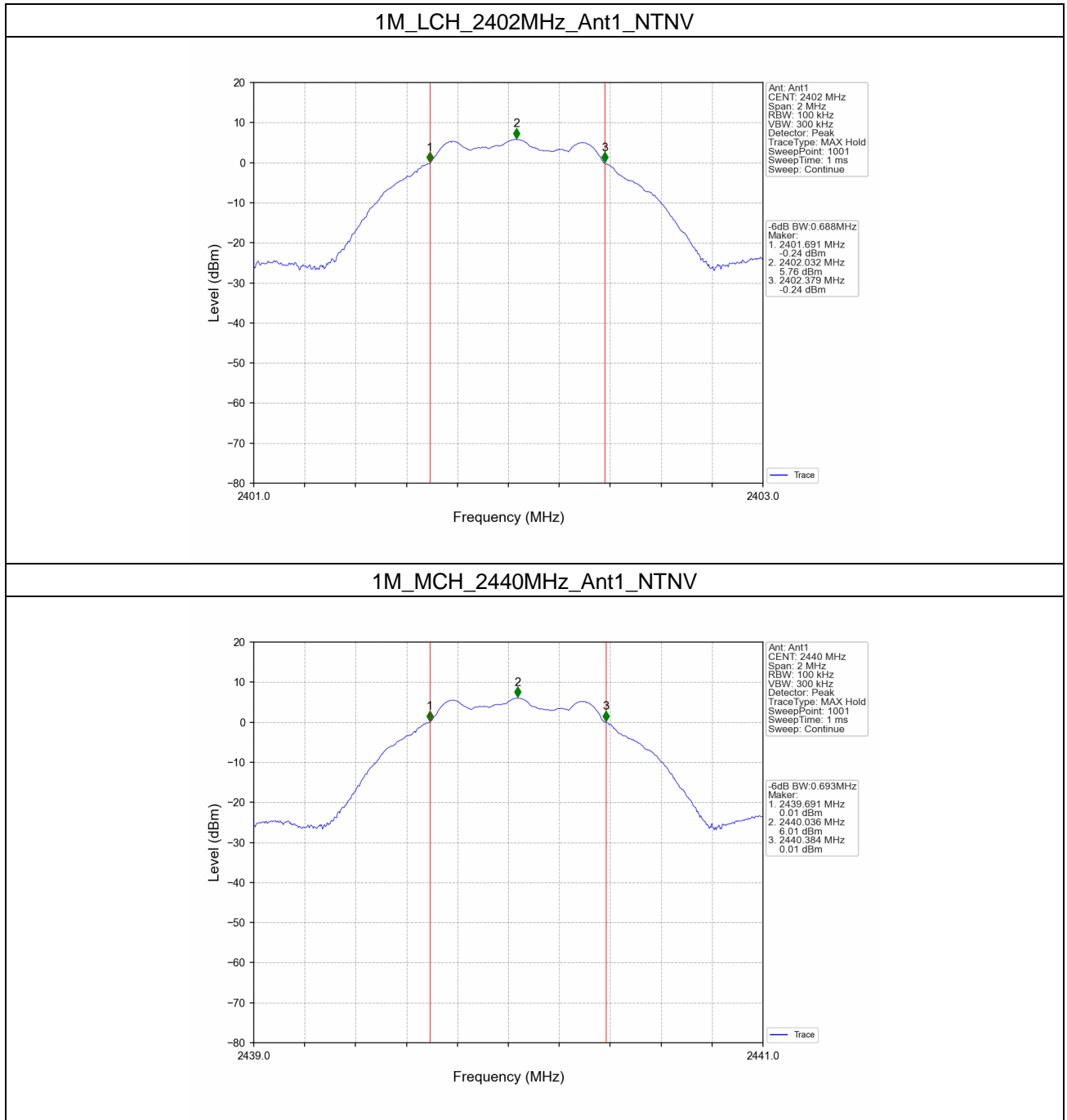
1.1 6dB BW

1.1.1 Test Result

Mode	TX Type	Frequency (MHz)	ANT	6dB Bandwidth (MHz)		Verdict
				Result	Limit	
1M	SISO	2402	1	0.688	≥ 0.5	Pass
		2440	1	0.693	≥ 0.5	Pass
		2480	1	0.684	≥ 0.5	Pass
2M	SISO	2402	1	1.156	≥ 0.5	Pass
		2440	1	1.157	≥ 0.5	Pass
		2480	1	1.158	≥ 0.5	Pass



