

# FCC PART 15.249


## TEST REPORT

For

### Shenzhen Sonoff Technologies Co., Ltd.

1001, BLDG8, Lianhua Industrial Park, Shenzhen, GD, China

**FCC ID: 2APN5S-MATE**

<b>Report Type:</b> Original Report	<b>Product Type:</b> SONOFF S-MATE Switch Mate
<b>Report Number:</b>	DG1210603-21201E-00A
<b>Report Date:</b>	2021-07-23
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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

<b>EUT Name:</b>	SONOFF S-MATE Switch Mate
<b>EUT Model:</b>	S-MATE
<b>Operation Frequency:</b>	2426 MHz
<b>Antenna Gain▲:</b>	0 dBi
<b>Modulation Type:</b>	GFSK
<b>Rated Input Voltage:</b>	AC 120V/60 Hz
<b>Serial Number:</b>	DG1210603-21201E-RF-S_8K7
<b>EUT Received Date:</b>	2021.06.06
<b>EUT Received Status:</b>	Good

### Objective

This type approval report is prepared on behalf of *Shenzhen Sonoff Technologies Co., Ltd.* in accordance with Part 2-Subpart J, and Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Rules Part 15, Subpart C, and section 15.203, 15.205, 15.209, 15.207, 15.215 and 15.249 rules.

### Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

### Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
Unwanted Emissions, radiated	30M~200MHz: 4.58 dB for Horizontal, 4.59 dB for Vertical 200M~1GHz: 4.83 dB for Horizontal, 5.85 dB for Vertical 1G~6GHz: 4.45 dB, 6G~26.5GHz: 5.23 dB
Temperature	±1 °C
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	3.12 dB (150 kHz to 30 MHz)

*Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.*

## Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.12, Pulong East 1<sup>st</sup> Road, Tangxia Town, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218, the FCC Designation No. : CN1220.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0022.

## Declarations

BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol “▲”. Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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## SYSTEM TEST CONFIGURATION

### Justification

The system was configured for testing in Engineering Mode, which was provided by the manufacturer.

The device only operates on 2426 MHz.

### EUT Exercise Software

No software was used during test, the test mode was provided by the manufacturer ▲.

### Equipment Modifications

No modifications were made to the EUT.

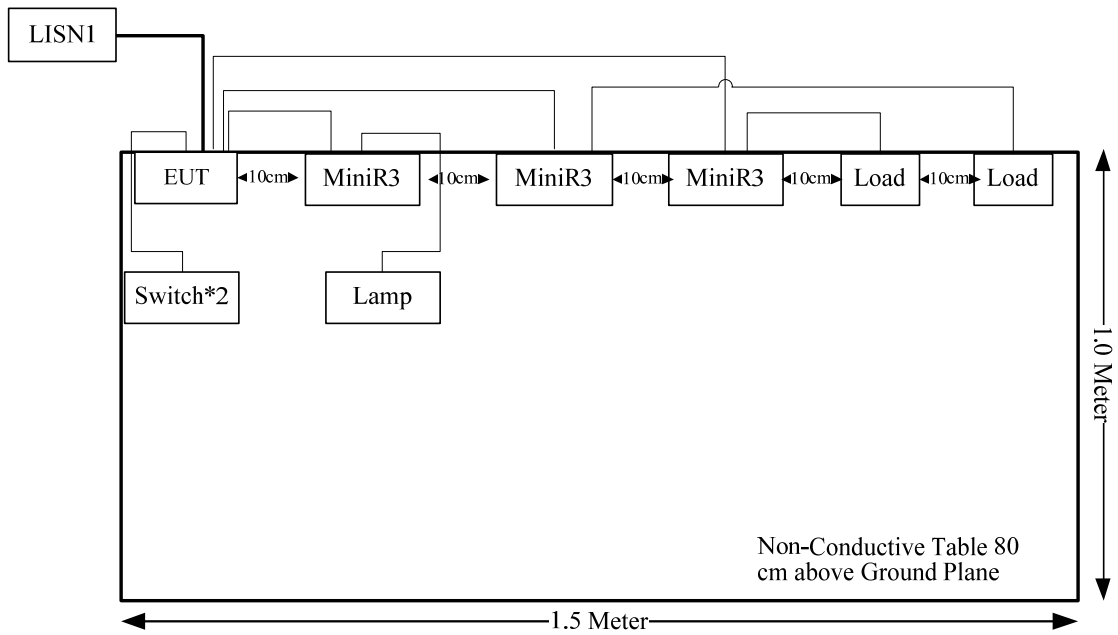
### Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
SONOFF	Wi-Fi Switch	miniR3	DG1210603-21179E-RF-S 78D-1
SONOFF	Wi-Fi Switch	miniR3	DG1210603-21179E-RF-S 78D-2
SONOFF	Wi-Fi Switch	miniR3	DG1210603-21179E-RF-S 78D-3
MANK	Switch	KD11	MK/KD11P001
MANK	Switch	KD11	MK/KD11P002
HUAQIANG	Incandescent Lamp	PZ220V95W.X.12.IV	HQPZ20042803
Unknown	Load	Unknown	Load-1
Unknown	Load	Unknown	Load-2

