

TEST REPORT

Application No.: GZCR2110021188AT
Applicant: Shantou Helicute Model Aircraft Industrial Co.,Ltd
Address of Applicant: Jiangbei Road, Longtian, Guangyi Street,Chenghai District,Chenghai,Shantou City,Guangdong, China
Manufacturer: Shantou Helicute Model Aircraft Industrial Co.,Ltd
Address of Manufacturer: Jiangbei Road, Longtian, Guangyi Street,Chenghai District,Chenghai,Shantou City,Guangdong, China
Factory: Shantou Helicute Model Aircraft Industrial Co.,Ltd
Address of Factory: Jiangbei Road, Longtian, Guangyi Street,Chenghai District,Chenghai,Shantou City,Guangdong, China

Equipment Under Test (EUT):

EUT Name: R/C DRONE

Model No.: H816HW, DRC-445, DRC-447, H05NL, H05NCL, H07NL, H07NCL, H09NL, H09NCL, M801R, M803R, H805, H805W, H806, H806W, H809HW, H809SW, H811C, H811W, H812R, S812, H815HW, H815SC, H815SW, H816H, H816HC, H817, H817C, H817W, H817H, H817HC, H817HW, H818H, H818HW, H818HC, H818S, H818SC, H818SW, H818HP, H818HPC, H818HPW, H819, H819HW, H820H, H820HC, H820HW, H821H, H821HC, H821HW, H822HW, H823, H823W, H823H, H823HW, H802G, H802W, H02G, H01C, H825, H825G, H825W, H826H, H826HW, H826HP, H826HPW, H827S, H827SC, H827SW, H828P, H828PC, H828PW, H829, H830, H831, H832, H833, H835, H836, H837, H838, H839, H850H, H851, H851SW, H851SPW, H852, H853H, H855HW, H856, H857, H858, H859HPW, H859HW, H860, H860HW, H860SW, H860SPW, H861G, H862, H863HW, H865HW, H866HW, H867HW, H868HW, 56814, NH530 ♣

♣ Please refer to section 2 of this report which indicates which model was actually tested and which were electrically identical.

Standard(s) : 47 CFR Part 15, Subpart C 15.249

Date of Receipt: 2021-09-24

Date of Test: 2021-09-26 to 2021-10-21

Date of Issue: 2021-10-21

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		2021-10-21		Original

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



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2 Test Summary

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

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
Radiated Emissions (below 1GHz)	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.4&6.5&6.6	47 CFR Part 15, Subpart C 15.209 & 15.249 (a),(d)	Pass
Radiated Emissions (above 1GHz)		ANSI C63.10 (2013) Section 6.4&6.5&6.6	47 CFR Part 15, Subpart C 15.209 & 15.249 (a),(d)	Pass
20dB Bandwidth		ANSI C63.10 (2013) Section 6.9	47 CFR Part 15, Subpart C 15.215	Pass
Field Strength of the Fundamental Signal (15.249(a))		ANSI C63.10 (2013) Section 6.5&6.6	47 CFR Part 15, Subpart C 15.249(a)	Pass
Restricted Band Around Fundamental Frequency		ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.205 & 15.249(d) & 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.

Declaration of EUT Family Grouping:

Model No.: H816HW, DRC-445, DRC-447, H05NL, H05NCL, H07NL, H07NCL, H09NL, H09NCL, M801R, M803R, H805, H805W, H806, H806W, H809HW, H809SW, H811C, H811W, H812R, S812, H815HW, H815SC, H815SW, H816H, H816HC, H817, H817C, H817W, H817H, H817HC, H817HW, H818H, H818HW, H818HC, H818S, H818SC, H818SW, H818HP, H818HPC, H818HPW, H819, H819HW, H820H, H820HC, H820HW, H821H, H821HC, H821HW, H822HW, H823, H823W, H823H, H823HW, H802G, H802W, H02G, H01C, H825, H825G, H825W, H826H, H826HW, H826HP, H826HPW, H827S, H827SC, H827SW, H828P, H828PC, H828PW, H829, H830, H831, H832, H833, H835, H836, H837, H838, H839, H850H, H851, H851SW, H851SPW, H852, H853H, H855HW, H856, H857, H858, H859HPW, H859HW, H860, H860HW, H860SW, H860SPW, H861G, H862, H863HW, H865HW, H866HW, H867HW, H868HW, 56814, NH530

Only the model H816HW was tested, since according to the declaration from the applicant, the electrical circuit design, PCB layout, components used and internal wiring and functions were identical for the above models, with only difference on packing, model and color.



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8 Test Setup Photo45

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4 General Information

4.1 Details of E.U.T.

Power supply: DC 6.0V (4*1.5V "AAA" Size Batteries)
 Antenna Gain: 2.5dBi
 Antenna Type: wire
 Modulation Type: GFSK
 Operation Frequency: 2416MHz to 2475MHz
 Number of Channels: 27

Channel list

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2416	11	2426	21	2469
2	2417	12	2427	22	2470
3	2418	13	2428	23	2471
4	2419	14	2450	24	2472
5	2420	15	2457	25	2473
6	2421	16	2458	26	2474
7	2422	17	2459	27	2475
8	2423	18	2463	28	
9	2424	19	2465	29	
10	2425	20	2468	30	

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
--	--	--	--
The EUT has been tested as an independent unit.			

4.3 Measurement Uncertainty

Test Item	Measurement Uncertainty
Radiated Emissions (below 1GHz)	5.06dB (30MHz-1GHz ; 3m) 4.46dB (30MHz-1GHz ; 10m)
Radiated Emissions (above 1GHz)	5.08dB (1GHz-6GHz); 5.14dB (above 6GHz)
20dB Bandwidth	± 3%
Field Strength of the Fundamental Signal (15.249(a))	± 4.5dB (Below 1GHz); ± 4.8dB (Above 1GHz)
Restricted Band Around Fundamental Frequency	± 4.5dB (Below 1GHz); ± 4.8dB (Above 1GHz)
<p>Remark:</p> <p>The U_{lab} (lab Uncertainty) is less than U_{cispr} (CISPR Uncertainty), so the test results</p> <ul style="list-style-type: none"> – 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. 	



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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

Radiated 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
EMI Test Receiver(1Hz-8GHz)	Rohde & Schwarz	ESW8	EMC2220	2021-05-26	2022-05-25

Radiated Emissions (above 1GHz)					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
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
EXA Signal Analyzer(10Hz-44GHz)	Keysight	N9010A	EMC2138	2021-09-16	2022-09-15
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
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A



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20 dB 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
MI CABLE	SGS-EMC	0.8M	EMC2137	2019-11-02	2021-11-01

Field Strength of the Fundamental Signal (15.249(a))					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
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
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
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2021-09-16	2022-09-15

Restricted Band Around Fundamental Frequency					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
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
EXA Signal Analyzer(10Hz-44GHz)	Keysight	N9010A	EMC2138	2021-09-16	2022-09-15
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
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A



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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



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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

15.203 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.

6.1.2 Conclusion

EUT Antenna:

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 2.5dBi.

Antenna location: Refer to Internal photos



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7 Radio Spectrum Matter Test Results

7.1 Radiated Emissions (below 1GHz)

Test Requirement 47 CFR Part 15, Subpart C 15.209 & 15.249 (a),(d)
 Test Method: ANSI C63.10 (2013) Section 6.4&6.5
 Measurement Distance: 3m

Limit:

Frequency(MHz)	Field strength (microvolts/meter)	Limit (dBuV/m)	Detector	Measurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	-	300
0.490-1.705	24000/F(kHz)	-	-	30
1.705-30	30	-	-	30
30-88	100	40.0	QP	3
88-216	150	43.5	QP	3
216-960	200	46.0	QP	3
960-1000	500	54.0	QP	3

7.1.1 E.U.T. Operation

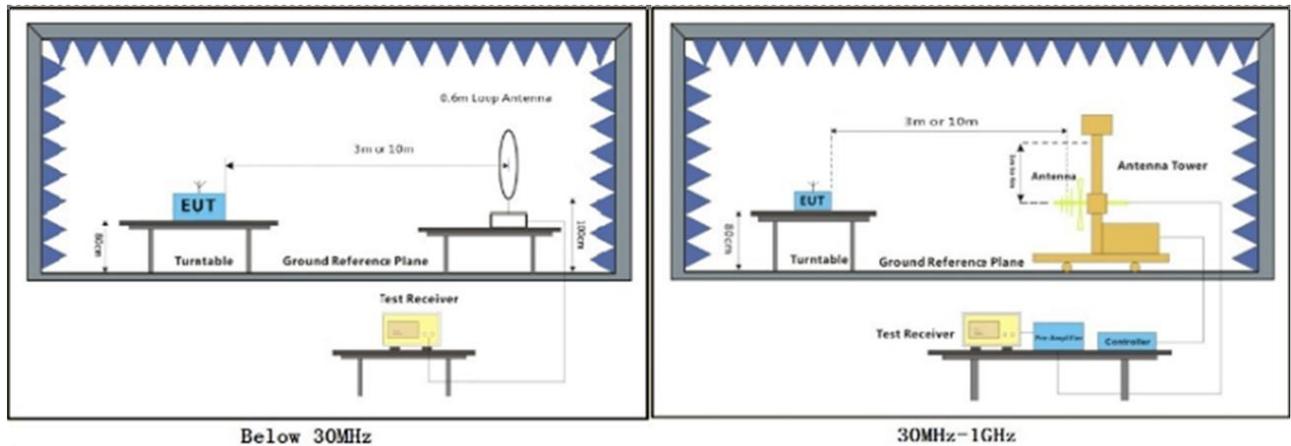
Operating Environment:

Temperature: 23.6 °C Humidity: 54.9 % RH Atmospheric Pressure: 1003 mbar

7.1.2 Test Mode Description

Pre-scan / Mode	Code	Description
Final test	00	TX mode_Keep the EUT in transmitting with modulation mode.

7.1.3 Test Setup Diagram



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7.1.4 Measurement Procedure and Data

- a. 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.

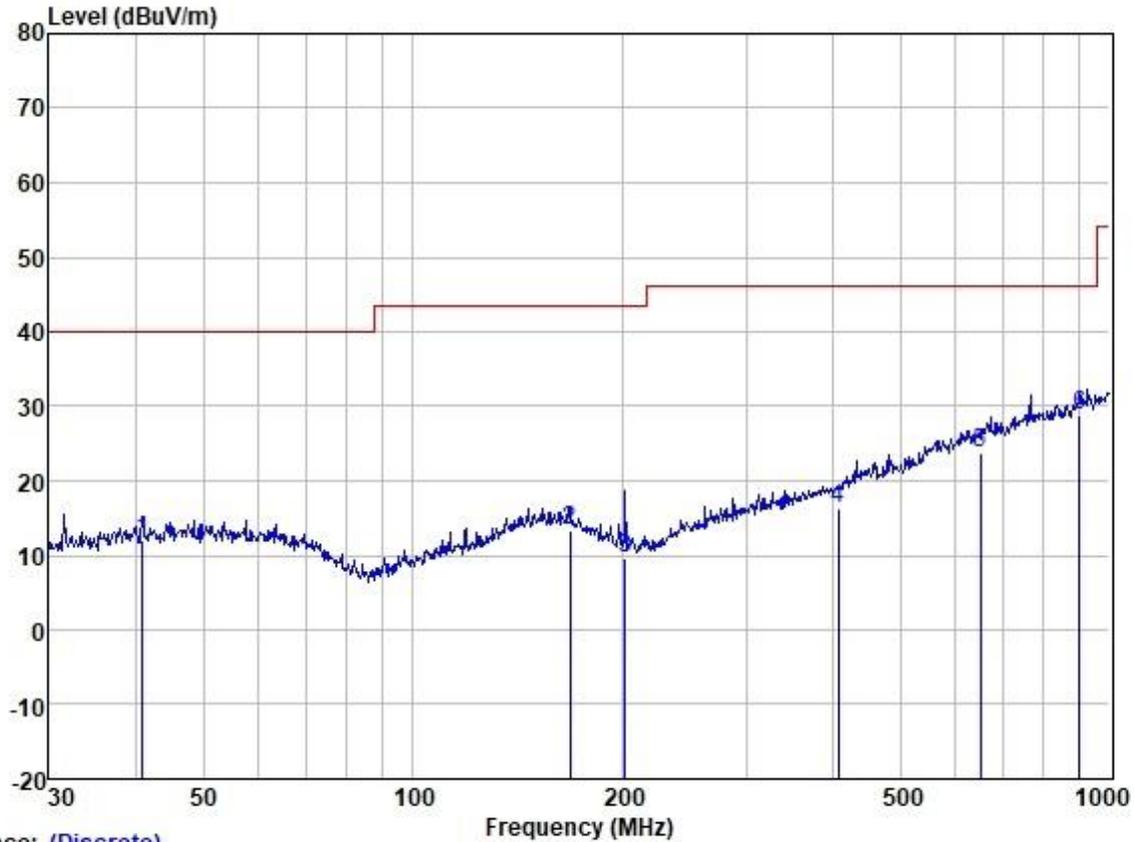
Remark:

- 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.



