



# FCC PART 15.231

# **TEST REPORT**

For

# Shenzhen Sonoff Technologies Co.,Ltd.

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

FCC ID: 2APN5BRIDGER2

Report Type: **Product Type:** 

Original Report RF BridgeR2

Report Number: RDG210222002-00B

**Report Date:** 2021-02-09

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# **GENERAL INFORMATION**

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

EUT Name:	RF BridgeR2
EUT Model:	RF BridgeR2
Operation Frequency:	433.92MHz
Modulation Type:	ASK
Rated Input Voltage:	DC 5V from USB Port
Serial Number:	RDG210222002-RF-S1
<b>EUT Received Date:</b>	2021.02.23
<b>EUT Received Status:</b>	Good

# **Objective**

This report is prepared on behalf of *Shenzhen Sonoff Technologies Co.,Ltd.* in accordance with Part 2, Subpart J, Part 15, Subparts A, and C of the Federal Communications Commission's rules.

The tests were performed in order to determine compliance with FCC Rules Part 15, Subpart C, and section 15.203, 15.205, 15.207,15.209, and 15.231 rules.

# **Test Methodology**

All measurements detailed in this Test Report were performed in accordance 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: 4.55 dB,200M~1GHz: 5.92 dB,1G~6GHz: 4.98 dB, 6G~18GHz: 5.89 dB,18G~26.5G:5.47 dB,26.5G~40G:5.63 dB
Temperature	±1℃
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 1st Road, Tangxia Town, Dongguan, Guangdong, China.

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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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This report may contain data that are not covered by the accreditation scope and shall be marked with an asterisk " $\star$ ".

# **SYSTEM TEST CONFIGURATION**

# **Description of Test Configuration**

The system was configured in testing mode which was provided by manufacturer.

The device operation frequency is 433.92 MHz.

# **Equipment Modifications**

No modifications were made to the unit tested.

# **EUT Exercise Software**

No software was used in test.

# **Local Support Equipment List and Details**

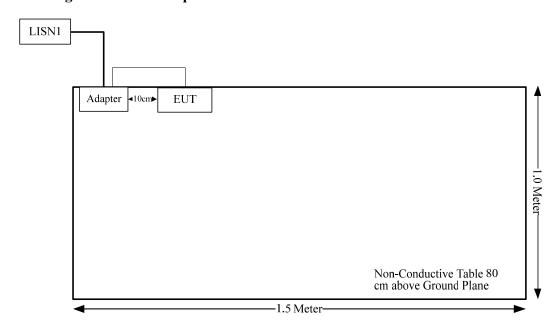
Manufacturer	Description	Model	Serial Number
Huajin	adapter	A1	A1-1

# **Support Cable List and Details**

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	То
Adapter Cable	No	No	1.5	Adapter	EUT

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# **Block Diagram of Test Setup**



# **SUMMARY OF TEST RESULTS**

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207 (a)	Conducted Emissions	Compliance
§15.205, §15.209, §15.231 (b)	Radiated Emissions	Compliance
§15.231 (c)	20dB Bandwidth	Compliance
§15.231 (a)	Deactivation Testing	Compliance

# FCC §15.203 - ANTENNA REQUIREMENT

# **Applicable Standard**

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.

#### **Antenna Connector Construction**

The EUT has two internal antennas, which was permanently attached, fulfill the requirement of this section. Please refer to the EUT photos.

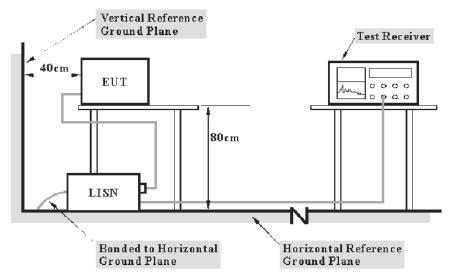
Result: Compliant.

# 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.

The spacing between the peripherals was 10 cm.