### Support Cable List and Details

Cable Description	Shielding Cable	Ferrite Core	Length (m)	From Port	To
AC Power Cable	Yes	No	1.2	EUT	LISN 1
AC Power Cable*2	Yes	No	0.3	EUT	Switch
AC Power Cable*3	Yes	Yes	1	EUT	miniR3
AC Power Cable	Yes	Yes	1	miniR3	Lamp
AC Power Cable	Yes	Yes	1	miniR3	Load
AC Power Cable	Yes	Yes	1	miniR3	Load

### Block Diagram of Test Setup



**SUMMARY OF TEST RESULTS**

<b>FCC Rules</b>	<b>Description of Test</b>	<b>Result</b>
§15.203	Antenna Requirement	Compliance
§15.207(a)	Conduction Emissions	Compliance
15.205, §15.209, §15.249	Radiated Emissions	Compliance
§15.215 (c)	20 dB Bandwidth	Compliance

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## **FCC§15.203 - ANTENNA REQUIREMENT**

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### **Applicable Standard**

According to § 15.203, 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 shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.
- c. Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

### **Antenna Connector Construction**

The EUT has internal PCB Antenna permanently attached to the unit, the antenna gain is 0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

**Result:** Compliant.

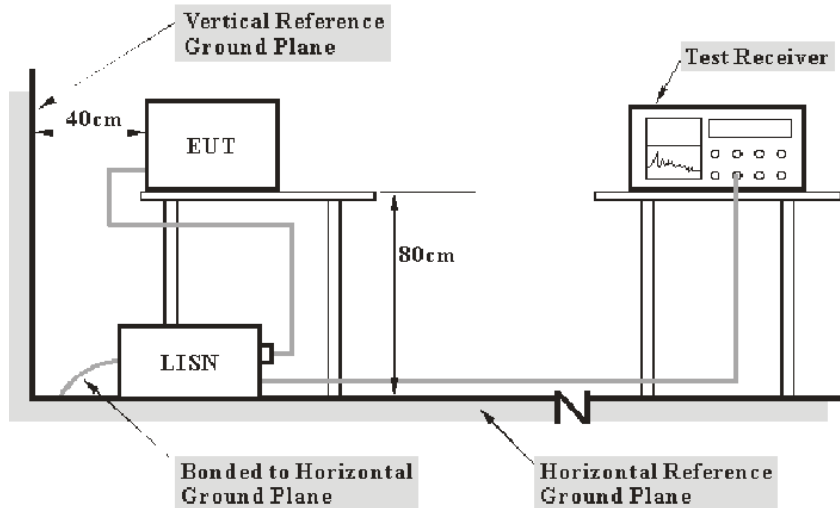


**FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS**

**Applicable Standard**

FCC§15.207(a)

**EUT Setup**



- Note: 1. Support units were connected to second LISN.  
 2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

The EUT was connected to the main LISN with a 120 V/60 Hz AC power source.

**EMI Test Receiver Setup**

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

## Test Procedure

During the conducted emission test, the EUT was connected to the outlet of the first LISN.

The frequency and amplitude of the six highest ac power-line conducted emissions relative to the limit, measured over all the current-carrying conductors of the EUT power cords, and the operating frequency or frequency to which the EUT is tuned (if appropriate), should be reported, unless such emissions are more than 20 dB below the limit. AC power-line conducted emissions measurements are to be separately carried out only on each of the phase (“hot”) line(s) and (if used) on the neutral line(s), but not on the ground [protective earth] line(s). If less than six emission frequencies are within 20 dB of the limit, then the noise level of the measuring instrument at representative frequencies should be reported. The specific conductor of the power-line cord for each of the reported emissions should be identified. Measure the six highest emissions with respect to the limit on each current-carrying conductor of each power cord associated with the EUT (but not the power cords of associated or peripheral equipment that are part of the test configuration). Then, report the six highest emissions with respect to the limit from among all the measurements identifying the frequency and specific current-carrying conductor identified with the emission. The six highest emissions should be reported for each of the current-carrying conductors, or the six highest emissions may be reported over all the current-carrying conductors.

## Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

Herein,

$V_C$ : corrected voltage amplitude

$V_R$ : reading voltage amplitude

$A_C$ : attenuation caused by cable loss

VDF: voltage division factor of AMN or ISN

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

## Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	LISN	ENV 216	101614	2020-09-12	2021-09-12
R&S	EMI Test Receiver	ESCI	101121	2020-07-07	2021-07-07
MICRO-COAX	Coaxial Cable	C-NJNJ-50	C-0200-01	2020-09-05	2021-09-05
R&S	Test Software	EMC32	Version 9.10.00	N/A	N/A