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



Trace: (Discrete)

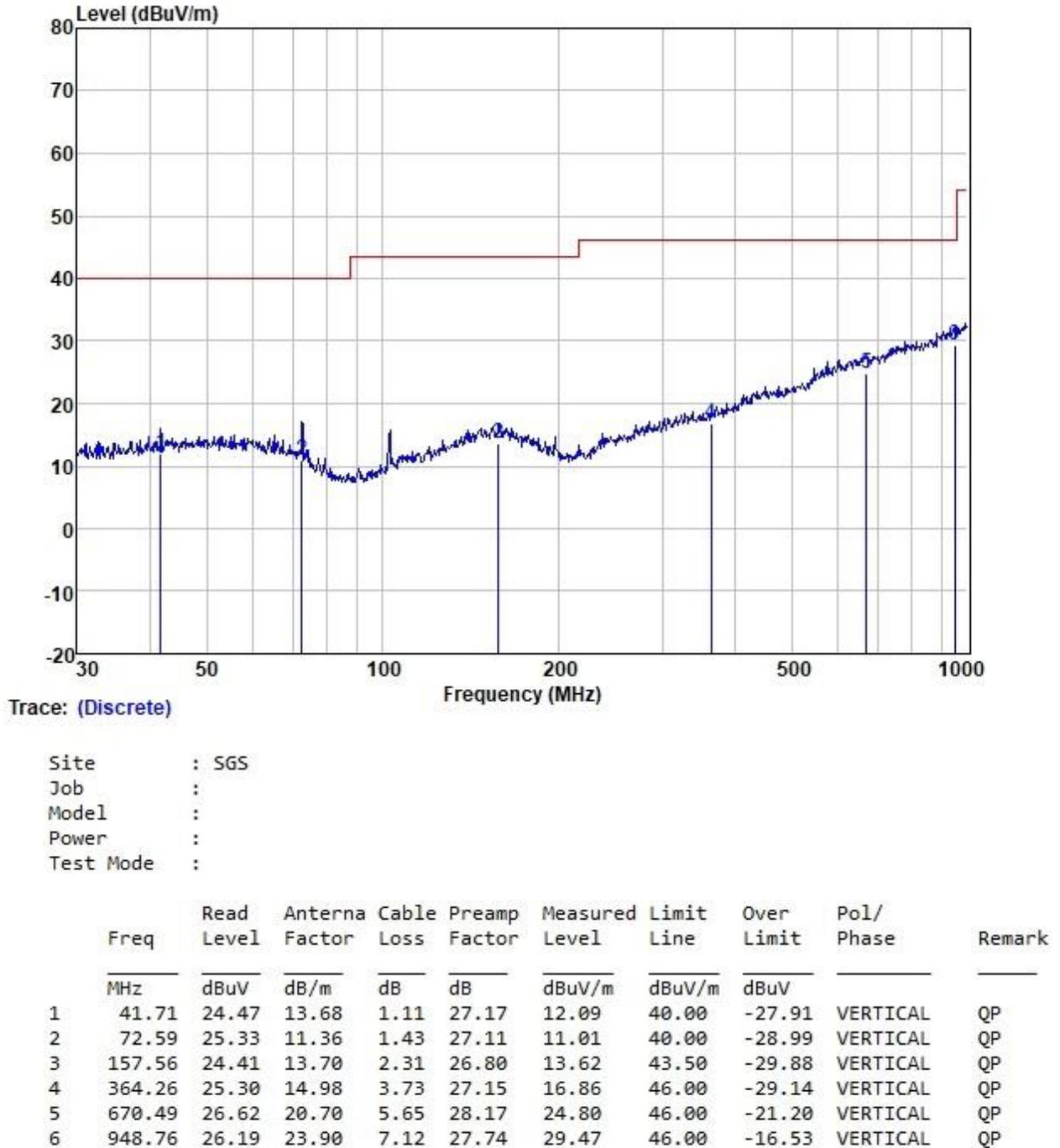
Site : SGS
Job :
Model :
Power :
Test Mode :

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Measured Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dBuV		
1	40.84	24.58	13.58	1.10	27.18	12.08	40.00	-27.92	HORIZONTAL	QP
2	167.82	24.57	13.30	2.38	26.78	13.47	43.50	-30.03	HORIZONTAL	QP
3	201.39	23.71	10.07	2.53	26.73	9.58	43.50	-33.92	HORIZONTAL	QP
4	407.51	23.83	15.85	3.97	27.36	16.29	46.00	-29.71	HORIZONTAL	QP
5	651.94	25.98	20.52	5.51	28.18	23.83	46.00	-22.17	HORIZONTAL	QP
6	903.31	26.33	23.33	6.92	27.84	28.74	46.00	-17.26	HORIZONTAL	QP



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



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7.2 Radiated Emissions (above 1GHz)

Test Requirement 47 CFR Part 15, Subpart C 15.209 & 15.249 (a),(d)
 Test Method: ANSI C63.10 (2013) Section 6.6
 Limit:

Frequency(MHz)	Field strength (microvolts/meter)	Limit (dBuV/m)	Detector	Measurement Distance (meters)
Above 1000	500	54.0	AV	3

7.2.1 E.U.T. Operation

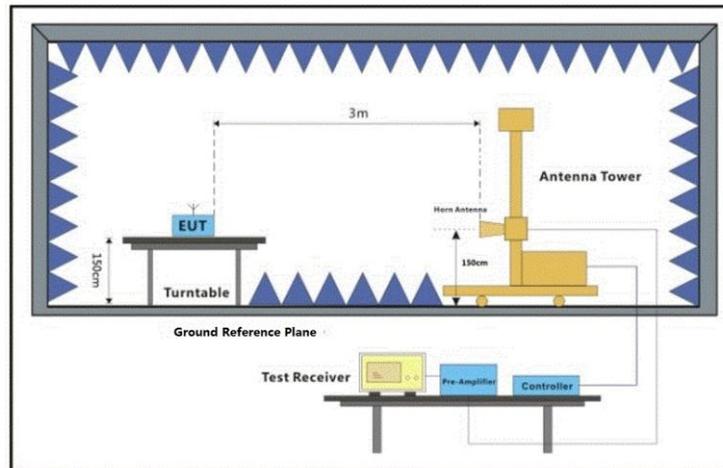
Operating Environment:

Temperature: 22.9 °C Humidity: 52.5 % RH Atmospheric Pressure: 1003 mbar

7.2.2 Test Mode Description

Pre-scan / Mode	Final test Code	Description
Final test	00	TX mode_Keep the EUT in transmitting with modulation mode.

7.2.3 Test Setup Diagram



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7.2.4 Measurement Procedure and Data

- a. 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 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 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.

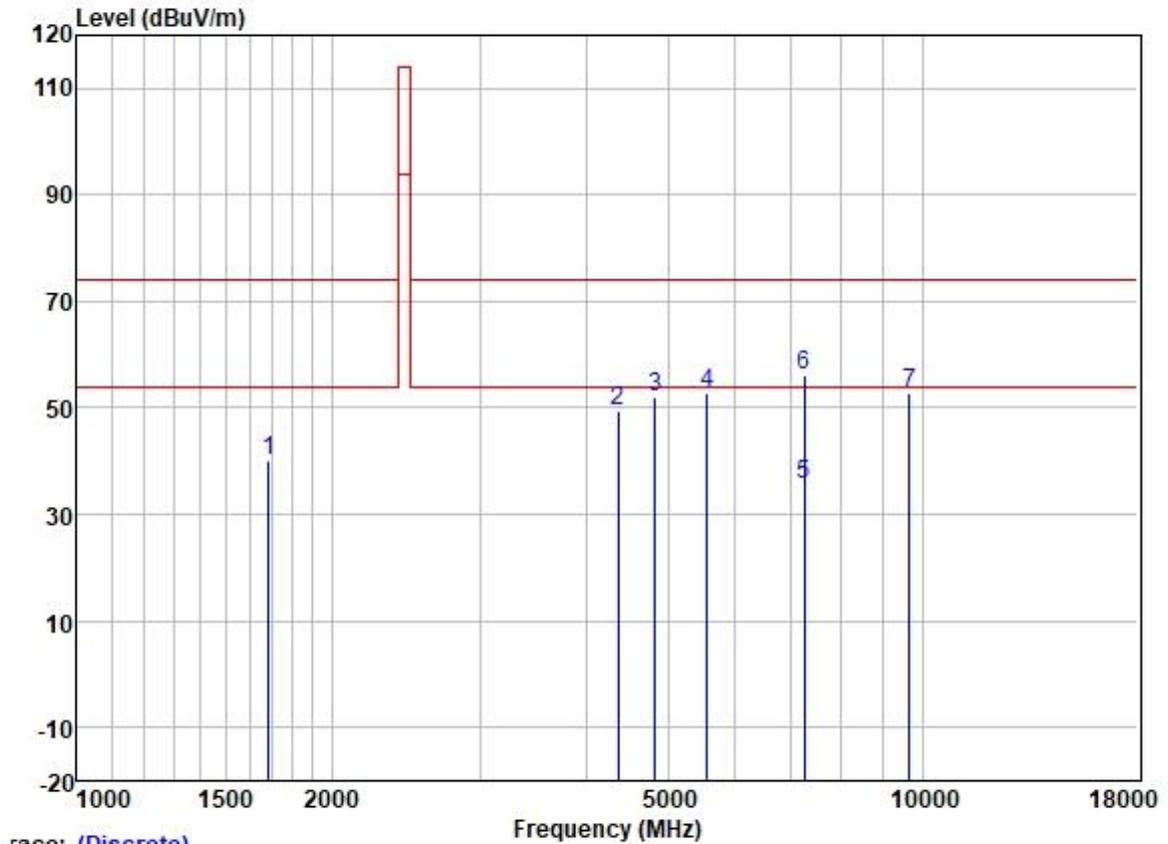
3) The field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only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



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



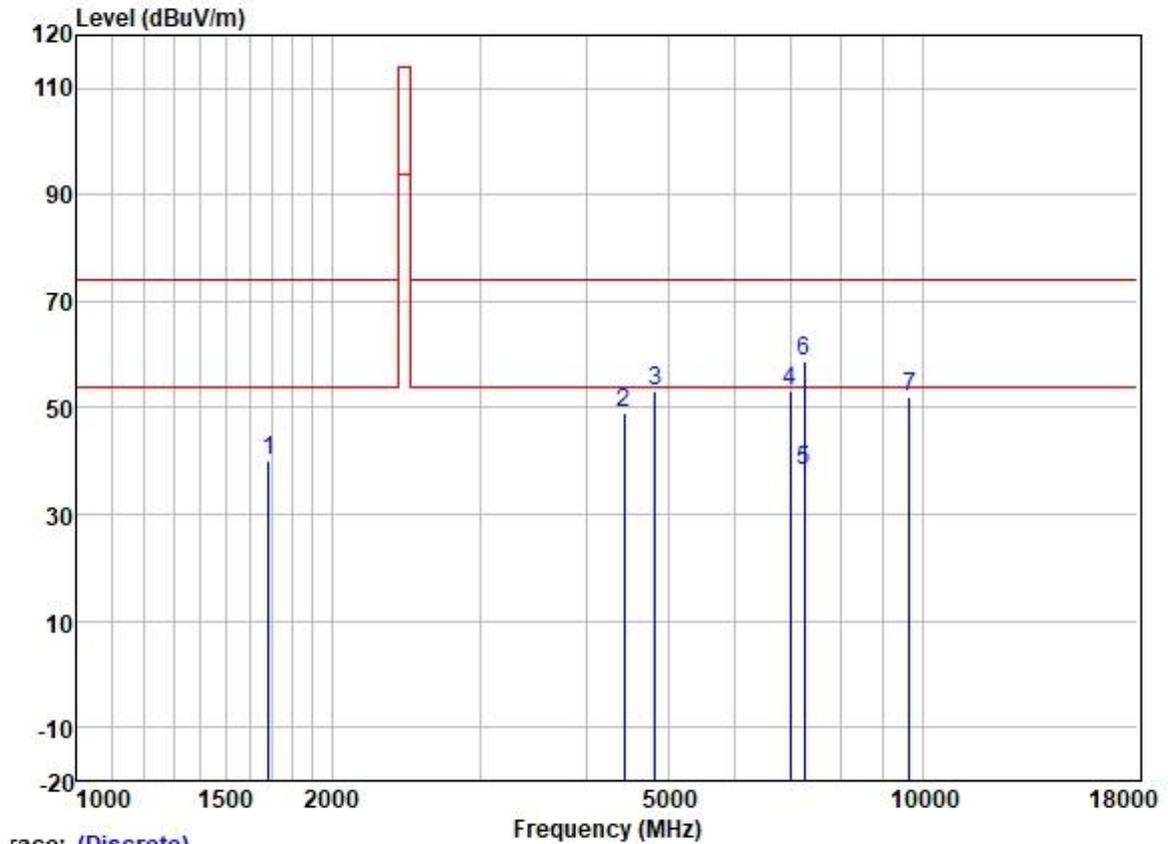
Trace: (Discrete)