1.1.2 Test Graph



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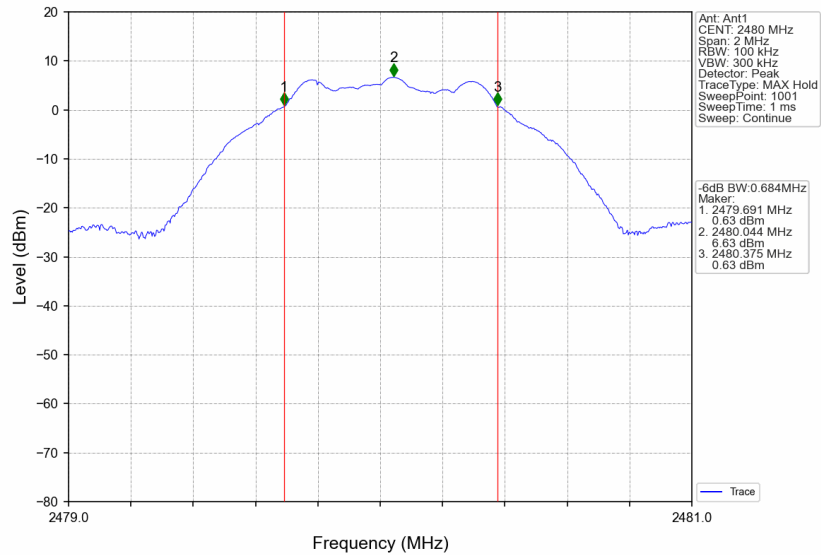
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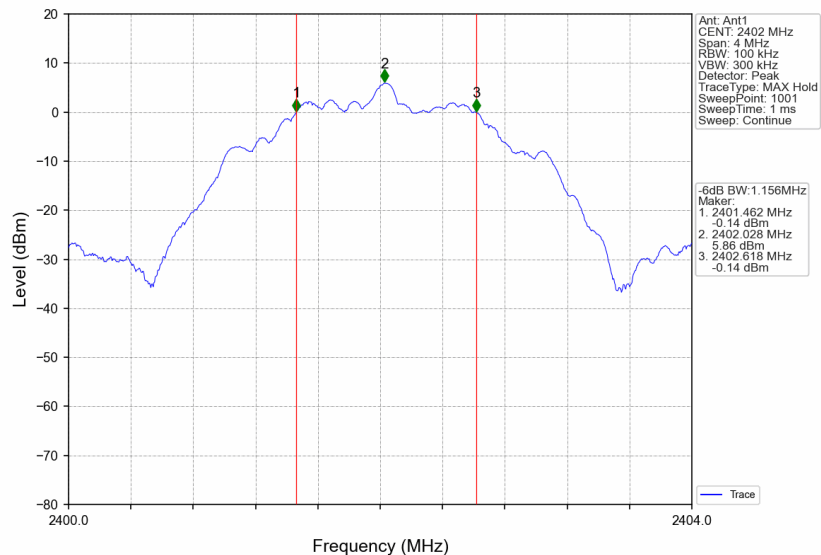
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1M_HCH_2480MHz_Ant1_NTNV