The adapter 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 adapter 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:

$$V_C = V_R + A_C + VDF$$
  
$$C_f = A_C + VDF$$

Herein,

V<sub>C</sub> (cord. Reading): corrected voltage amplitude

V<sub>R</sub>: reading voltage amplitude A<sub>c</sub>: attenuation caused by cable loss VDF: voltage division factor of AMN

C<sub>f</sub>: Correction Factor

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:

Margin = Limit – 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

<sup>\*</sup> 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**

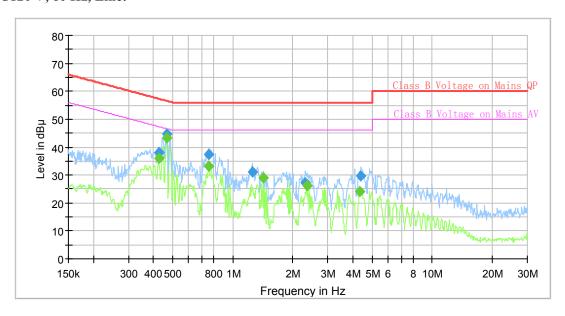
# **Environmental Conditions**

Test Item:	<b>Conducted emissions</b>
<b>Relative Humidity:</b>	63%
ATM Pressure:	102.0kPa
Tester:	Walker Chen
Test Date:	2021-03-19

Test Mode: Transmitting

Test Result: Compliance. Please refer to following table and plots:

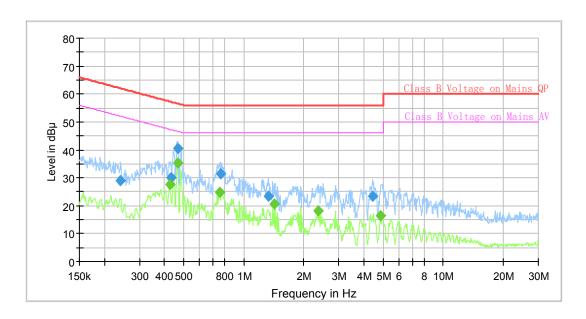
# AC120 V, 60 Hz, Line:



# Final\_Result

Frequency (MHz)	QuasiPeak	Average	Limit	Margin (dB)	Bandwidth (kHz)	Line	Corr.
(IVITZ)	(dB μ V)	(dB $\mu$ V)	(dB μ V)	(ub)	(KHZ)		(dB)
0.425401		35.82	47.34	11.52	9.000	L1	9.6
0.425401	37.99		57.34	19.35	9.000	L1	9.6
0.465358		43.31	46.60	3.29	9.000	L1	9.6
0.465358	44.68		56.60	11.92	9.000	L1	9.6
0.758685		33.02	46.00	12.98	9.000	L1	9.7
0.758685	37.28		56.00	18.72	9.000	L1	9.7
1.255549	31.14		56.00	24.86	9.000	L1	9.7
1.415204		28.90	46.00	17.10	9.000	L1	9.7
2.318778	27.33		56.00	28.67	9.000	L1	9.7
2.365502		26.33	46.00	19.67	9.000	L1	9.7
4.346933		24.15	46.00	21.85	9.000	L1	9.7
4.390511	29.58		56.00	26.42	9.000	L1	9.7

# AC120 V, 60 Hz, Neutral:



# **Final Result**

	<b>-</b>						
Frequency	QuasiPeak	Average	Limit	Margin	Bandwidth	Line	Corr.
(MHz)	(dB µ V)	(dB µ V)	(dB µ V)	(dB)	(kHz)		(dB)
0.240917	29.01		62.06	33.05	9.000	N	9.6
0.425401		27.58	47.34	19.76	9.000	N	9.6
0.429665	30.13		57.26	27.13	9.000	N	9.6
0.465358		35.12	46.60	11.48	9.000	N	9.6
0.465358	40.51		56.60	16.09	9.000	N	9.6
0.758685		24.84	46.00	21.16	9.000	N	9.6
0.770122	31.46		56.00	24.54	9.000	N	9.6
1.326356	23.46		56.00	32.54	9.000	N	9.6
1.415204		20.45	46.00	25.55	9.000	N	9.6
2.365502		18.11	46.00	27.89	9.000	N	9.6
4.412464	23.32		56.00	32.68	9.000	N	9.6
4.851056		16.55	46.00	29.45	9.000	N	9.6