	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	1687.347	49.62	25.69	2.80	37.91	40.20	74.00	-33.80	HORIZONTAL	Peak
2	4367.058	50.97	30.62	4.68	36.81	49.46	74.00	-24.54	HORIZONTAL	Peak
3	4832.000	52.13	31.47	5.44	36.83	52.21	74.00	-21.79	HORIZONTAL	Peak
4	5567.137	51.33	31.86	6.33	36.89	52.63	74.00	-21.37	HORIZONTAL	Peak
5	7248.000	31.23	35.70	6.03	37.40	35.56	54.00	-18.44	HORIZONTAL	Average
6	7248.000	51.67	35.70	6.03	37.40	56.00	74.00	-18.00	HORIZONTAL	Peak
7	9664.000	44.80	38.42	7.05	37.42	52.85	74.00	-21.15	HORIZONTAL	Peak



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



Trace: (Discrete)

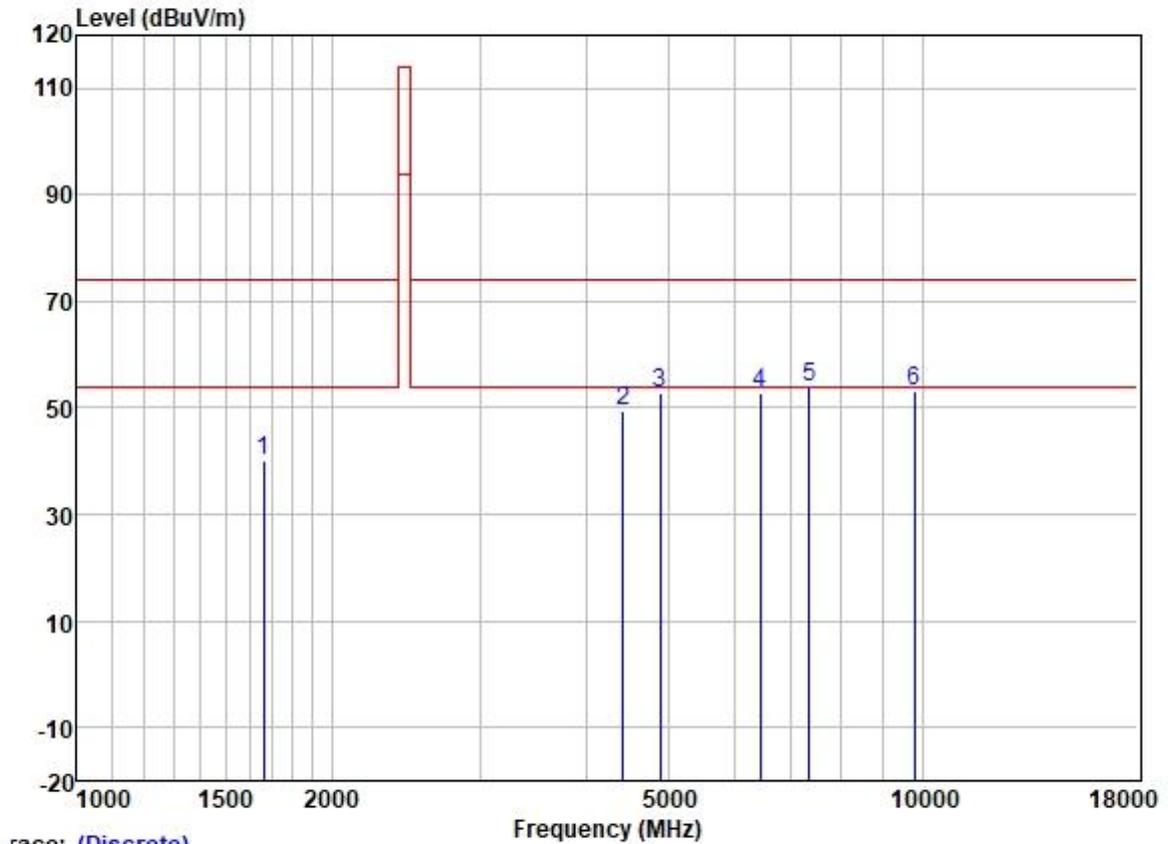
	Read	Antenna	Cable	Preamp		Limit	Over			
	Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	1687.347	49.61	25.69	2.80	37.91	40.19	74.00	-33.81	VERTICAL	Peak
2	4443.453	50.39	30.73	4.83	36.81	49.14	74.00	-24.86	VERTICAL	Peak
3	4832.000	52.97	31.47	5.44	36.83	53.05	74.00	-20.95	VERTICAL	Peak
4	6974.982	49.61	34.97	5.81	37.23	53.16	74.00	-20.84	VERTICAL	Peak
5	7248.000	34.04	35.70	6.03	37.40	38.37	54.00	-15.63	VERTICAL	Average
6	7248.000	54.48	35.70	6.03	37.40	58.81	74.00	-15.19	VERTICAL	Peak
7	9664.000	44.06	38.42	7.05	37.42	52.11	74.00	-21.89	VERTICAL	Peak



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



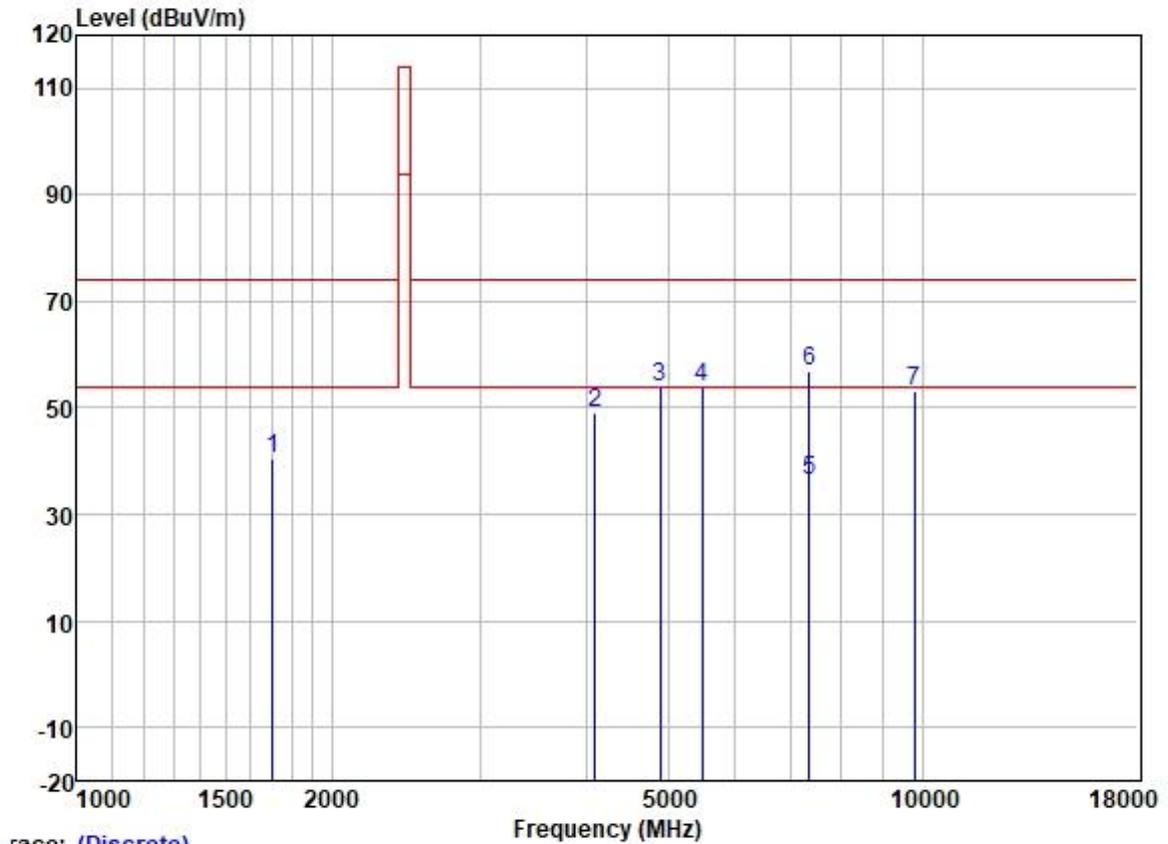
Trace: (Discrete)

	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	1663.137	49.71	25.65	2.80	37.91	40.25	74.00	-33.75	HORIZONTAL	Peak
2	4430.628	50.73	30.72	4.78	36.81	49.42	74.00	-24.58	HORIZONTAL	Peak
3	4900.000	52.63	31.58	5.55	36.84	52.92	74.00	-21.08	HORIZONTAL	Peak
4	6432.732	49.99	33.83	5.88	36.99	52.71	74.00	-21.29	HORIZONTAL	Peak
5	7350.000	49.15	36.06	6.15	37.44	53.92	74.00	-20.08	HORIZONTAL	Peak
6	9800.000	45.01	38.56	7.00	37.41	53.16	74.00	-20.84	HORIZONTAL	Peak



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



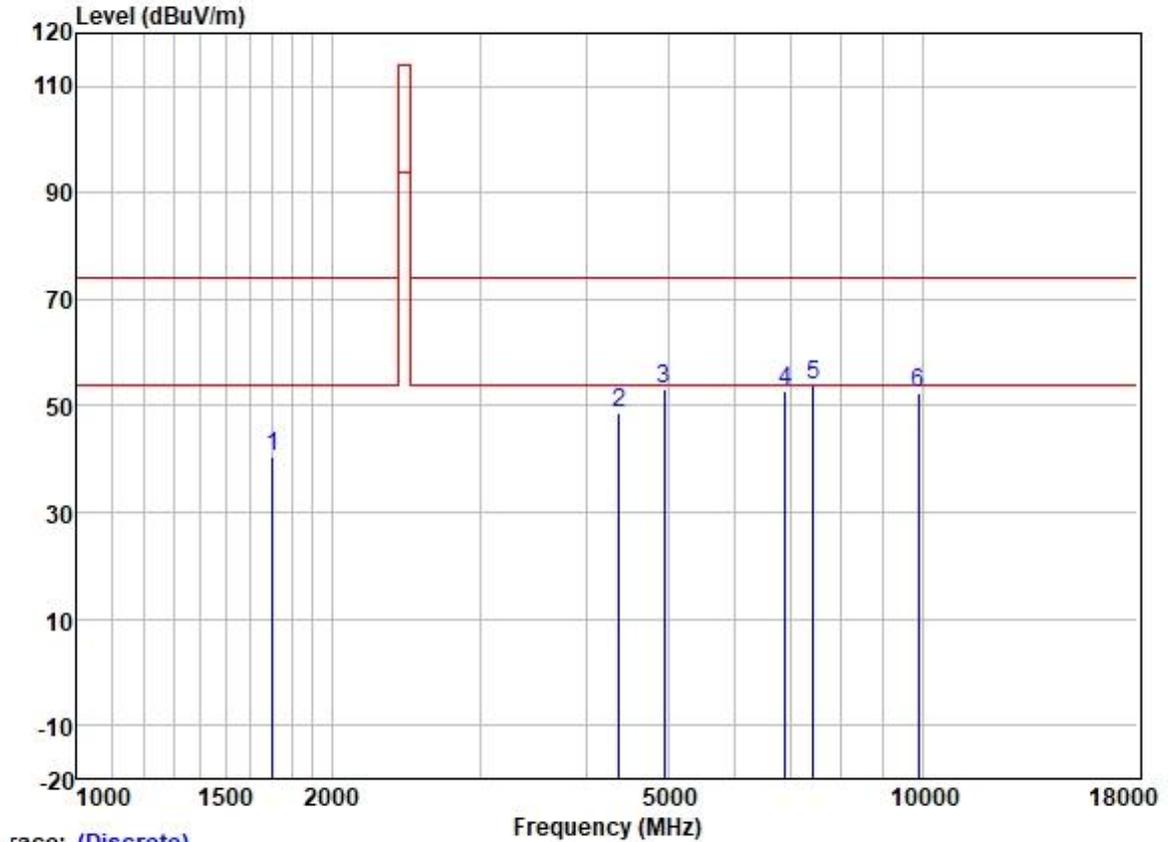
Trace: (Discrete)