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Data

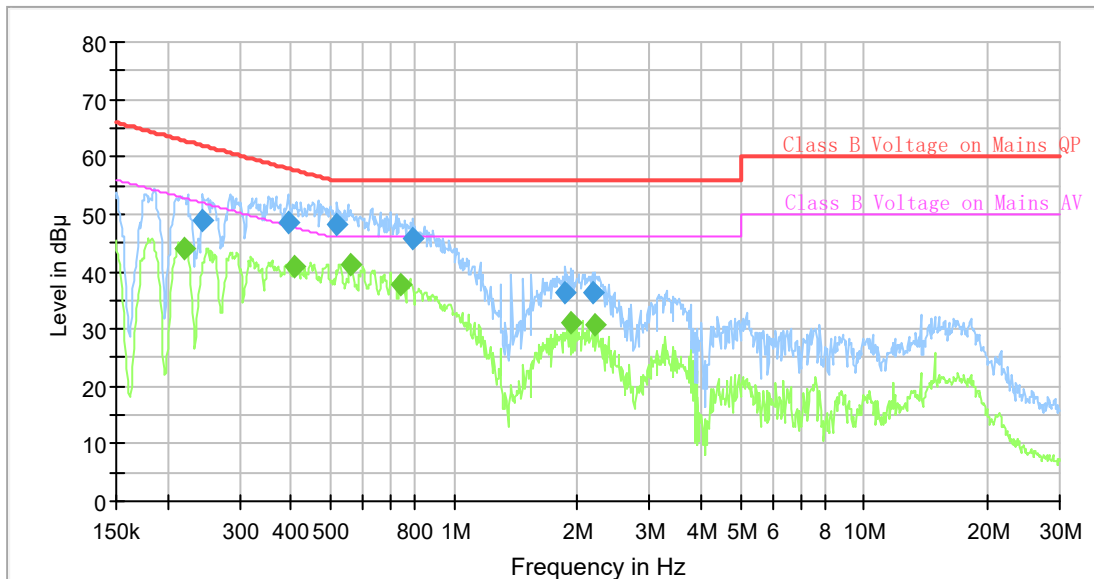
#### Environmental Conditions

<b>Temperature:</b>	25.0°C
<b>Relative Humidity:</b>	70%
<b>ATM Pressure:</b>	100.3kPa
<b>Tester:</b>	Walker Chen
<b>Test Date:</b>	2021-06-25

**Test Result:** Compliance

**Test Mode:** Transmitting

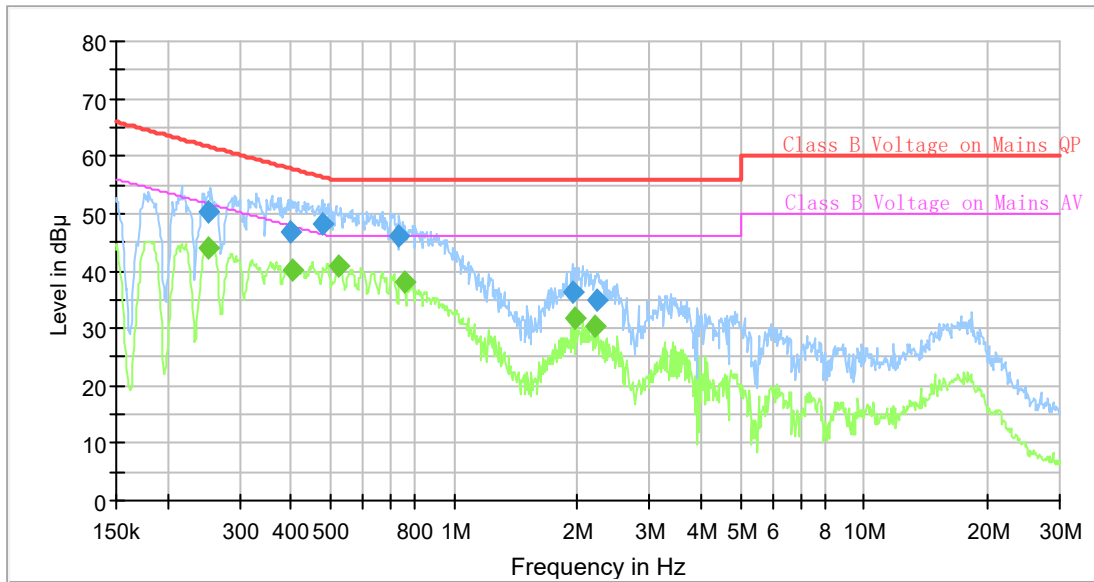
**AC120V, 60 Hz, Line:**



### Final Result

Frequency (MHz)	QuasiPeak (dB μV)	Average (dB μV)	Limit (dB μV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.220231	---	44.11	52.81	8.70	9.000	L1	9.6
0.243332	48.85	---	61.98	13.13	9.000	L1	9.6
0.392773	48.45	---	58.00	9.55	9.000	L1	9.6
0.406728	---	40.92	47.71	6.79	9.000	L1	9.6
0.519327	48.06	---	56.00	7.94	9.000	L1	9.6
0.562468	---	41.18	46.00	4.82	9.000	L1	9.6
0.743699	---	37.83	46.00	8.17	9.000	L1	9.7
0.793516	45.80	---	56.00	10.20	9.000	L1	9.7
1.871193	36.42	---	56.00	19.58	9.000	L1	9.7
1.928035	---	31.02	46.00	14.98	9.000	L1	9.7
2.173203	36.39	---	56.00	19.61	9.000	L1	9.7
2.205965	---	30.78	46.00	15.22	9.000	L1	9.7

**AC120V, 60 Hz, Neutral:**



**Final Result**

Frequency (MHz)	QuasiPeak (dB µ V)	Average (dB µ V)	Limit (dB µ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.251977	---	43.86	51.69	7.83	9.000	N	9.6
0.251977	50.18	---	61.69	11.51	9.000	N	9.6
0.400687	46.83	---	57.84	11.01	9.000	N	9.6
0.404704	---	40.02	47.76	7.74	9.000	N	9.6
0.477109	48.25	---	56.39	8.14	9.000	N	9.6
0.524533	---	40.94	46.00	5.06	9.000	N	9.6
0.736317	46.06	---	56.00	9.94	9.000	N	9.6
0.754910	---	38.20	46.00	7.80	9.000	N	9.6
1.947363	36.37	---	56.00	19.63	9.000	N	9.6
1.966886	---	31.82	46.00	14.18	9.000	N	9.6
2.205965	---	30.46	46.00	15.54	9.000	N	9.6
2.239220	34.97	---	56.00	21.03	9.000	N	9.6