# FCC §15.205, §15.209, §15.231 (b) - RADIATED EMISSIONS

# **Applicable Standard**

FCC §15.205, §15.209, §15.231 (b)

(b) In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

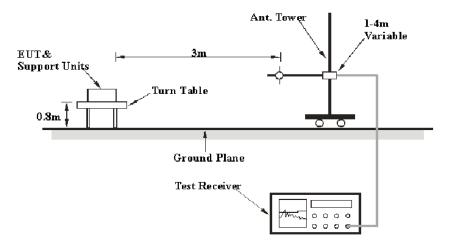
Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	<sup>1</sup> 1,250 to 3,750	<sup>1</sup> 125 to 375
174-260	3,750	375
260-470	<sup>1</sup> 3,750 to 12,500	<sup>1</sup> 375 to 1,250
Above 470	12,500	1,250

<sup>&</sup>lt;sup>1</sup>Linear interpolations.

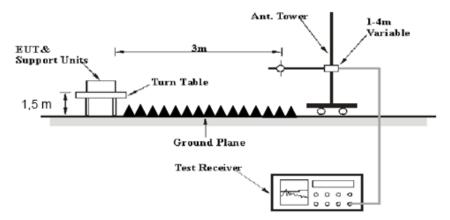
- (1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.
- (2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.
- (3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

# **EUT Setup**

# **Below 1 GHz:**



#### **Above 1 GHz:**



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15 § 15.209, 15.205 and 15.231.

# **EMI Test Receiver Setup**

The system was investigated from 30 MHz to 5 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	100 kHz	PK
1 GHz – 5 GHz	1 MHz	3 MHz	/	PK

# **Test Equipment List and Details**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date		
	Radiation Below 1GHz						
Sunol Sciences	Antenna	JB3	A060611-1	2020-11-10	2023-11-10		
R&S	EMI Test Receiver	ESR3	102453	2020-09-12	2021-09-12		
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2020-09-05	2021-09-05		
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2020-09-05	2021-09-05		
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2020-05-06	2021-05-06		
HP	Amplifier	8447D	2727A05902	2020-09-05	2021-09-05		
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A		
		Radiation Above 1G	Hz				
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12		
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	2020-06-27	2021-06-27		
Mini-Circuit	Amplifier	ZVA-213-S+	54201245	2020-09-05	2021-09-05		
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A		

<sup>\*</sup> 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 Procedure**

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

According to §15.231, Intentional radiators operating under the provisions of this Section shall demonstrate compliance with the limits on the field strength of emissions, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector

# **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:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - 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:

 $Margin = Limit - Corrected\ Amplitude$ 

**Test Data** 

# **Environmental Conditions**

Test Items	Radiation Below 1GHz	Radiation Above 1GHz
Temperature:	25.2°C	26 °C
Relative Humidity:	62 %	51 %
ATM Pressure:	101.2 kPa	101.6 kPa
Tester:	Jalon Liu	Lee li
Test Date:	2021.03.16	2021.03.21

Test mode: Transmitting

# Field Strength (Peak)

Frequency	Receiver	Rx A	ntenna	Cable	Amplifier	Corrected	T	M
(MHz)	Reading (dBµV)	Polar (H/V)	Factor (dB/m)	loss (dB)	Gain (dB)	Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
			Operating	Frequency:	433.92 MHz			
433.92	75.41	Н	16.48	2.27	26.54	67.62	100.83	33.21
433.92	70.79	V	16.48	2.27	26.54	63.00	100.83	37.83
867.84	57.06	Н	21.76	3.15	26.68	55.29	80.83	25.54
867.84	58.81	V	21.76	3.15	26.68	57.04	80.83	23.79
1301.76	43.88	Н	24.53	1.57	26.15	43.83	74.00	30.17
1301.76	43.22	V	24.53	1.57	26.15	43.17	74.00	30.83
1735.68	39.84	Н	26.19	1.65	25.81	41.87	80.83	38.96
1735.68	38.69	V	26.19	1.65	25.81	40.72	80.83	40.11
2169.60	44.44	Н	27.64	1.74	25.54	48.28	80.83	32.55
2169.60	42.91	V	27.64	1.74	25.54	46.75	80.83	34.08
2603.52	38.58	Н	28.67	1.88	26.19	42.94	80.83	37.89
2603.52	38.12	V	28.67	1.88	26.19	42.48	80.83	38.35
3037.44	47.77	Н	30.19	2.18	26.00	54.14	80.83	26.69
3037.44	44.88	V	30.19	2.18	26.00	51.25	80.83	29.58
3471.36	37.81	Н	31.23	2.39	25.88	45.55	80.83	35.28
3471.36	37.24	V	31.23	2.39	25.88	44.98	80.83	35.85
3905.28	47.34	Н	32.19	2.58	25.77	56.34	74.00	17.66
3905.28	44.57	V	32.19	2.58	25.77	53.57	74.00	20.43
4339.20	43.08	Н	32.33	2.85	25.74	52.52	74.00	21.48
4339.20	38.27	V	32.33	2.85	25.74	47.71	74.00	26.29