	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	1702.042	49.75	25.72	2.80	37.89	40.38	74.00	-33.62	VERTICAL	Peak
2	4098.010	51.42	29.94	4.60	36.80	49.16	74.00	-24.84	VERTICAL	Peak
3	4900.000	53.67	31.58	5.55	36.84	53.96	74.00	-20.04	VERTICAL	Peak
4	5487.260	52.55	31.80	6.36	36.88	53.83	74.00	-20.17	VERTICAL	Peak
5	7350.000	31.60	36.06	6.15	37.44	36.37	54.00	-17.63	VERTICAL	Average
6	7350.000	52.04	36.06	6.15	37.44	56.81	74.00	-17.19	VERTICAL	Peak
7	9800.000	45.10	38.56	7.00	37.41	53.25	74.00	-20.75	VERTICAL	Peak



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



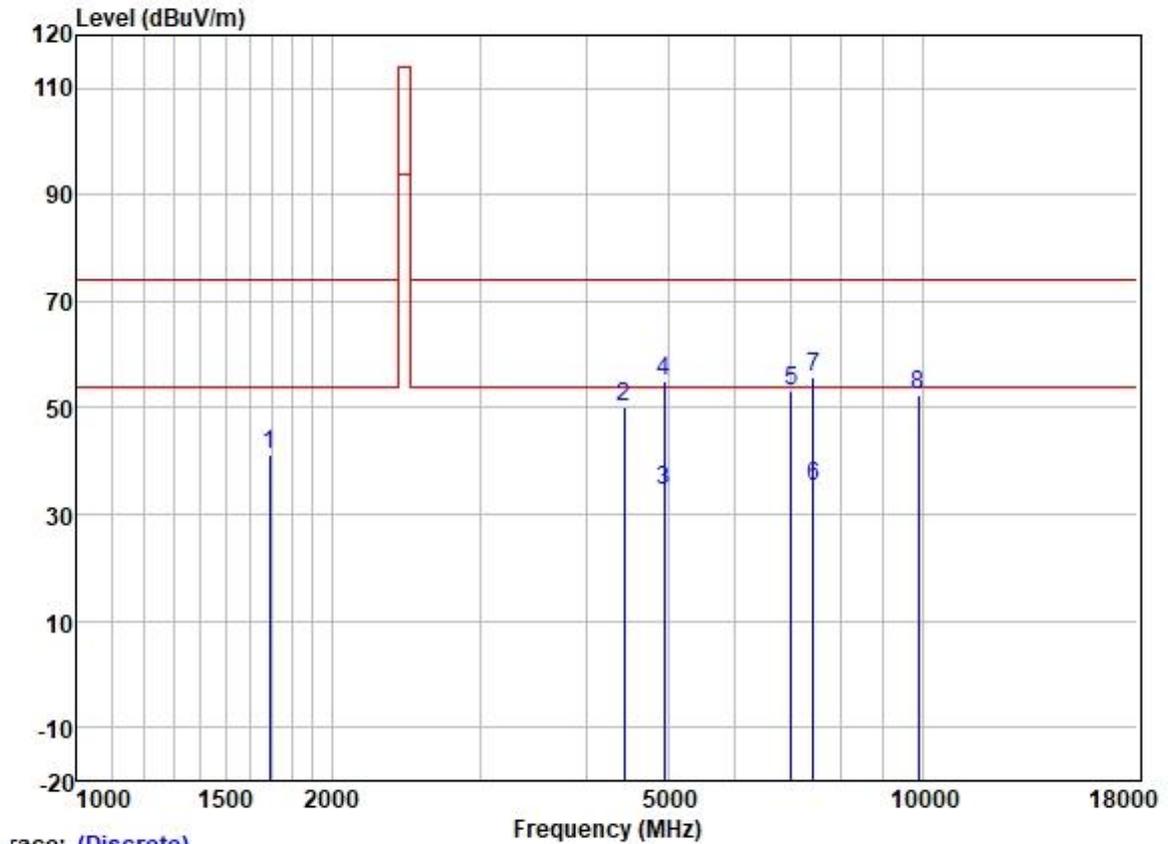
Trace: (Discrete)

	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	1702.042	49.95	25.72	2.80	37.89	40.58	74.00	-33.42	HORIZONTAL	Peak
2	4379.699	50.30	30.64	4.69	36.81	48.82	74.00	-25.18	HORIZONTAL	Peak
3	4950.000	52.92	31.64	5.62	36.84	53.34	74.00	-20.66	HORIZONTAL	Peak
4	6874.906	49.21	34.82	5.82	37.16	52.69	74.00	-21.31	HORIZONTAL	Peak
5	7425.000	48.73	36.27	6.22	37.47	53.75	74.00	-20.25	HORIZONTAL	Peak
6	9900.000	44.38	38.63	6.97	37.41	52.57	74.00	-21.43	HORIZONTAL	Peak



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Test Mode: 00; Polarity: Vertical; 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	1692.231	50.48	25.70	2.80	37.89	41.09	74.00	-32.91	VERTICAL	Peak
2	4443.453	51.40	30.73	4.83	36.81	50.15	74.00	-23.85	VERTICAL	Peak
3	4950.000	34.27	31.64	5.62	36.84	34.69	54.00	-19.31	VERTICAL	Average
4	4950.000	54.71	31.64	5.62	36.84	55.13	74.00	-18.87	VERTICAL	Peak
5	6995.172	49.68	35.00	5.81	37.25	53.24	74.00	-20.76	VERTICAL	Peak
6	7425.000	30.37	36.27	6.22	37.47	35.39	54.00	-18.61	VERTICAL	Average
7	7425.000	50.81	36.27	6.22	37.47	55.83	74.00	-18.17	VERTICAL	Peak
8	9900.000	44.39	38.63	6.97	37.41	52.58	74.00	-21.42	VERTICAL	Peak



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7.3 20dB Bandwidth

Test Requirement: 47 CFR Part 15, Subpart C 15.215
 Test Method: ANSI C63.10 (2013) Section 6.9
 Limit: N/A

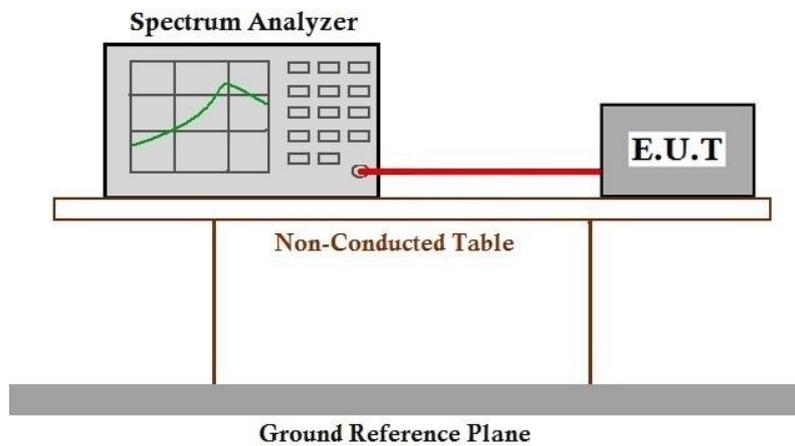
7.3.1 E.U.T. Operation

Operating Environment:
 Temperature: 24.1 °C Humidity: 56.3 % RH Atmospheric Pressure: 1003 mbar

7.3.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode_Keep the EUT in transmitting with modulation mode.

7.3.3 Test Setup Diagram



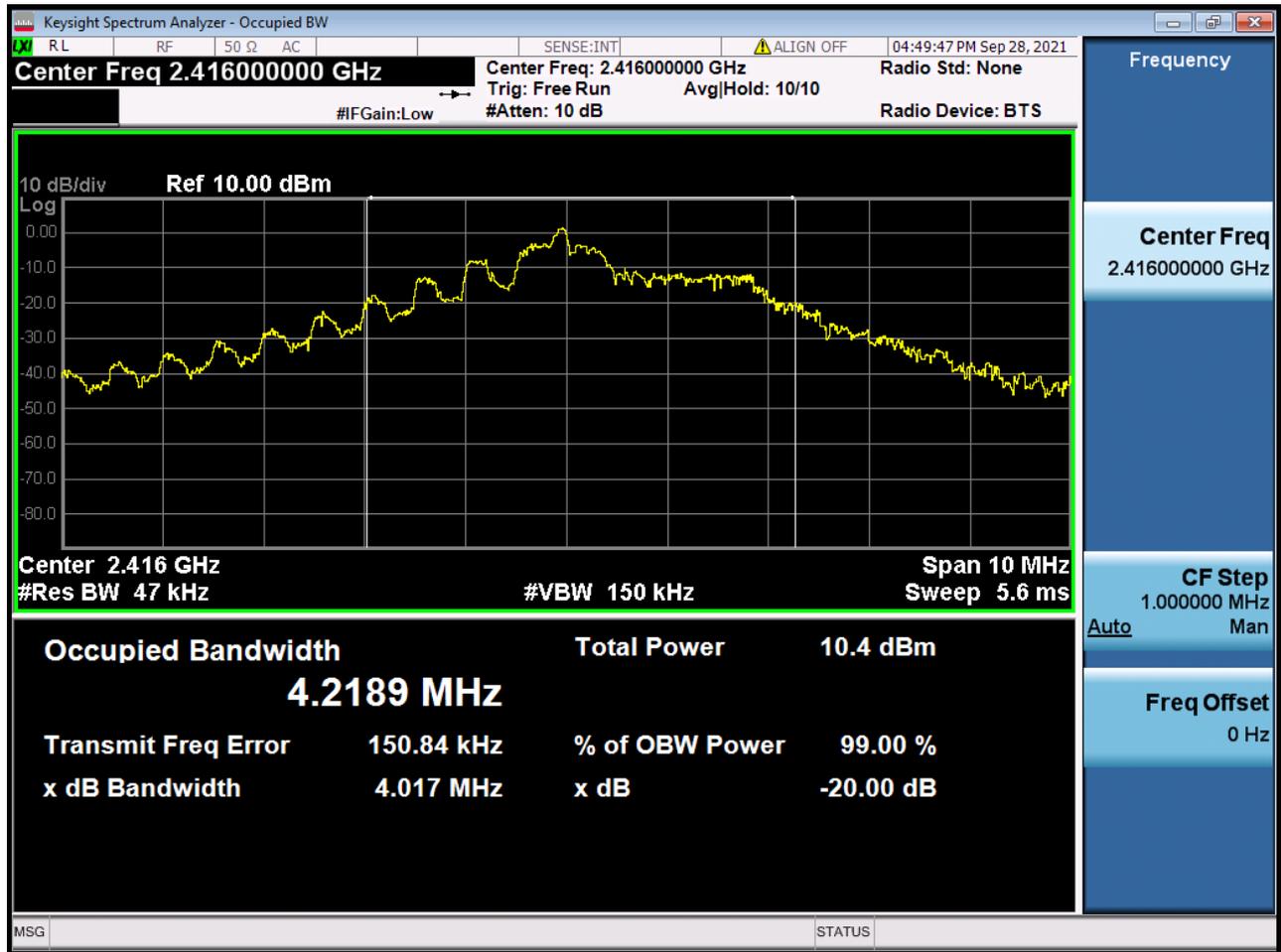
7.3.4 Measurement Procedure and Data

Test channel	20dB bandwidth (MHz)	Results
Lowest	4.017	Pass
Middle	4.159	Pass
Highest	3.894	Pass