## FCC§15.205, §15.209&§15.249- RADIATED EMISSIONS

### Applicable Standard

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

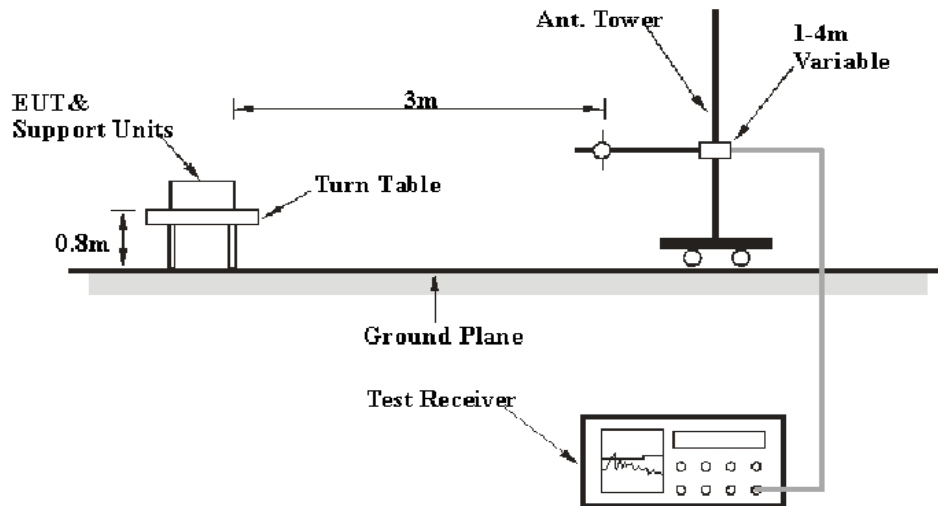
Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

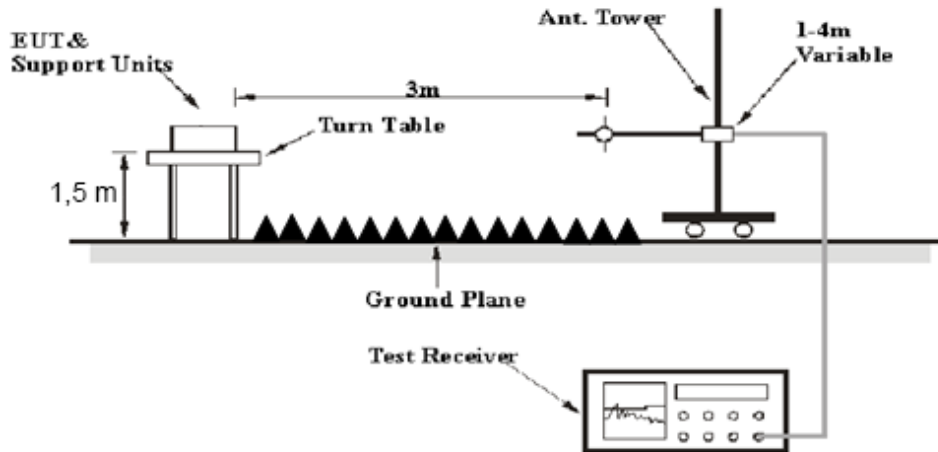
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

### EUT Setup

Below 1 GHz:



**1-25 GHz:**



The radiated emission below 1GHz tests were performed in the 10 meters chamber test site, above 1GHz tests were performed in the 3 meters chamber test site B, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.249 limits.

**Test Equipment Setup**

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	AV

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

**Test Procedure**

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz - 1 GHz, peak and average detection modes for frequencies above 1 GHz.

## Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

## Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiation Below 1GHz					
Sunol Sciences	Antenna	JB3	A060611-2	2020-08-25	2023-08-25
R&S	EMI Test Receiver	ESCI	100224	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-1000-01	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-02	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0530-01	2020-09-24	2021-09-24
Sonoma	Amplifier	310N	185914	2020-10-13	2021-10-13
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Radiation Above 1GHz					
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2020-12-05	2023-12-04
Agilent	Spectrum Analyzer	E4440A	SG43360054	2020-07-07	2021-07-07
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-2.4J2.4J-50	C-0700-02	2021-06-27	2022-06-26
Mini-Circuit	Amplifier	ZVA-213-S+	54201245	2020-09-05	2021-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2021-06-27	2022-06-26
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
E-Microwave	Band-stop Filters	OBSF-2400-2483.5-S	OE01601525	2021-06-16	2022-06-15
Mini Circuits	High Pass Filter	VHF-6010+	31118	2021-06-16	2022-06-15