2M_LCH_2402MHz_Ant1_NTNV



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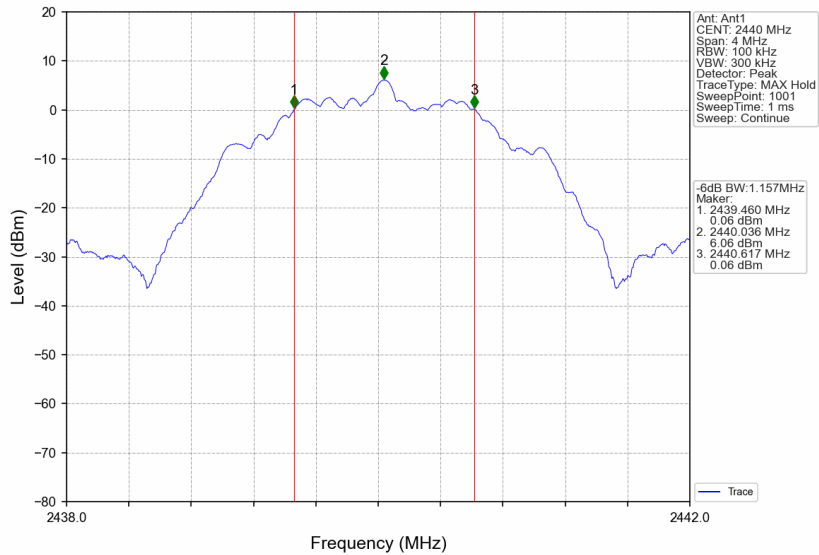
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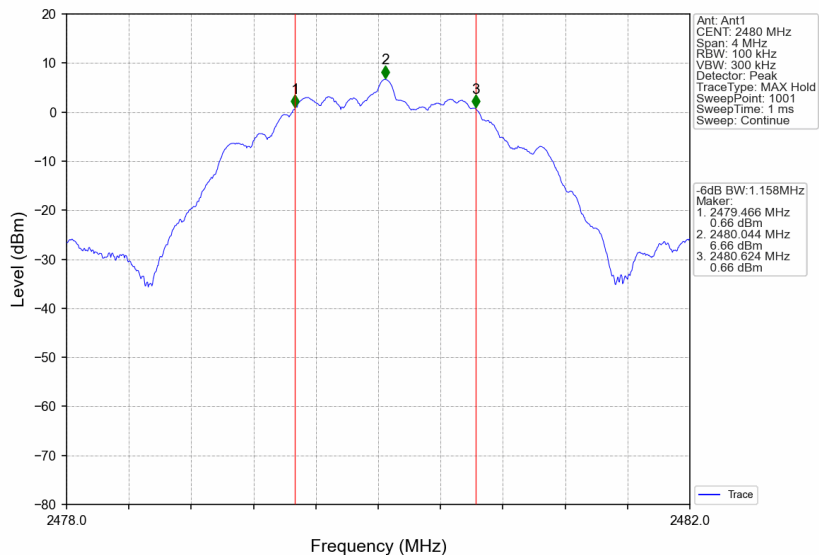
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2M_MCH_2440MHz_Ant1_NTNV



2M_HCH_2480MHz_Ant1_NTNV



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2. Maximum Conducted Output Power