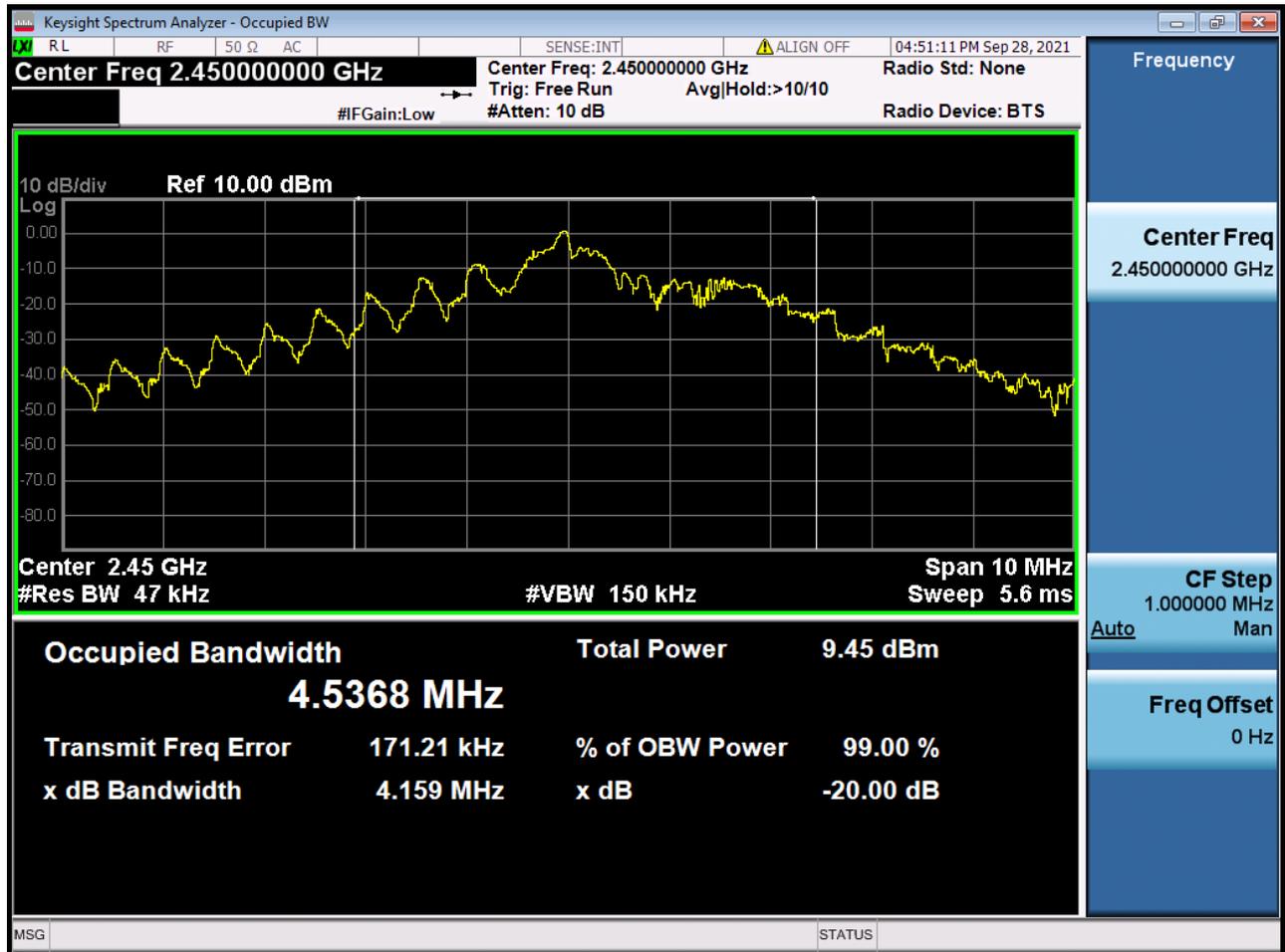
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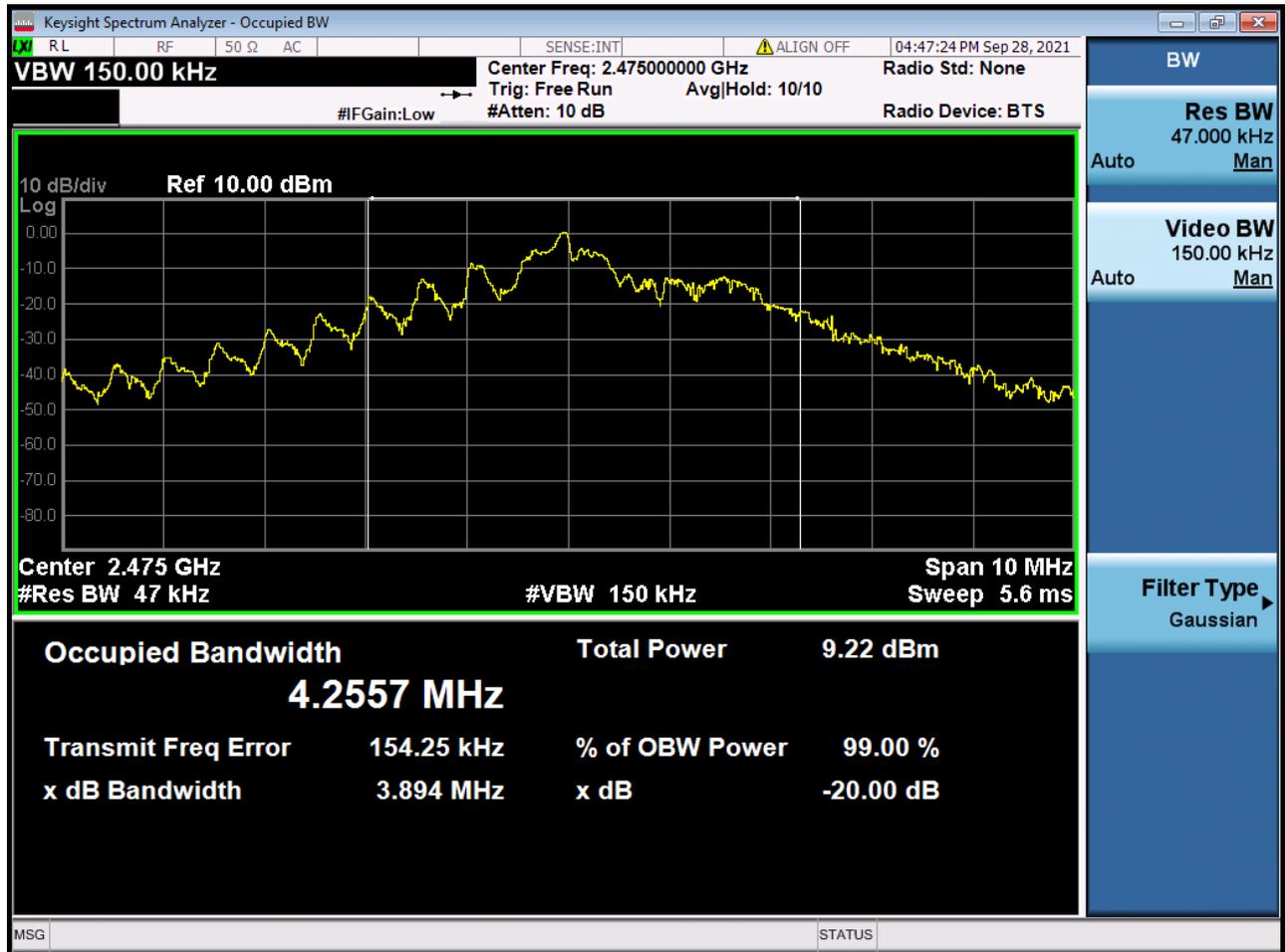
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7.4 Field Strength of the Fundamental Signal (15.249(a))

Test Requirement 47 CFR Part 15, Subpart C 15.249(a)
 Test Method: ANSI C63.10 (2013) Section 6.5&6.6
 Measurement Distance: 3m

Limit:

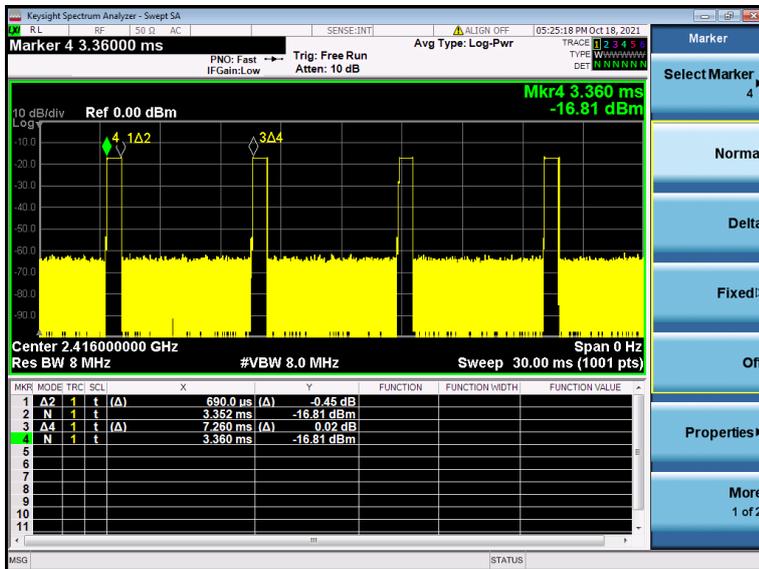
Fundamental frequency(MHz)	Field strength of fundamental(millivolts/meter)	Field strength of harmonics(microvolts/meter)
902-928	50	500
2400-2483.5	50	500
5725-5875	50	500
24000-24250	250	2500

Remark: The frequencies above 1000MHz 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 fundamental frequency in "902-928MHz", the field strength of fundamental is based on Quasi-Peak.

Average value:

Calculate Formula:	Average value=Peak value + PDCF
	PDCF=20 log(Duty cycle)
	Duty cycle= T on time / T period
Test data:	Ton time =0.69ms
	T period =7.26ms
	Duty cycle=9.50%
	PDCF value= -20.44dB



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7.4.1 E.U.T. Operation

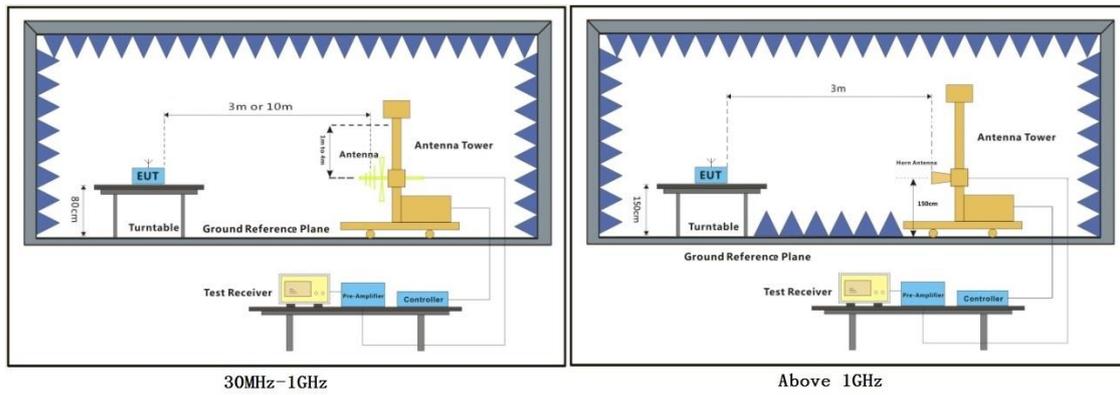
Operating Environment:

Temperature: 22.9 °C Humidity: 54.6 % RH Atmospheric Pressure: 1003 mbar

7.4.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode_Keep the EUT in transmitting with modulation mode.

7.4.3 Test Setup Diagram



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7.4.4 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.