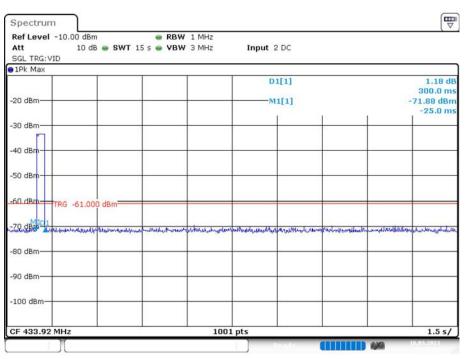
Field Strength (Average)

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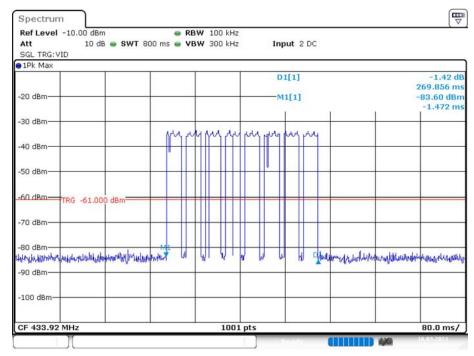
Field Strength (Average)						
Frequency (MHz)	Peak Measurement@3m (dBµV/m)	Polar (H/V)	Duty Cycle Correction Factor (dB)	Average Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
		Operati	ng Frequency: 43	3.92 MHz		
433.92	67.62	Н	-9.29	58.33	80.83	22.5
433.92	63.00	V	-9.29	53.71	80.83	27.12
867.84	55.29	Н	-9.29	46	60.83	14.83
867.84	57.04	V	-9.29	47.75	60.83	13.08
1301.76	43.83	Н	-9.29	34.54	54.00	19.46
1301.76	43.17	V	-9.29	33.88	54.00	20.12
1735.68	41.87	Н	-9.29	32.58	60.83	28.25
1735.68	40.72	V	-9.29	31.43	60.83	29.4
2169.60	48.28	Н	-9.29	38.99	60.83	21.84
2169.60	46.75	V	-9.29	37.46	60.83	23.37
2603.52	42.94	Н	-9.29	33.65	60.83	27.18
2603.52	42.48	V	-9.29	33.19	60.83	27.64
3037.44	54.14	Н	-9.29	44.85	60.83	15.98
3037.44	51.25	V	-9.29	41.96	60.83	18.87
3471.36	45.55	Н	-9.29	36.26	60.83	24.57
3471.36	44.98	V	-9.29	35.69	60.83	25.14
3905.28	56.34	Н	-9.29	47.05	54.00	6.95
3905.28	53.57	V	-9.29	44.28	54.00	9.72
4339.20	52.52	Н	-9.29	43.23	54.00	10.77
4339.20	47.71	V	-9.29	38.42	54.00	15.58

Duty cycle=Ton/Ton+off =(0.808\*10+0.256\*15)/34.72 =34.33% Duty Cycle Correction Factor= 20\*log(Duty cycle)= -9.29 dB