2.1 Power

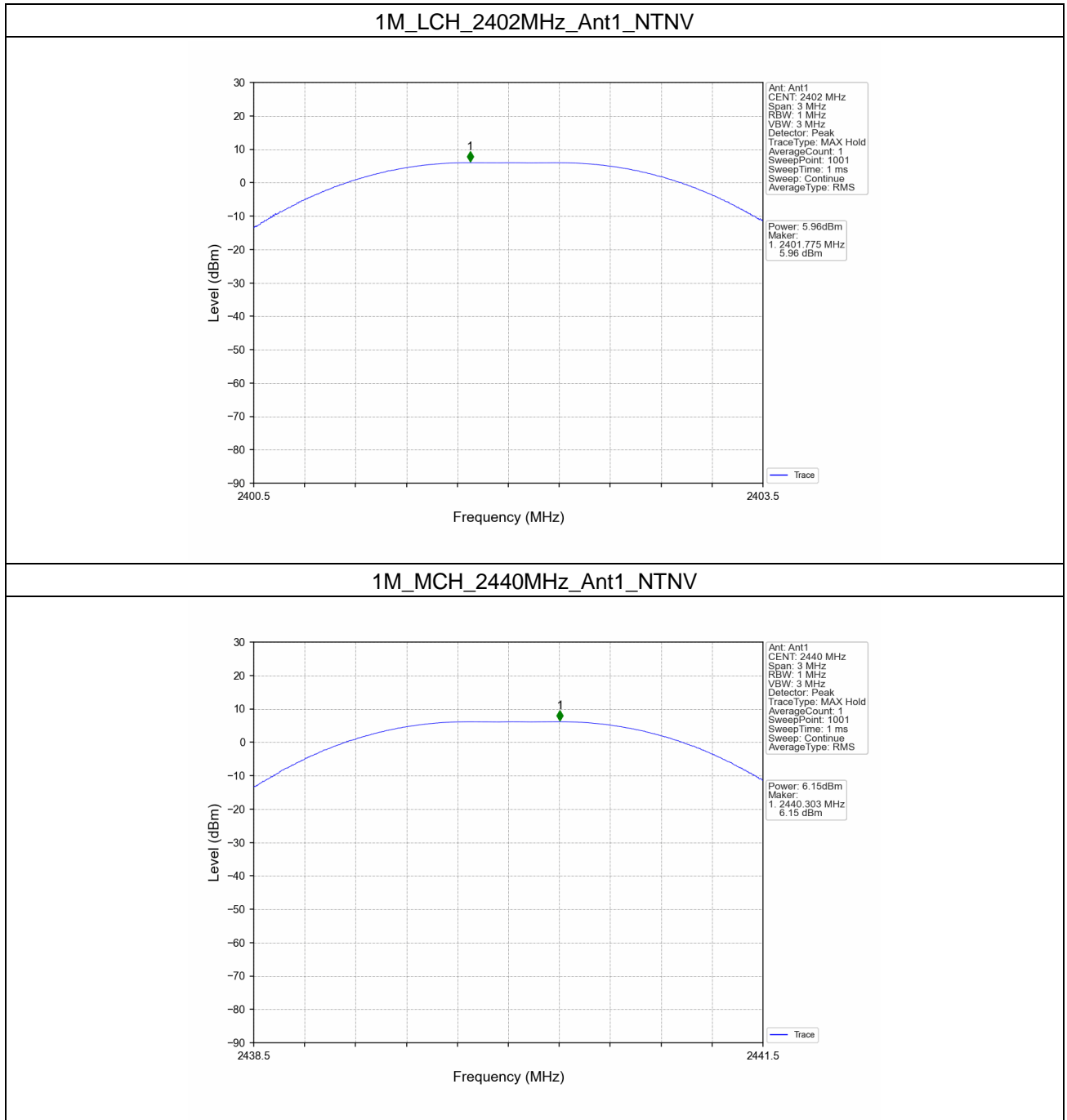
2.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)		Verdict
			ANT1	Limit	
1M	SISO	2402	5.96	<=30	Pass
		2440	6.15	<=30	Pass
		2480	6.76	<=30	Pass
2M	SISO	2402	5.99	<=30	Pass
		2440	6.16	<=30	Pass
		2480	6.77	<=30	Pass

Note1: Antenna Gain: Ant1: -3.80dBi;