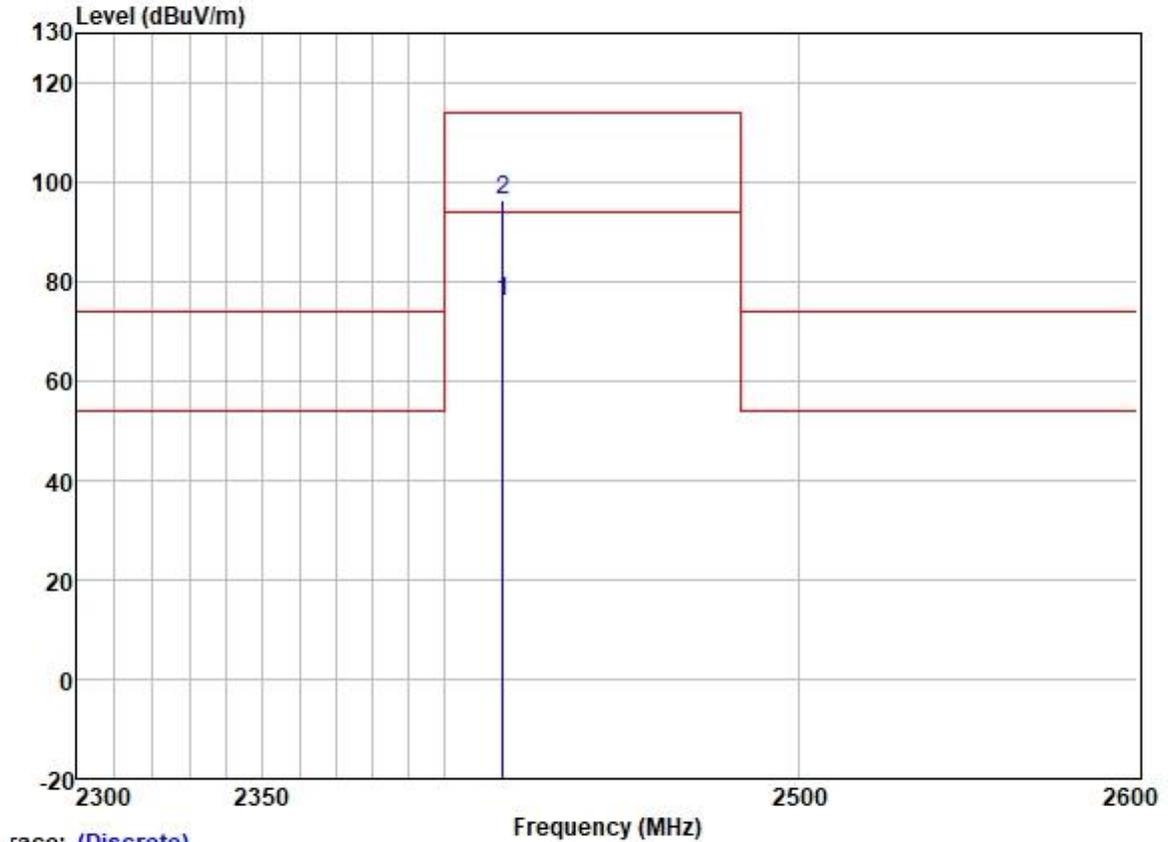
Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor



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



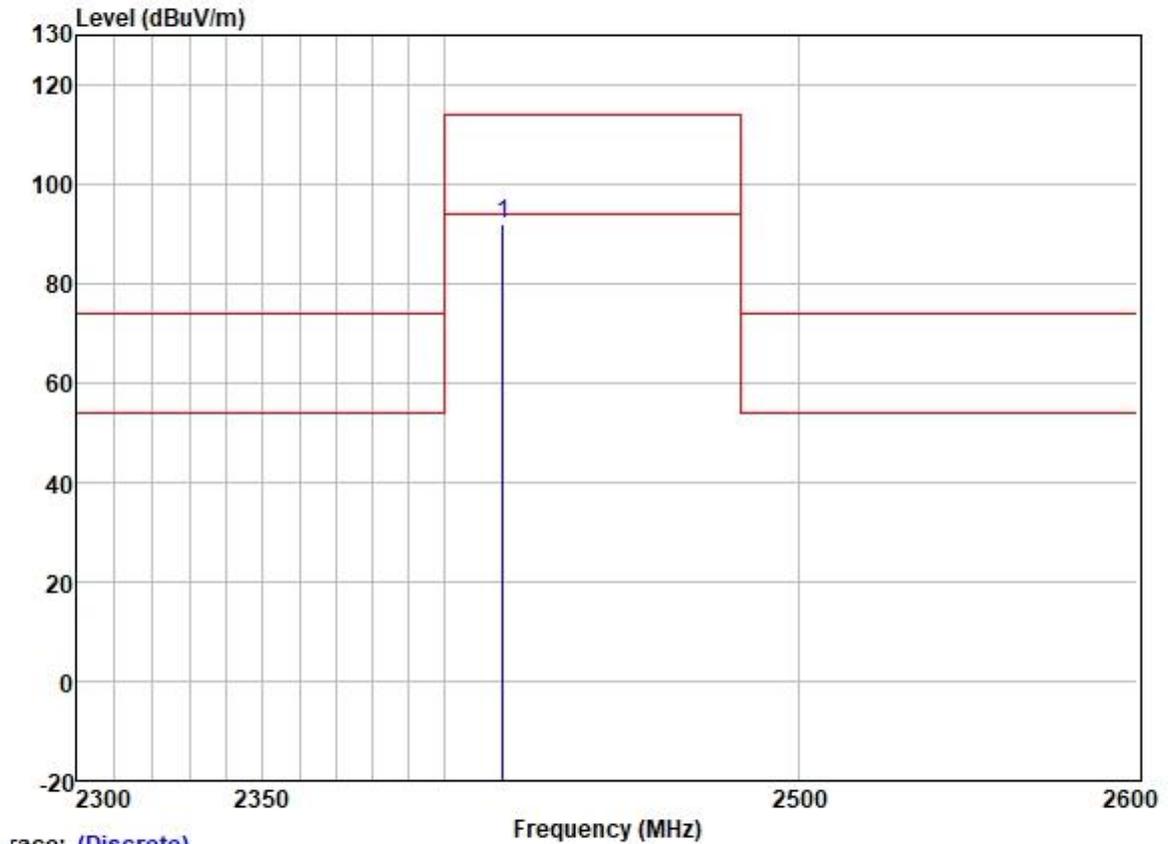
Trace: (Discrete)

	Read	Antenna	Cable	Preamp		Limit	Over		
	Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	2416.000	82.54	27.38	3.47	37.58	75.81	94.00	-18.19	HORIZONTAL Average
2	2416.000	102.98	27.38	3.47	37.58	96.25	114.00	-17.75	HORIZONTAL Peak



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



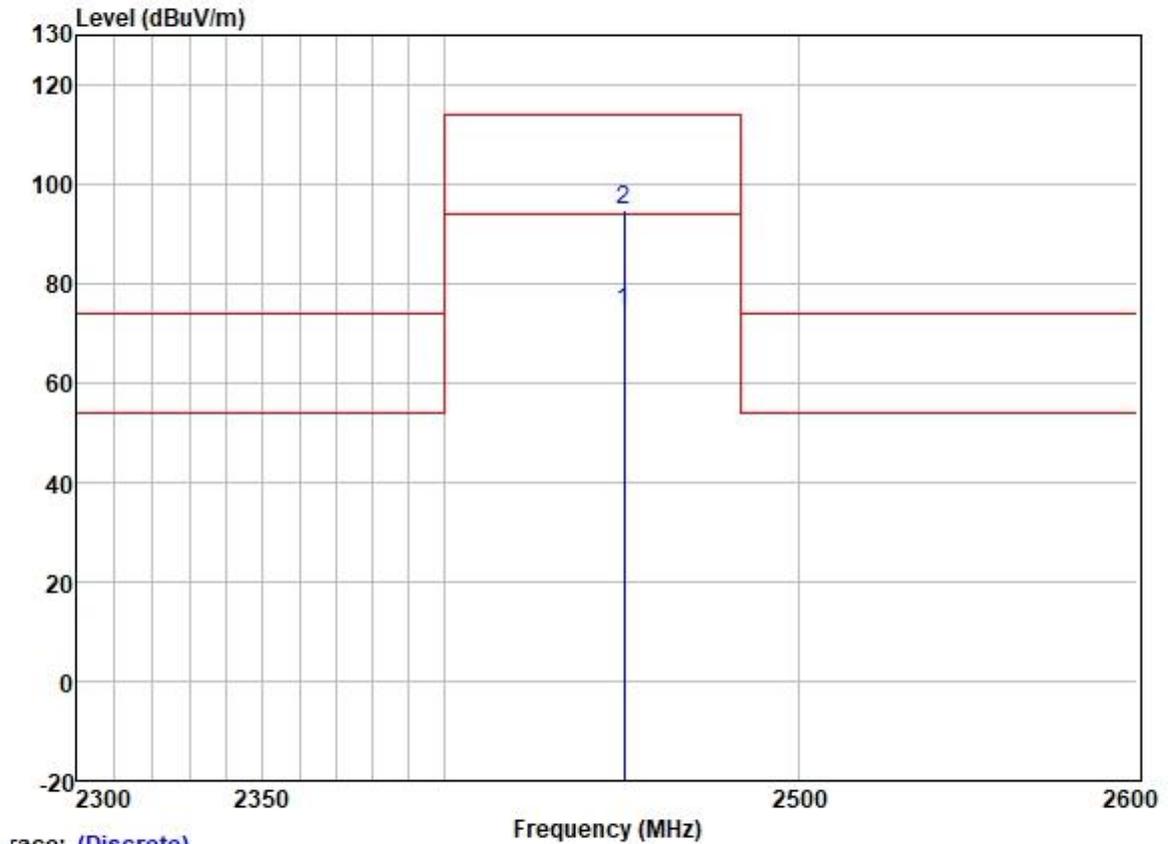
Trace: (Discrete)

	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	2416.000	98.58	27.38	3.47	37.58	91.85	114.00	-22.15	VERTICAL Peak



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



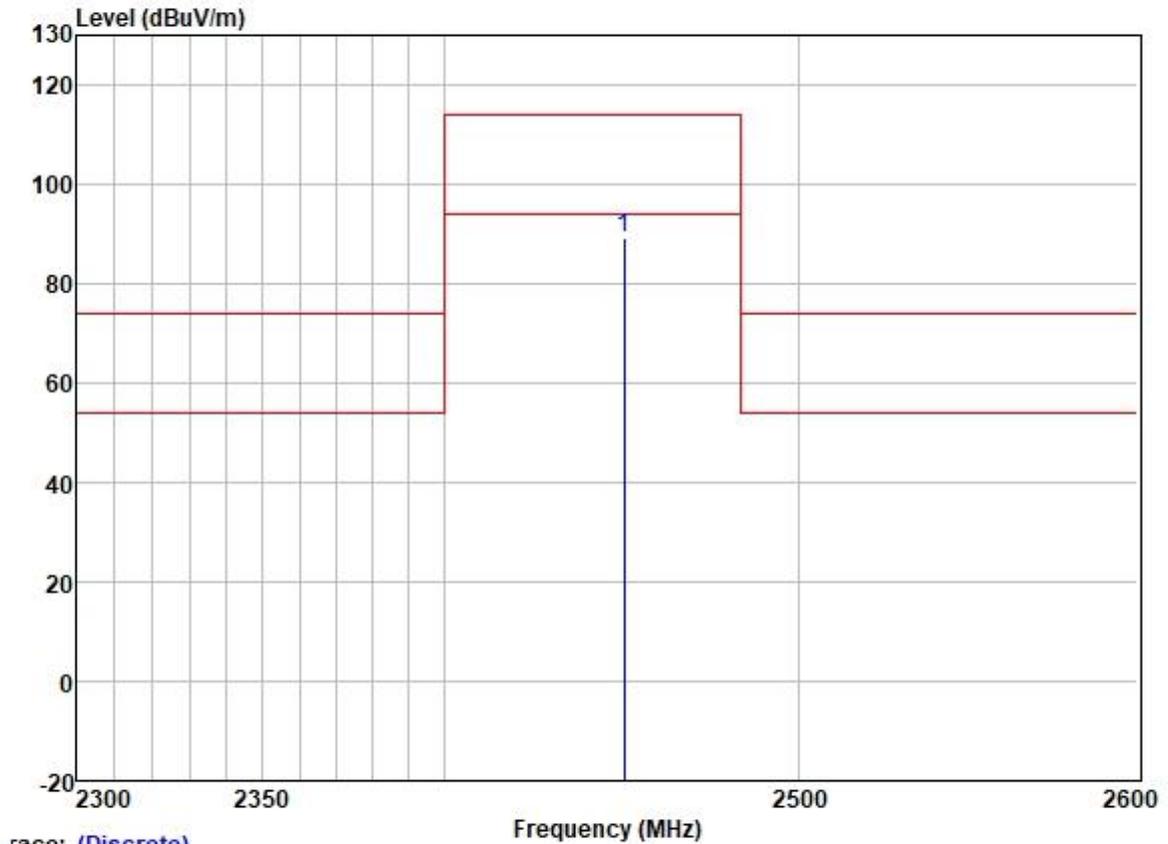
Trace: (Discrete)

	Read Freq	Antenna Level	Cable Factor	Preamp Loss	Limit Level	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB	
1	2450.000	81.25	27.43	3.40	37.58	74.50	94.00	-19.50 HORIZONTAL Average
2	2450.000	101.69	27.43	3.40	37.58	94.94	114.00	-19.06 HORIZONTAL Peak