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

## Test Data

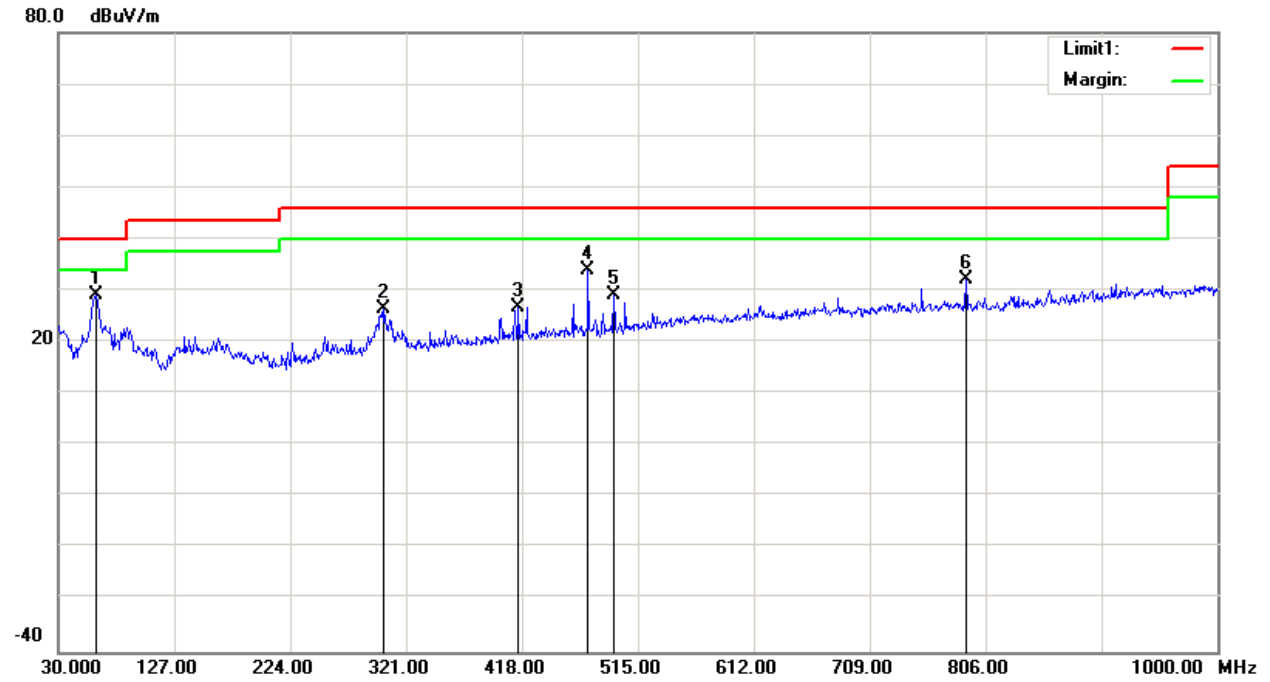
### Environmental Conditions

Test Items	Radiation Below 1GHz	Radiation Above 1GHz
<b>Temperature:</b>	21.4°C	26.6°C
<b>Relative Humidity:</b>	53 %	47%
<b>ATM Pressure:</b>	100.7kPa	100.8kPa
<b>Tester:</b>	Burt Hu	Jeremy Liang
<b>Test Date:</b>	2021-07-02	2021-07-07

Test Mode: Transmitting

1) 30MHz-1GHz

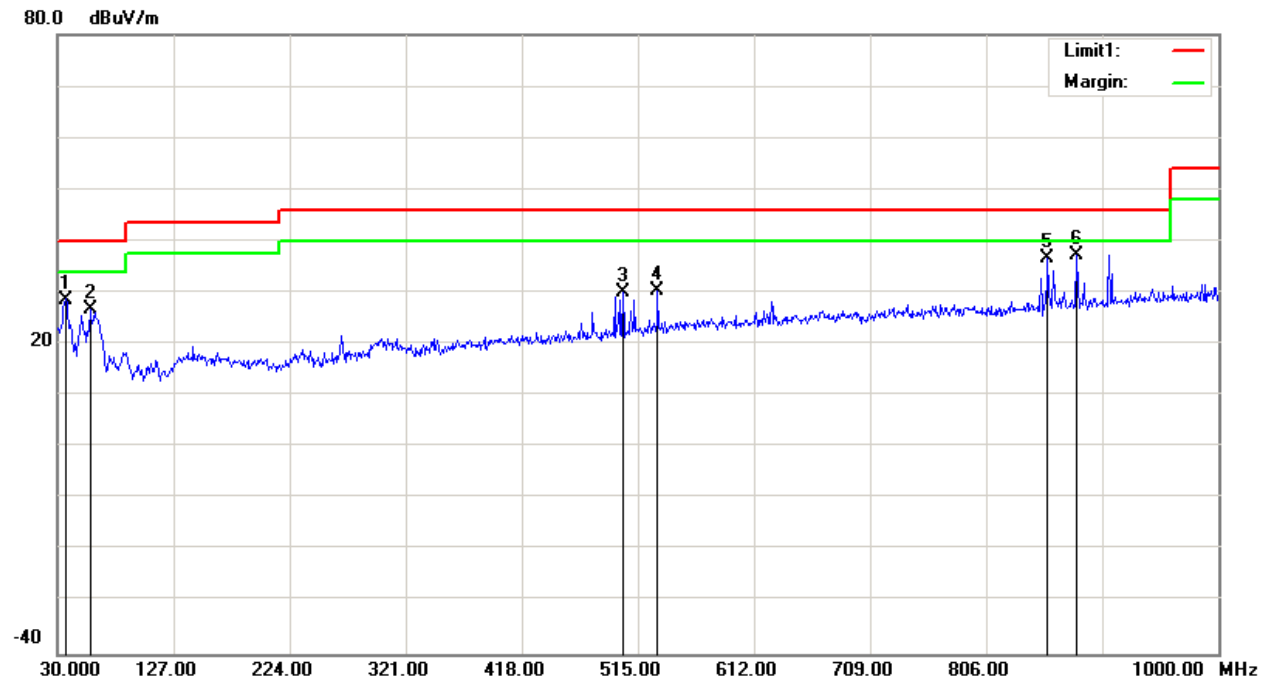
Horizontal:



Frequency (MHz)	Reading (dBμV)	Detector	Corrected (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
61.0400	45.64	peak	-16.42	29.22	40.00	10.78
302.5700	33.76	peak	-7.27	26.49	46.00	19.51
415.0900	31.64	peak	-4.82	26.82	46.00	19.18
473.2900	37.75	peak	-3.86	33.89	46.00	12.11
494.6300	32.58	peak	-3.52	29.06	46.00	16.94
789.5100	30.91	peak	1.19	32.10	46.00	13.90



**Vertical:**



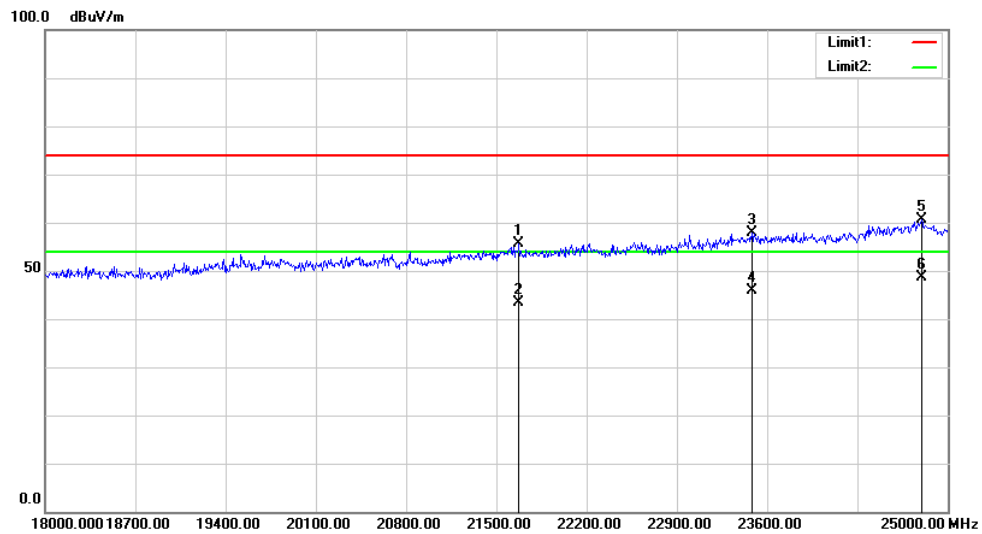
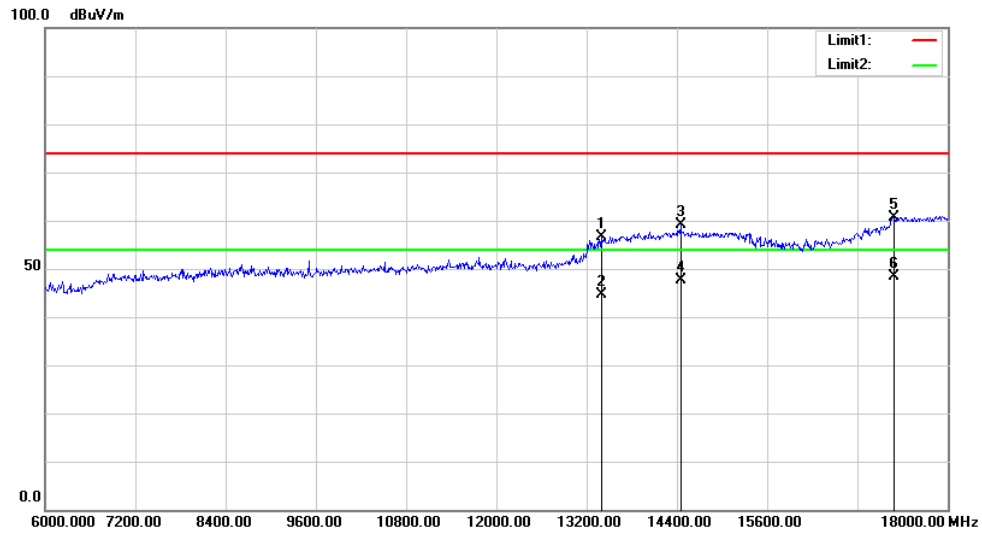
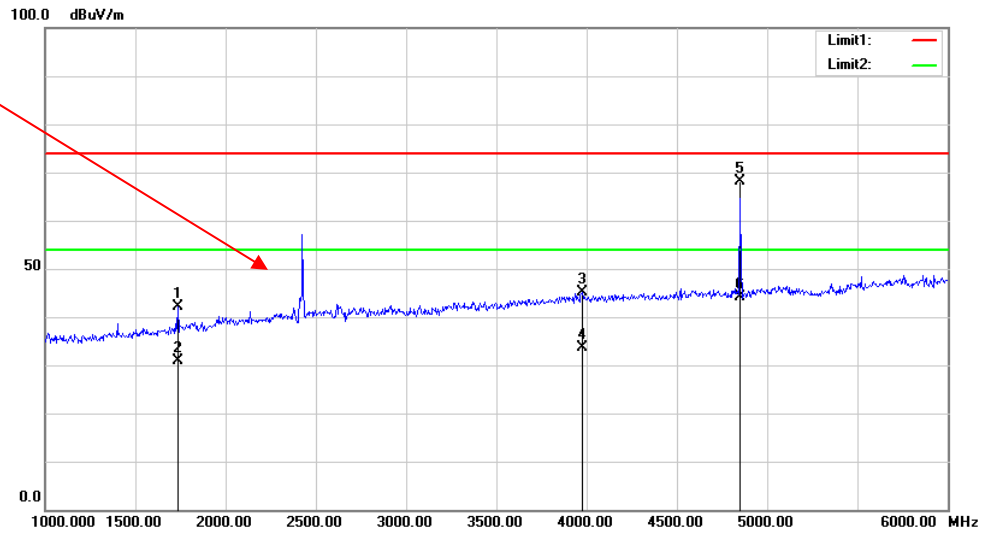
Frequency (MHz)	Reading (dBμV)	Detector	Corrected (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
36.7900	36.33	peak	-7.63	28.70	40.00	11.30
57.1600	43.10	peak	-16.42	26.68	40.00	13.32
502.3900	33.48	peak	-3.35	30.13	46.00	15.87
531.4900	32.72	peak	-2.43	30.29	46.00	15.71
857.4100	34.59	peak	1.98	36.57	46.00	9.43
881.6600	34.36	peak	3.00	37.36	46.00	8.64