2.1.2 Test Graph



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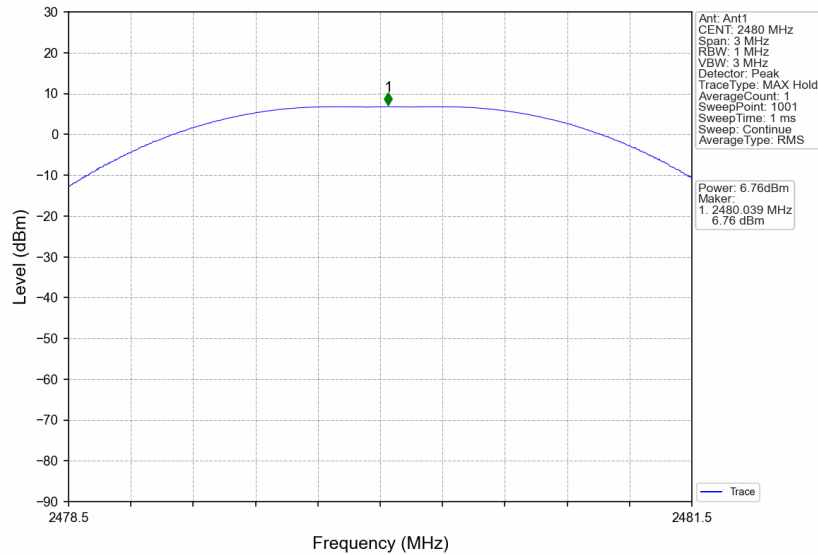
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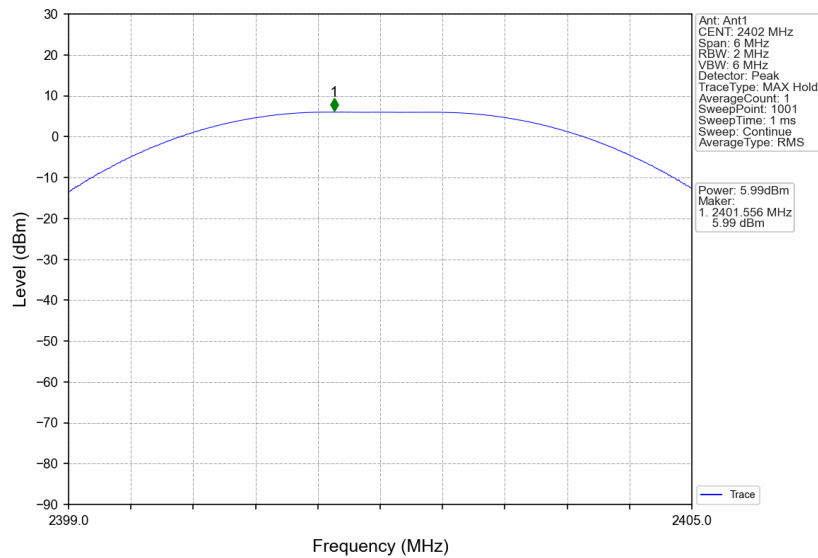
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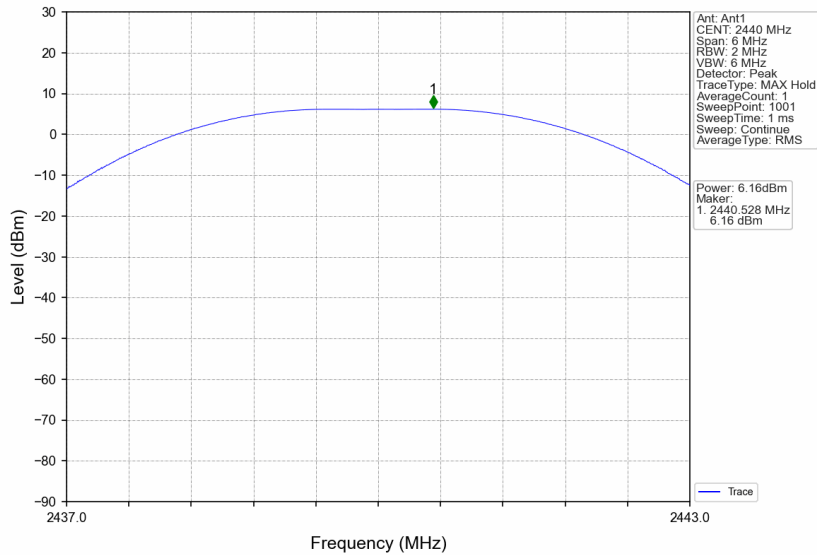
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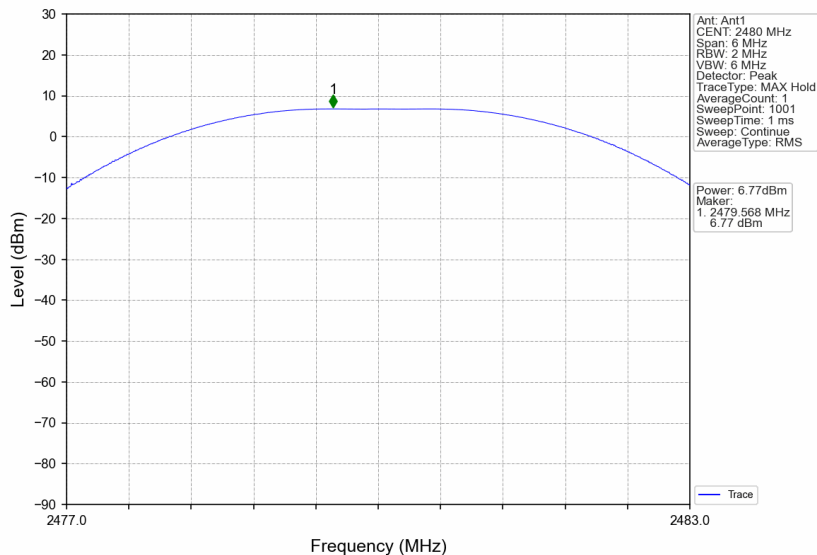
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- End of the Report -



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