ACCREDITED
TESTING LABORATORY
CERTIFICATE # 4821.01

BACL
Bay Area Compliance Labs Corp.

FCC PART 15.249

TEST REPORT

For

Avi-on Labs

2700 Rasmussen, Suite L-10 Park City, Utah United States 84098

FCC ID: 2AFZI-AVIDCMW

Report Type:	**Product Type:**
Original Report	Direct Connect™ Microwave Occupancy & Daylight Sensor

Report Number:	SZ4210324-08180E-RF-00
Report Date:	2021-08-19
Reviewed By:	Jimmy Xiao RF Engineer
Prepared By:	Bay Area Compliance Laboratories Corp. (Shenzhen) 5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★".

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 an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Direct Connect™ Microwave Occupancy & Daylight Sensor
Tested Model	AVI-DC-MW
Frequency Range	5726-5874MHz
Maximum Field Strength	86.44dBuV/m@3m
Antenna Specification*	4.0dBi (It is provided by the applicant)
Voltage Range	DC 5.0V
Date of Test	2021-05-15 to 2021-08-10
Sample serial number	SZ4210324-08180E-RF-S1(Assigned by BACL, Shenzhen)
Received date	2021-03-24
Sample/EUT Status	Good condition

Objective

This test report is 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 Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 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 radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±1℃
Humidity		±6%
Supply voltages		±0.4%

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

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0023.

SYSTEM TEST CONFIGURATION

Justification

Channel List

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	5726	2	5727
3	5728	4	5729
…	…	…	…
75	5800	76	5801
147	5872	148	5873
149	5874	/	/

EUT was tested with Channel 1, 75 and 149.

EUT Exercise Software

“SecureCRTPortable.exe”* software was use to the EUT test and power level is 2*. The software and power level was provided by the applicant.

Equipment Modifications

No modifications were made to the unit tested.

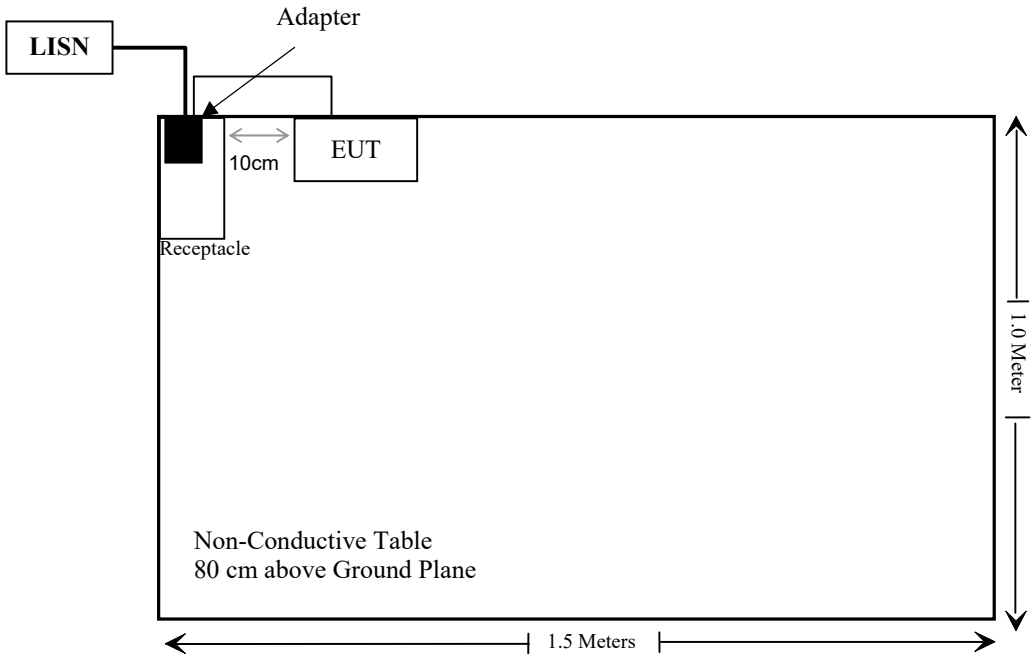
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
ZTE	Adapter	STC-A51A	STC-A51A

Support Cable Descriptions

Cable Description	Length (m)	From/Port	To
Un-Shielded Detachable DC Cable	1.0	Adapter	EUT