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



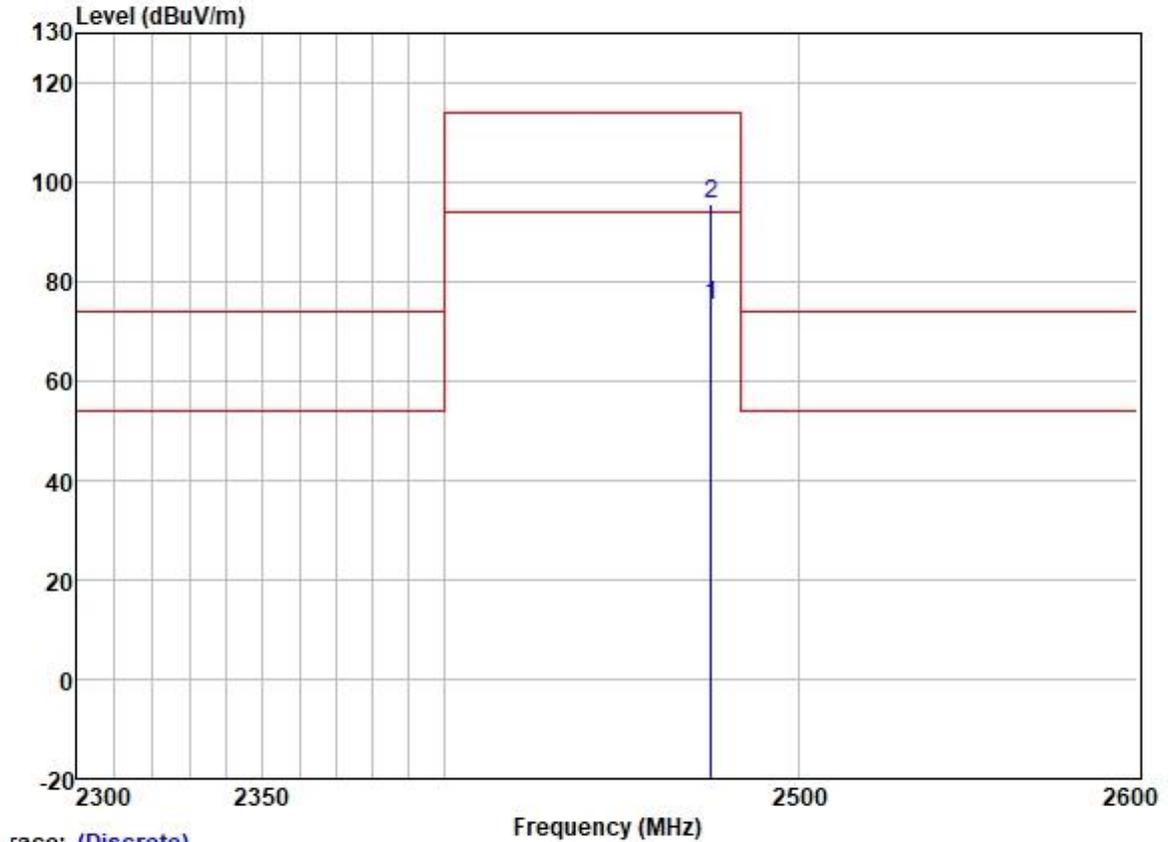
Trace: (Discrete)

	Read Freq	Antenna Level	Cable Loss	Preamp Factor	Limit Level	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB	
1	2450.000	95.93	27.43	3.40	37.58	89.18	114.00	-24.82 VERTICAL Peak



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



Trace: (Discrete)

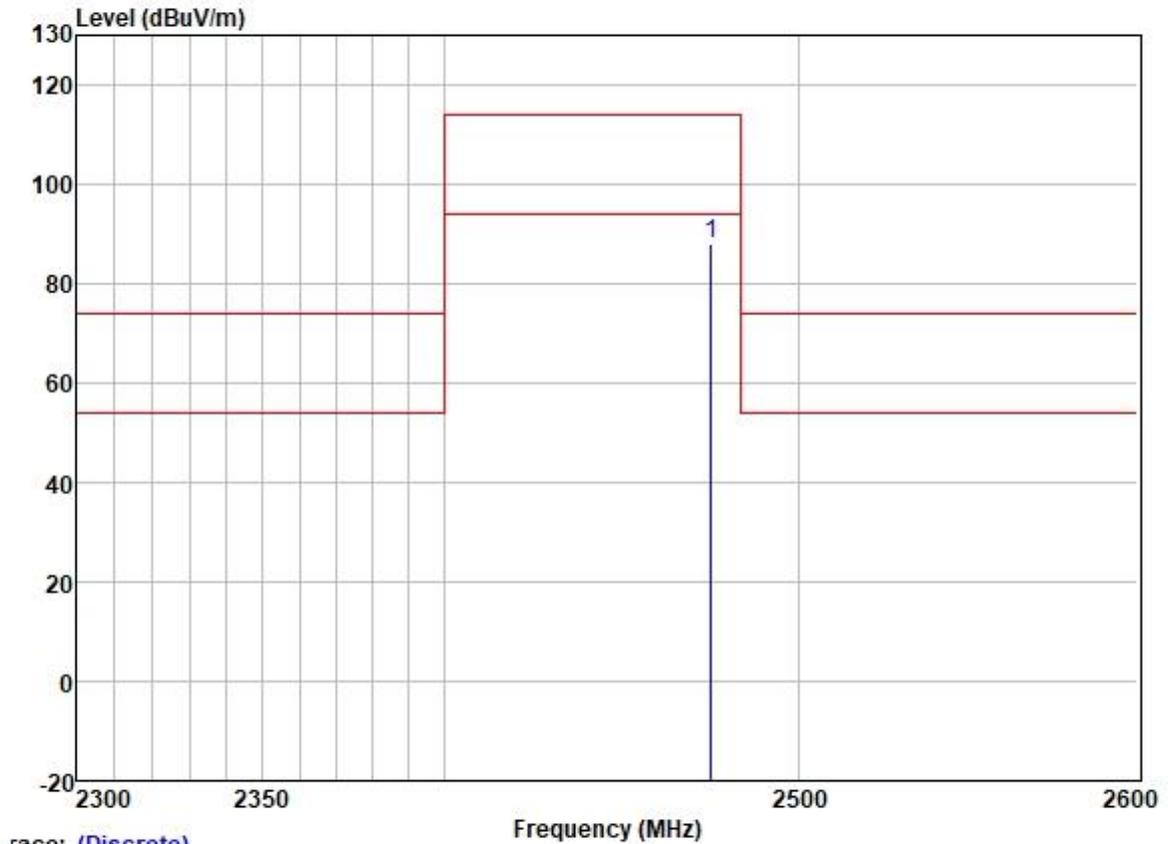
	Read	Antenna	Cable	Preamp		Limit	Over			
	Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2475.000	81.70	27.47	3.60	37.57	75.20	94.00	-18.80	HORIZONTAL	Average
2	2475.000	102.14	27.47	3.60	37.57	95.64	114.00	-18.36	HORIZONTAL	Peak



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Test Mode: 00; Polarity: Vertical; 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	2475.000	94.69	27.47	3.60	37.57	88.19	114.00	-25.81	VERTICAL Peak



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7.5 Restricted Band Around Fundamental Frequency

Test Requirement: 47 CFR Part 15, Subpart C 15.205 & 15.249(d) & 15.209
 Test Method: ANSI C63.10 (2013) Section 6.10.5
 Measurement Distance: 3m

Limit:

Frequency	Limit (dBuV/m @3m)	Remark
30MHz-88MHz	40.0	Quasi-peak Value
88MHz-216MHz	43.5	Quasi-peak Value
216MHz-960MHz	46.0	Quasi-peak Value
960MHz-1GHz	54.0	Quasi-peak Value
Above 1GHz	54.0	Average Value
Above 1GHz	74.0	Peak Value

Emission radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.

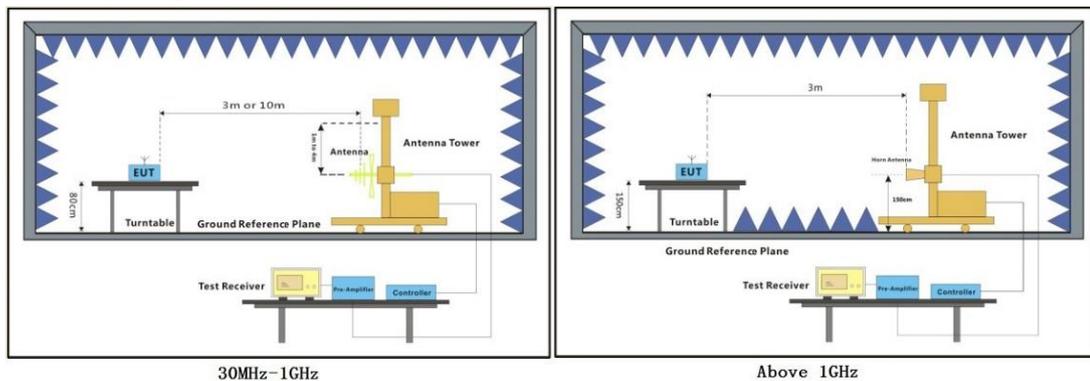
7.5.1 E.U.T. Operation

Operating Environment:
 Temperature: 22.9 °C Humidity: 54.6 % RH Atmospheric Pressure: 1003 mbar

7.5.2 Test Mode Description

Pre-scan / Mode	Description
Final test Code	
Final test 00	TX mode_Keep the EUT in transmitting with modulation mode.

7.5.3 Test Setup Diagram



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7.5.4 Measurement Procedure and Data

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

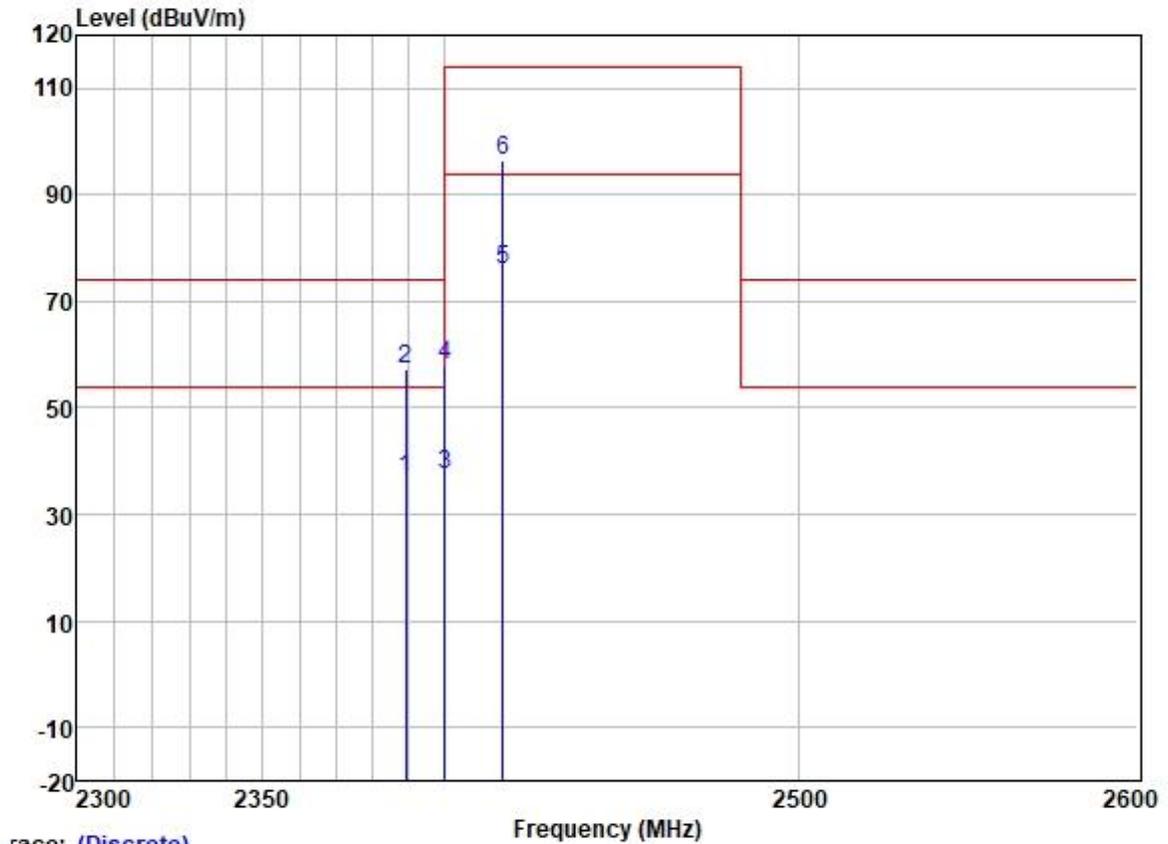
Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor