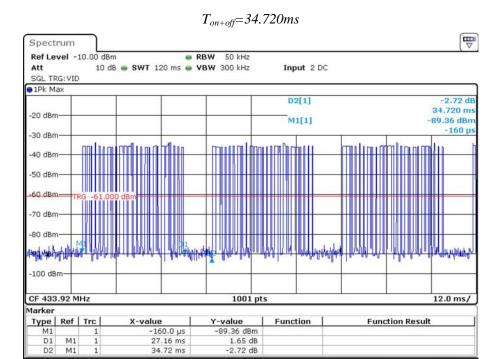
Please refer to the following plots for duty cycle test:



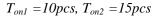
Date: 16.MAR.2021 09:19:04

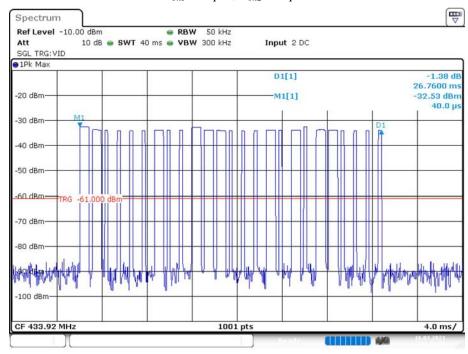


Date: 16.MAR.2021 09:44:07



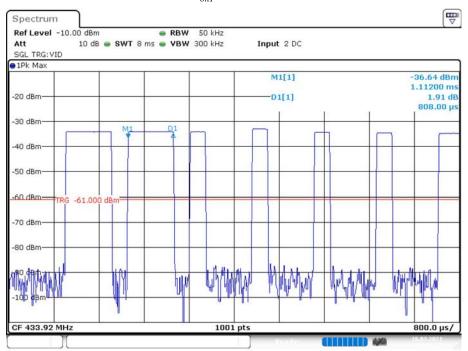
Date: 16.MAR.2021 09:32:41





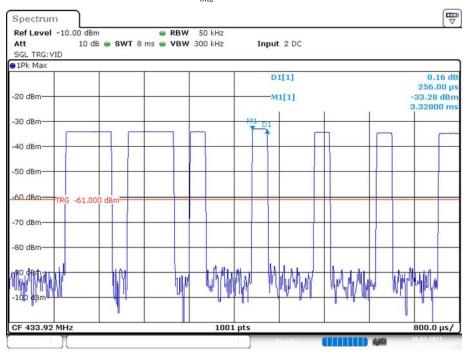


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Date: 16.MAR.2021 09:38:16

# $T_{on2} = 0.256ms$

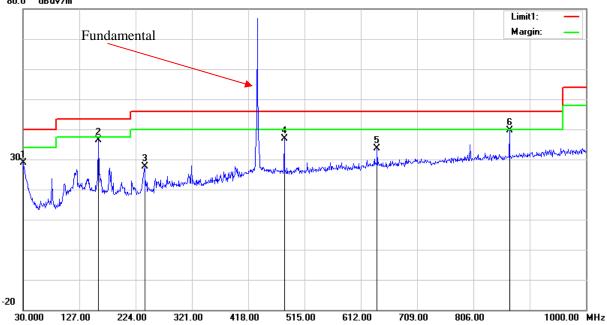


Date: 16.MAR.2021 09:39:29

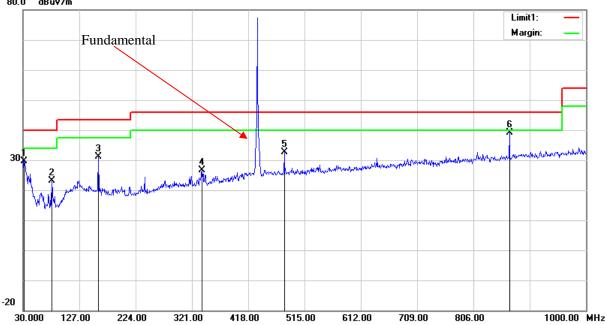
# 30MHz-1GHz

# Horizontal: 80.0 dBuV/m





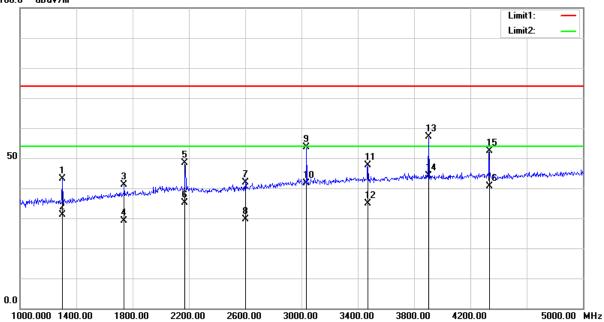




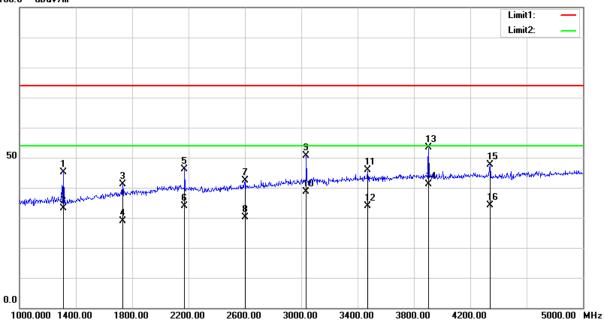
# **Above 1GHz:**

#### **Horizontal:**

100.0 dBuV/m



Vertical: 100.0 dBuV/m



# FCC §15.231(c) – 20 dB BANDWIDTH TESTING

# Requirement

Per 15.231(c), The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

# **Test Equipment List and Details**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESR3	102453	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2020-09-05	2021-09-05

<sup>\*</sup> 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 Procedure**

The waveform was received by the spectrum analyzer/EMI Test Receiver, plot the 20 dB bandwidth.