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliant
§15.207(a)	Conduction Emissions	Compliant
15.205, §15.209, §15.249(a), §15.249(d)	Radiated Emissions& Outside of Band Emission	Compliant
§15.215 (c)	20 dB Bandwidth	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2021/07/07	2022/07/06
Rohde & Schwarz	LISN	ENV216	101613	2021/07/07	2022/07/06
Rohde & Schwarz	Transient Limitor	ESH3Z2	DE25985	2020/11/29	2021/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2020/11/29	2021/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2020/08/04	2021/08/03
Sonoma instrument	Pre-amplifier	310 N	186238	2020/08/04	2021/08/03
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2020/12/22	2023/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2020/11/29	2021/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2020/11/29	2021/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2021/07/06	2022/07/05
COM-POWER	Pre-amplifier	PA-122	181919	2020/11/29	2021/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2021/08/03	2022/08/02
Sunol Sciences	Horn Antenna	3115	9107-3694	2021/01/15	2024/01/14
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2020/11/29	2021/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2020/11/29	2021/11/28
SNSD	Band Reject filter	BSF5150-5850MN-0899-004	5G filter	2021/04/20	2022/04/20
Ducommun Technolagies	Horn antenna	ARH-4223-02	1007726-02 1304	2020/12/06	2023/12/05
Ducommun Technolagies	Horn antenna	ARH-2823-02	1007726-02 1302	2020/12/06	2023/12/05

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

FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 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 use of a standard antenna jack or electrical connector is prohibited.

Antenna Connector Construction

The EUT has one internal antenna which was permanently attached and the antenna gain is 4.0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

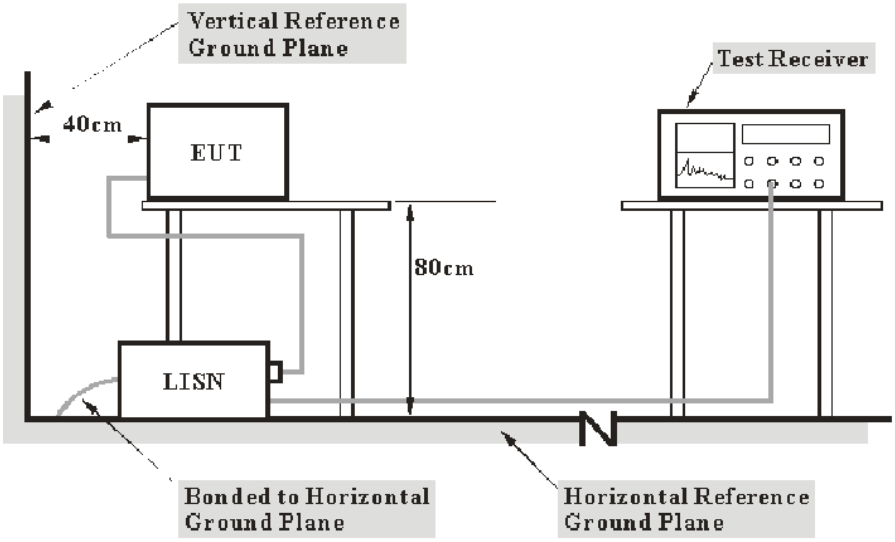
Result: Compliance.

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 measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

The spacing between the peripherals was 10 cm.

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

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Correction Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