**2) 1GHz-25GHz:**

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Detector	Polar	Factor					
MHz	dB $\mu$ V	PK/QP/AV	H/V	dB/m	dB	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB
2426.00	69.51	PK	H	28.15	1.81	0.00	99.47	113.98	14.51
2426.00	43.68	AV	H	28.15	1.81	0.00	73.64	93.98	20.34
2426.00	63.45	PK	V	28.15	1.81	0.00	93.41	113.98	20.57
2426.00	36.54	AV	V	28.15	1.81	0.00	66.50	93.98	27.48
2400.00	33.53	PK	H	28.10	1.80	0.00	63.43	74.00	10.57
2400.00	14.99	AV	H	28.10	1.80	0.00	44.89	54.00	9.11
2483.50	33.56	PK	H	28.27	1.84	0.00	63.67	74.00	10.33
2483.50	15.26	AV	H	28.27	1.84	0.00	45.37	54.00	8.63
4852.00	58.79	PK	H	33.00	3.23	25.64	69.38	74.00	4.62
4852.00	33.65	AV	H	33.00	3.23	25.64	44.24	54.00	9.76
7278.00	36.59	PK	H	35.92	4.70	25.68	51.53	74.00	22.47
7278.00	24.51	AV	H	35.92	4.70	25.68	39.45	54.00	14.55