#### **Test Data**

#### **Environmental Conditions**

Temperature:	25.2°C
Relative Humidity:	62 %
ATM Pressure:	101.2 kPa
Tester:	Jalon Liu
Test Date:	2021.03.16

Test Mode: Transmitting

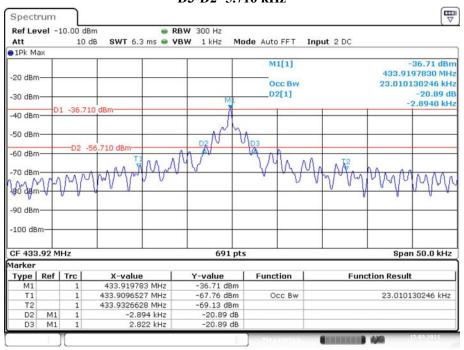
Please refer to following table and plot.

Channel Frequency	20 dB Bandwidth	Limit	Result
(MHz)	(kHz)	(kHz)	
433.92	5.716	1084.8	Pass

Note: Limit = 0.25% \* Center Frequency = 0.25% \*433.92MHz = 1084.8 kHz

# 20 dB Bandwidth D3-D2=5.716 kHz

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# FCC §15.231(a) - DEACTIVATION TESTING

# **Applicable Standard**

Per 15.231(a) (1), a manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

# **Test Equipment List and Details**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESR3	102453	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2020-09-05	2021-09-05

<sup>\*</sup> 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**

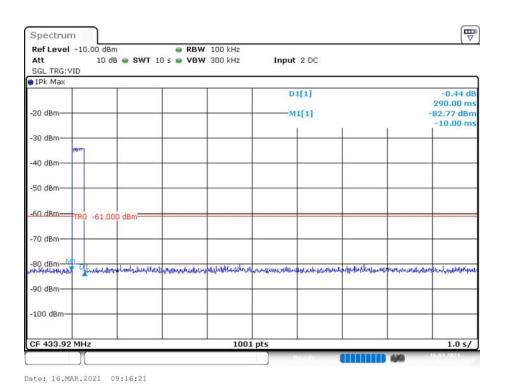
#### **Environmental Conditions**

Temperature:	25.2°C
Relative Humidity:	62 %
ATM Pressure:	101.2 kPa
Tester:	Jalon Liu
Test Date:	2021.03.16

Test Mode: Transmitting

Test Result: Compliance. Please refer to following plot.

Maximum Deactivate Time (s)	Limit (s)	Result
0.29	<5	Pass



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