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

Margin = Limit – Corrected Amplitude

Test Data

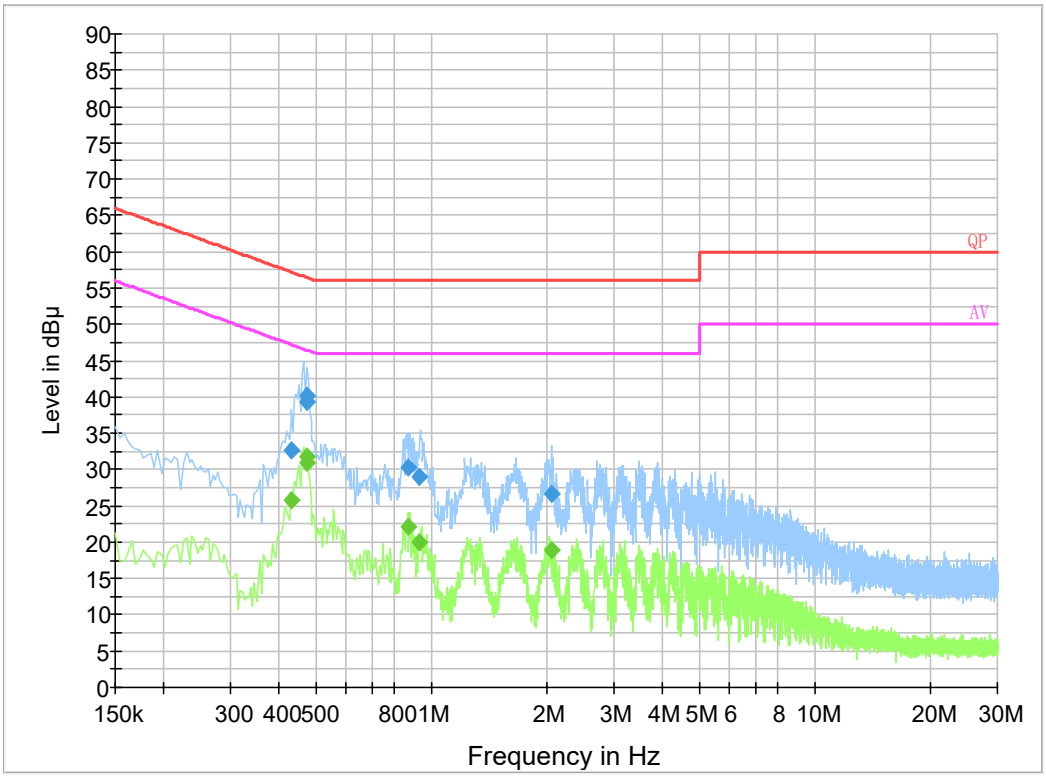
Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2021-08-04.