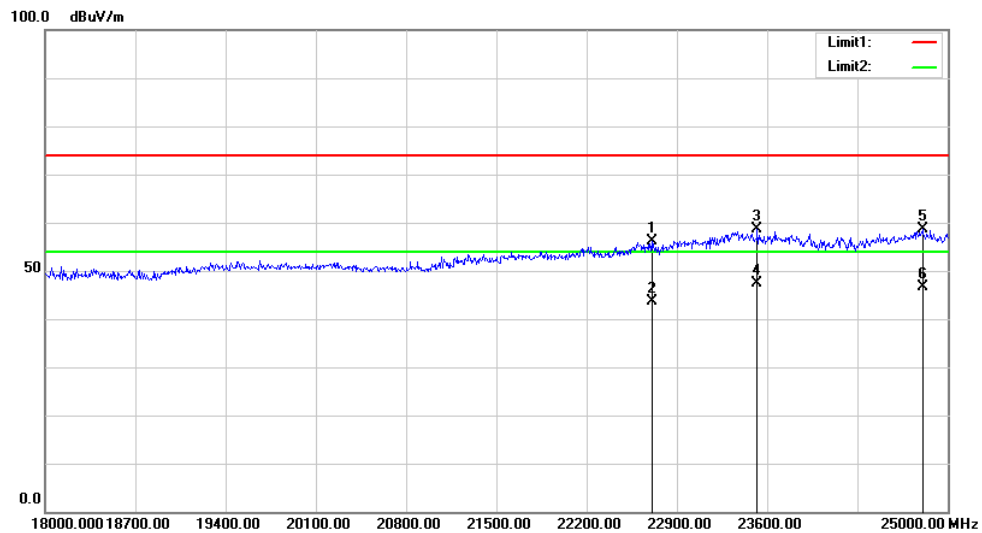
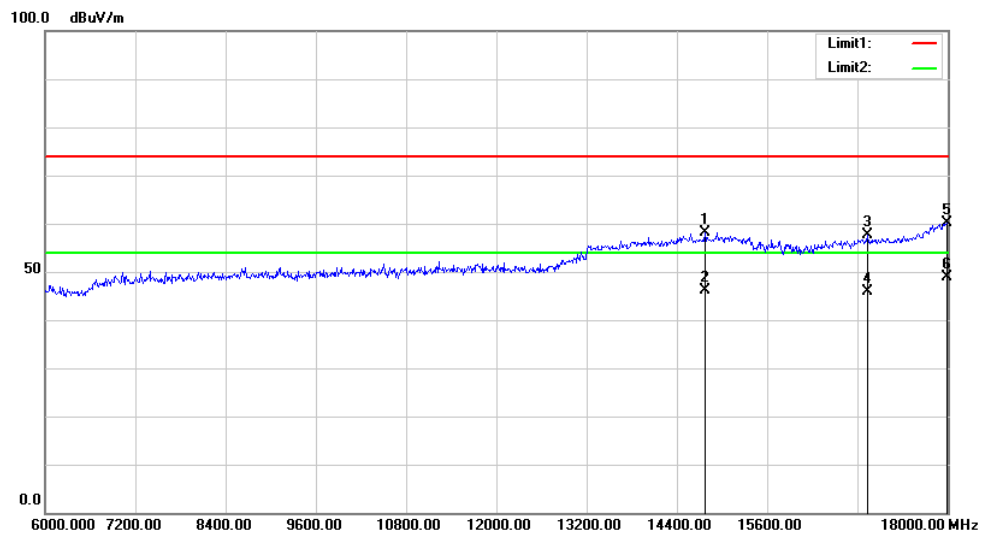
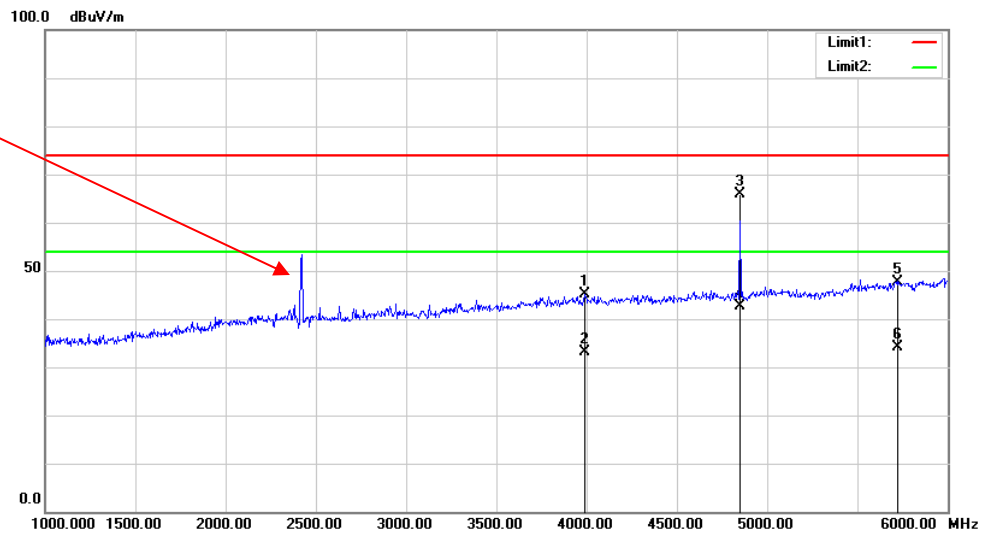
**Test plots:  
Horizontal**

Fundamental  
Test with Band  
Rejection Filter



Vertical:

Fundamental  
Test with Band  
Rejection Filter



## FCC §15.215(c) – 20 dB BANDWIDTH TESTING

### Applicable Standard

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

### Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
3. Repeat above procedures until all frequencies measured were complete.

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2021-07-06	2022-07-05
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41005012	2020-09-05	2021-09-05

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Data

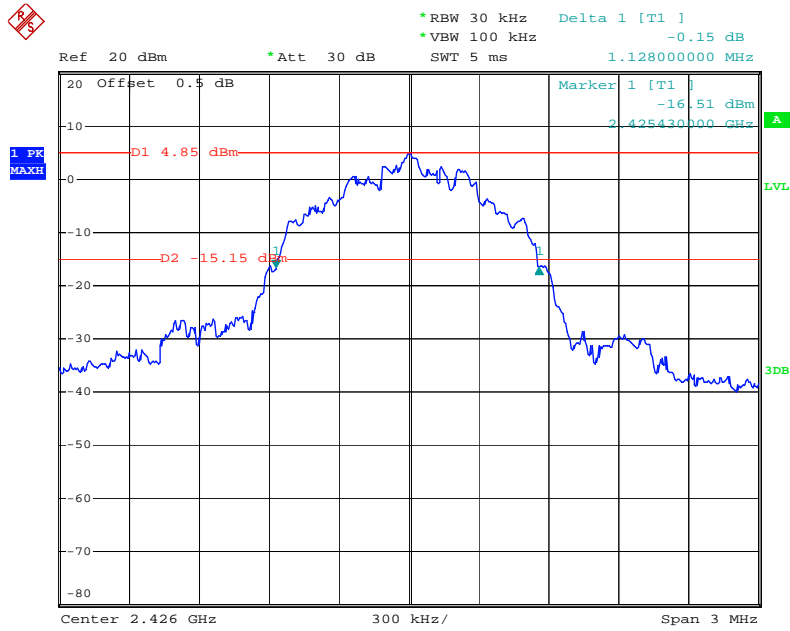
#### Environmental Conditions

<b>Temperature:</b>	28.8 °C
<b>Relative Humidity:</b>	51 %
<b>ATM Pressure:</b>	100.7 kPa
<b>Tester:</b>	Rennes Guo
<b>Test Date:</b>	2021-07-23

**Test Result:** Compliant. Please refer to following tables and plots

Test Mode: Transmitting

20dB Bandwidth: 1.128 MHz



Date: 23.JUL.2021 10:08:37

\*\*\*\*\* END OF REPORT \*\*\*\*\*