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



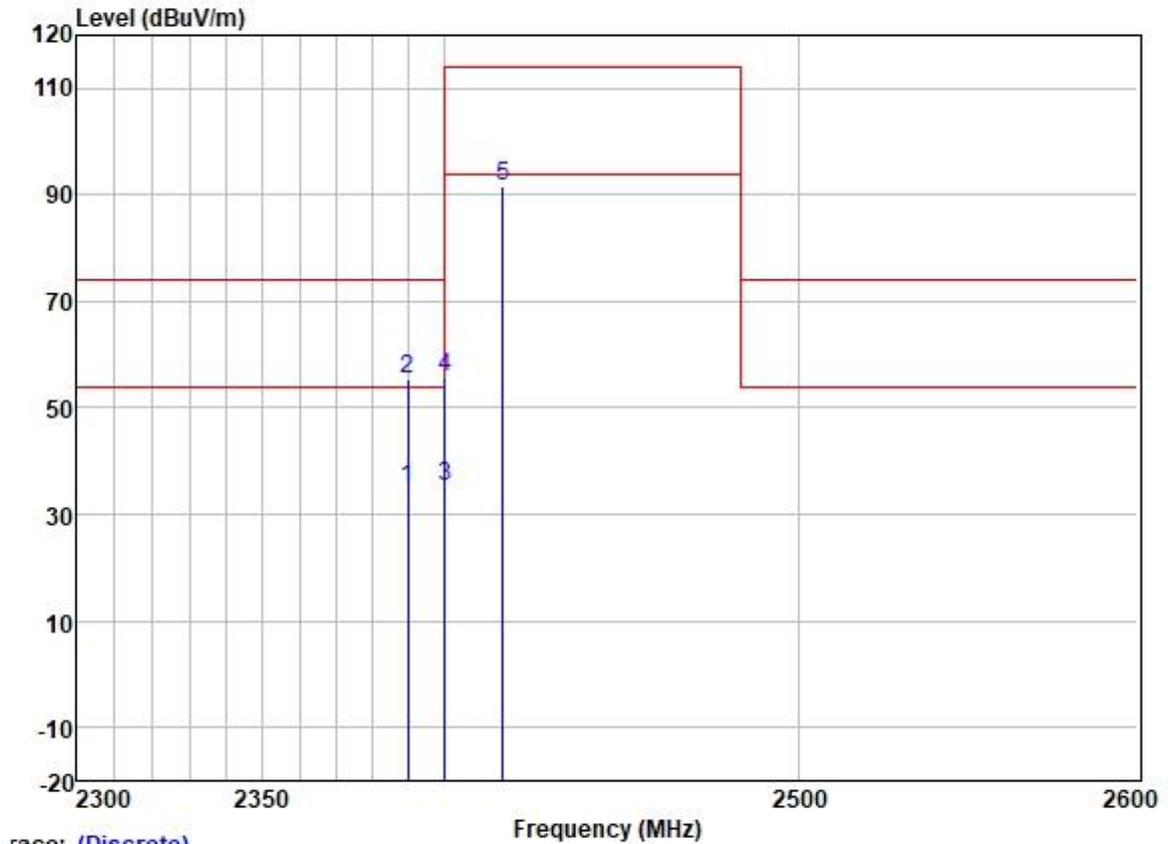
Trace: (Discrete)

	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	2389.196	43.50	27.33	3.48	37.59	36.72	54.00	-17.28	HORIZONTAL	Average
2	2389.196	63.94	27.33	3.48	37.59	57.16	74.00	-16.84	HORIZONTAL	Peak
3	2400.000	44.32	27.35	3.50	37.59	37.58	54.00	-16.42	HORIZONTAL	Average
4	2400.000	64.76	27.35	3.50	37.59	58.02	74.00	-15.98	HORIZONTAL	Peak
5	2416.000	82.67	27.38	3.47	37.58	75.94	94.00	-18.06	HORIZONTAL	Average
6	2416.000	103.11	27.38	3.47	37.58	96.38	114.00	-17.62	HORIZONTAL	Peak



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



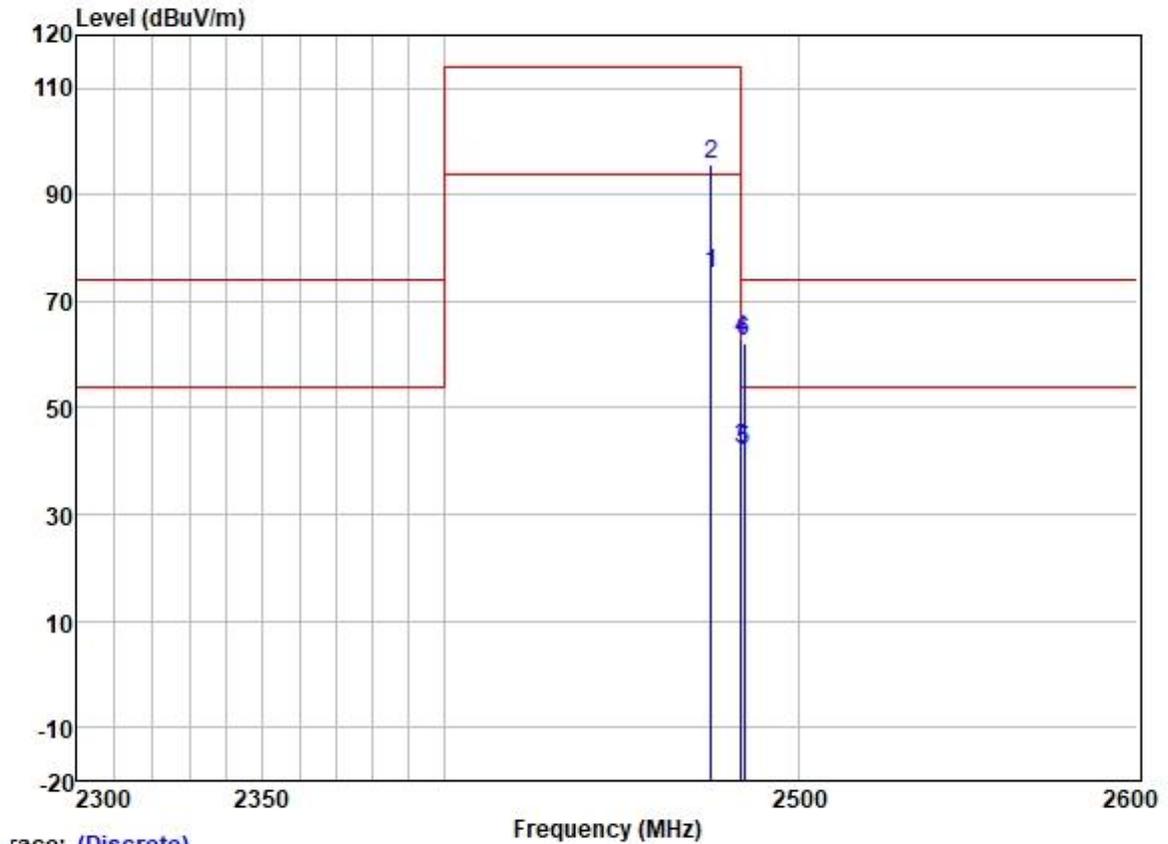
Trace: (Discrete)

	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	2389.547	41.60	27.33	3.48	37.59	34.82	54.00	-19.18	VERTICAL Average
2	2389.547	62.04	27.33	3.48	37.59	55.26	74.00	-18.74	VERTICAL Peak
3	2400.000	42.17	27.35	3.50	37.59	35.43	54.00	-18.57	VERTICAL Average
4	2400.000	62.61	27.35	3.50	37.59	55.87	74.00	-18.13	VERTICAL Peak
5	2416.000	98.52	27.38	3.47	37.58	91.79	114.00	-22.21	VERTICAL Peak



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



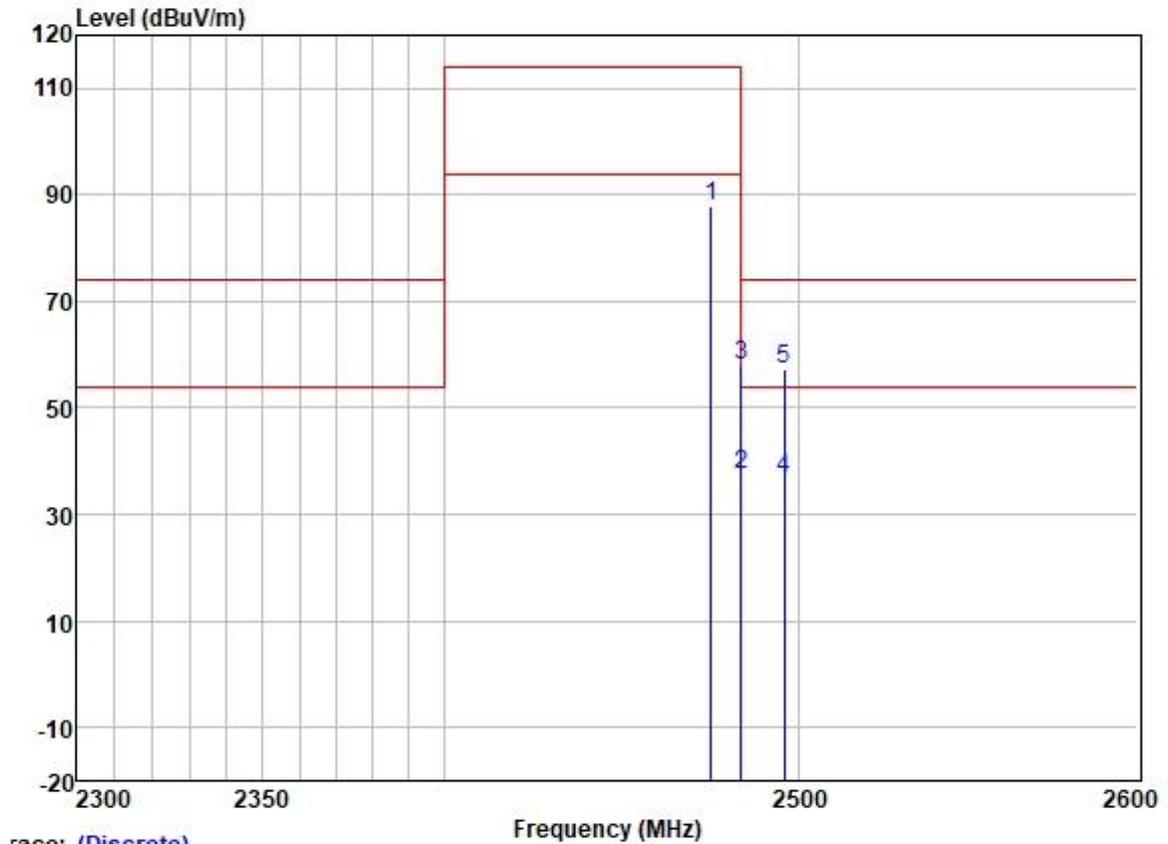
Trace: (Discrete)

	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	2475.000	81.85	27.47	3.60	37.57	75.35	94.00	-18.65	HORIZONTAL Average
2	2475.000	102.29	27.47	3.60	37.57	95.79	114.00	-18.21	HORIZONTAL Peak
3	2483.500	48.99	27.48	3.53	37.57	42.43	54.00	-11.57	HORIZONTAL Average
4	2483.500	69.43	27.48	3.53	37.57	62.87	74.00	-11.13	HORIZONTAL Peak
5	2484.224	48.44	27.48	3.53	37.57	41.88	54.00	-12.12	HORIZONTAL Average
6	2484.224	68.88	27.48	3.53	37.57	62.32	74.00	-11.68	HORIZONTAL Peak



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Test Mode: 00; Polarity: Vertical; 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	2475.000	94.46	27.47	3.60	37.57	87.96	114.00	-26.04	VERTICAL	Peak
2	2483.500	44.18	27.48	3.53	37.57	37.62	54.00	-16.38	VERTICAL	Average
3	2483.500	64.62	27.48	3.53	37.57	58.06	74.00	-15.94	VERTICAL	Peak
4	2495.879	43.34	27.49	3.47	37.56	36.74	54.00	-17.26	VERTICAL	Average
5	2495.879	63.78	27.49	3.47	37.56	57.18	74.00	-16.82	VERTICAL	Peak



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8 Test Setup Photo

Radiated Emissions (below 1GHz)



Radiated Emissions (above 1GHz)



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Field Strength of the Fundamental Signal (15.249(a))



Restricted Band Around Fundamental Frequency



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9 EUT Constructional Details (EUT Photos)

Refer to Appendix – External and Internal Photos for GZCR2110021188AT

- End of the Report -



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