EUT operation mode: Transmitting

AC 120V/60 Hz, Line



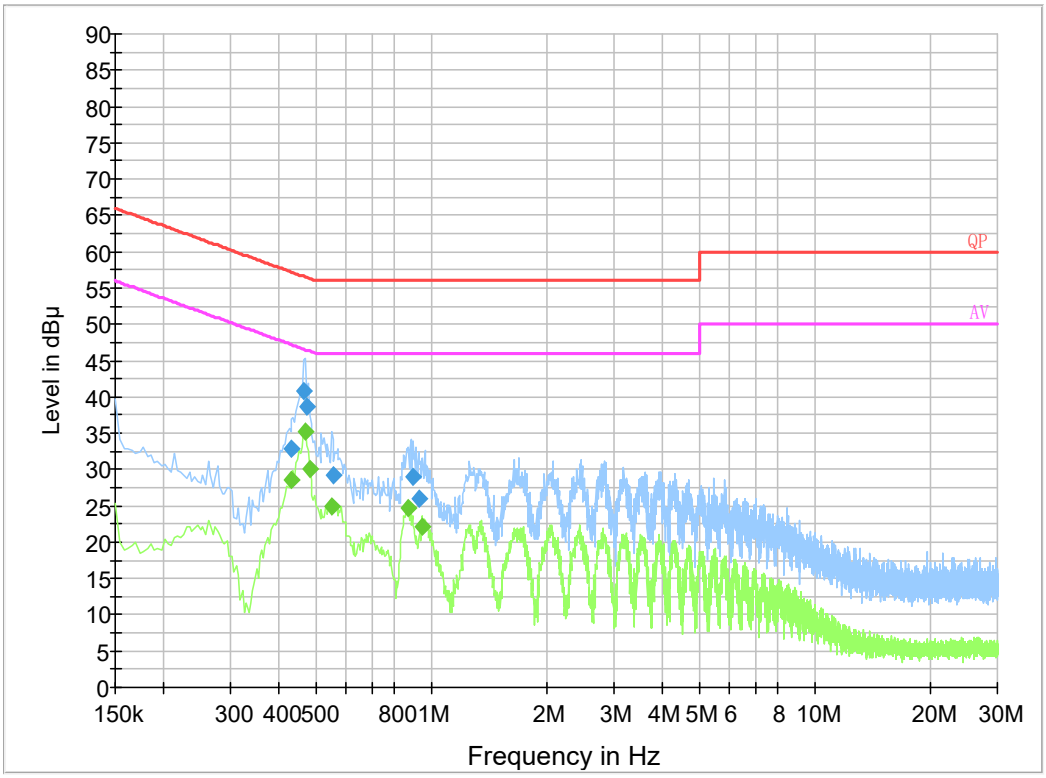
Final Result 1

Frequency (MHz)	QuasiPeak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.431550	32.6	9.000	L1	19.8	24.6	57.2
0.472990	40.2	9.000	L1	19.8	16.3	56.5
0.474770	39.3	9.000	L1	19.8	17.1	56.4
0.868950	30.4	9.000	L1	19.8	25.6	56.0
0.931930	29.0	9.000	L1	19.8	27.0	56.0
2.055010	26.6	9.000	L1	19.9	29.4	56.0

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.431550	25.8	9.000	L1	19.8	21.4	47.2
0.472990	31.7	9.000	L1	19.8	14.8	46.5
0.474770	31.0	9.000	L1	19.8	15.4	46.4
0.868950	22.1	9.000	L1	19.8	23.9	46.0
0.931930	20.1	9.000	L1	19.8	25.9	46.0
2.055010	18.9	9.000	L1	19.9	27.1	46.0

AC 120V/60 Hz, Neutral



Final Result 1

Frequency (MHz)	QuasiPeak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.432390	32.9	9.000	N	19.8	24.3	57.2
0.466950	40.8	9.000	N	19.8	15.8	56.6
0.474770	38.6	9.000	N	19.8	17.8	56.4
0.558250	29.1	9.000	N	19.8	26.9	56.0
0.896710	28.9	9.000	N	19.7	27.1	56.0
0.927710	26.0	9.000	N	19.8	30.0	56.0

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.430000	28.6	9.000	N	19.8	18.7	47.3
0.470000	35.3	9.000	N	19.8	11.2	46.5
0.482000	30.0	9.000	N	19.8	16.3	46.3
0.550000	24.9	9.000	N	19.8	21.1	46.0
0.874000	24.7	9.000	N	19.7	21.3	46.0
0.946000	22.1	9.000	N	19.8	23.9	46.0

FCC§15.205, §15.209 & §15.249(a) & 15.249(d) - 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.

As per FCC§15.249 (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.

Test Equipment Setup

The spectrum analyzer or receiver is set as:

Below 1000MHz:

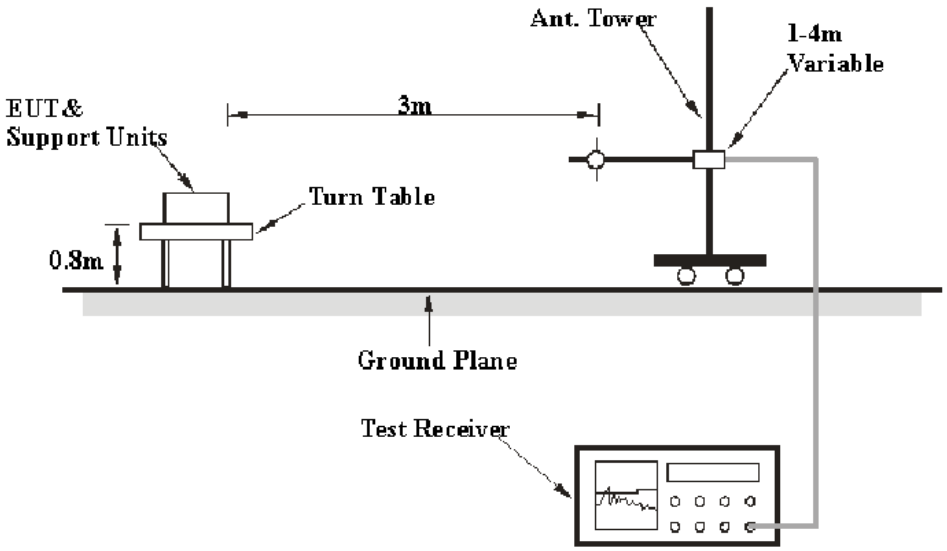
RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000MHz:

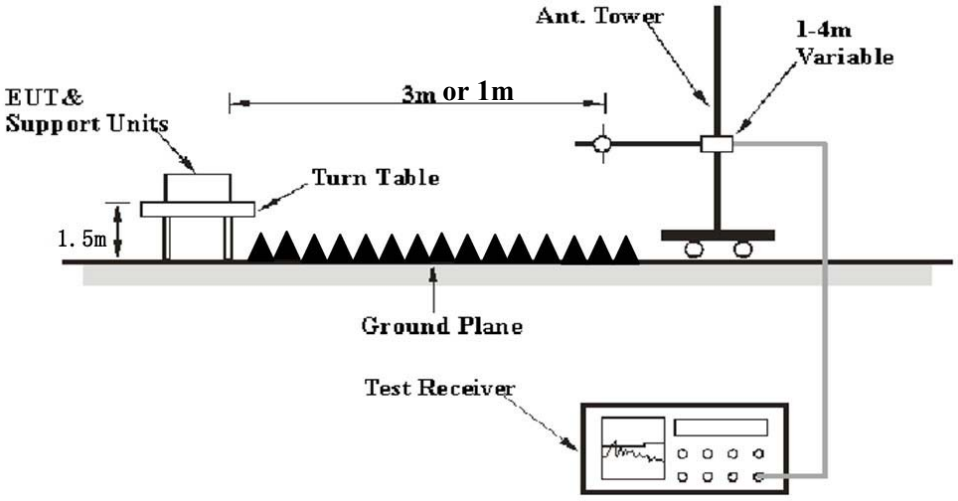
Peak: RBW = 1MHz / VBW = 3MHz / Sweep = Auto
Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission and out of band emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209/15.205 and FCC 15.249 limits.

Test Procedure

Radiated Spurious Emission

During the radiated emission test, the adapter was connected to the AC floor outlet.

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

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

According to ANSI C63.10-2013,9.4: For field strength measurements made at other than the distance at which the applicable limit is specified,extrapolate the measured field strength to the field strength at the distance specified by the limit using an inverse distance correction factor (20 dB/decade of distance). In some cases, a different distance correction factor may be required;

$$E_{\mathrm{SpecLimit}} = E_{\mathrm{Meas}} + 20\log\left(\frac{d_{\mathrm{Meas}}}{d_{\mathrm{SpecLimit}}}\right)$$

where

$E_{\mathrm{SpecLimit}}$	is the field strength of the emission at the distance specified by the limit, in dBµV/m
E_{Meas}	is the field strength of the emission at the measurement distance, in dBµV/m
d_{Meas}	is the measurement distance, in m
$d_{\mathrm{SpecLimit}}$	is the distance specified by the limit, in m

So the extrapolation factor of 1m is 20*log(1/3)= -9.5 dB

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

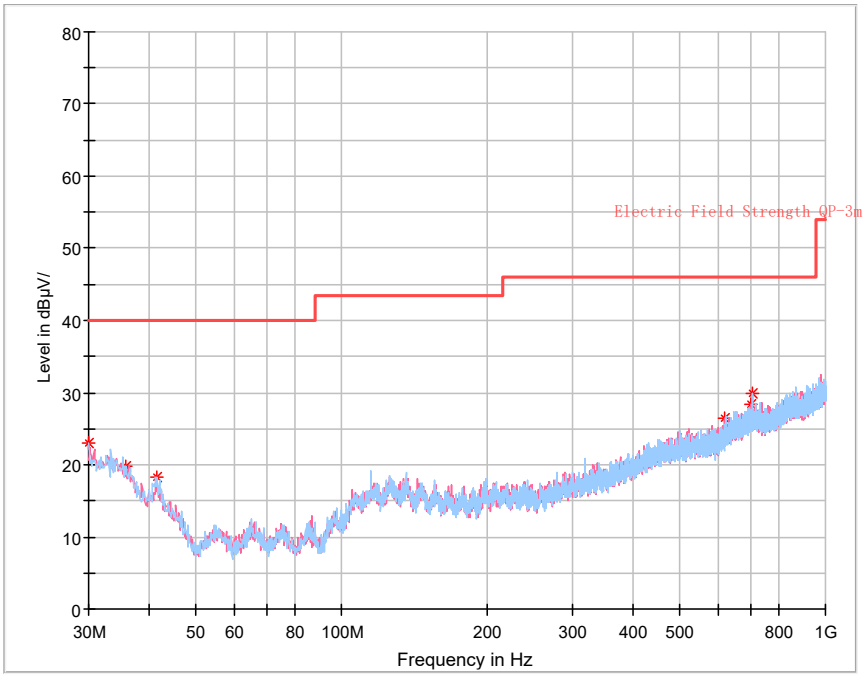
Environmental Conditions

Temperature:	28~28.4 ℃
Relative Humidity:	45~72 %
ATM Pressure:	101.0 kPa

The testing was performed by Harris He on 2021-05-15 for below 1GHz and Dio Ding on 2021-08-10 for above 1GHz.

Test Mode: Transmitting

30MHz – 1 GHz:



Critical_Freqs

Frequency (MHz)	MaxPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.000000	22.96	40.00	17.04	400.0	H	212.0	-3.5
35.820000	19.85	40.00	20.15	100.0	H	0.0	-7.8
41.640000	18.38	40.00	21.62	200.0	H	289.0	-11.5
620.608750	26.46	46.00	19.54	100.0	V	322.0	-3.6
700.755000	28.35	46.00	17.65	300.0	V	14.0	-1.5
706.211250	29.81	46.00	16.19	300.0	H	156.0	-1.5

1 ~ 40 GHz:

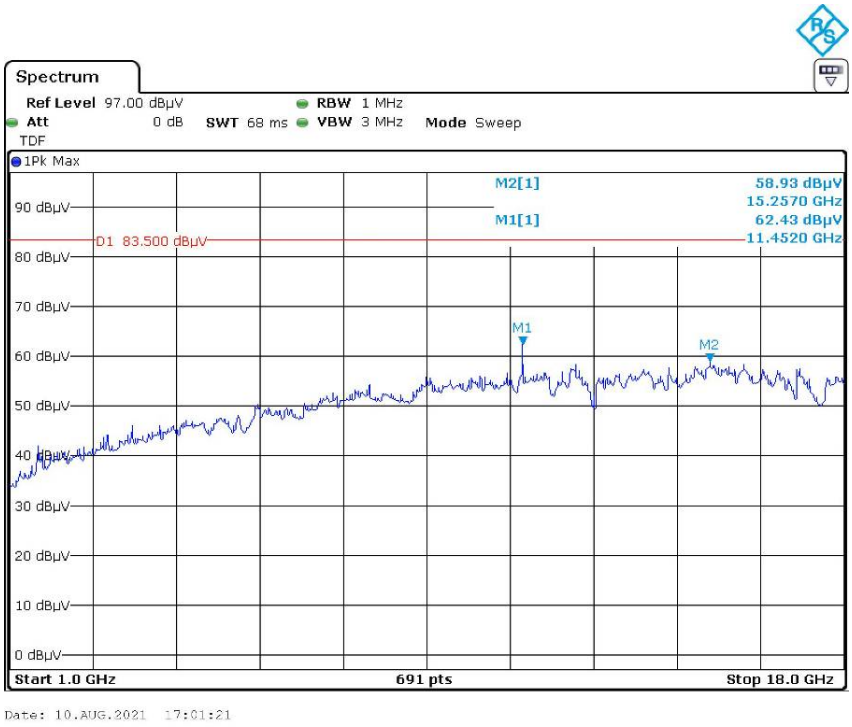
Note: The test distance is 1m, so the correct factor from 3m to 1m is 20log(3/1)=9.5dB which was added into the final limit.

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	FCC Part 15.249&15.209	
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Low Channel(5726MHz)									
5726.00	44.57	PK	4	1.5	H	39.49	84.06	123.5	39.44
5726.00	41.29	Ave.	4	1.5	H	39.49	80.78	103.5	22.72
5726.00	40.37	PK	214	2.5	V	39.49	79.86	123.5	43.64
5726.00	38.22	Ave.	214	2.5	V	39.49	77.71	103.5	25.79
5725.00	35.27	PK	137	1.3	H	39.49	74.76	83.5	8.74
5725.00	20.41	Ave.	137	1.3	H	39.49	59.90	63.5	3.60
11452.00	48.04	PK	203	2.0	H	17.47	65.51	83.5	17.99
11452.00	43.99	Ave.	203	2.0	H	17.47	61.46	63.5	2.04
17178.00	45.71	PK	200	1.7	H	22.14	67.85	83.5	15.65
17178.00	37.05	Ave.	200	1.7	H	22.14	59.19	63.5	4.31
Middle Channel(5800MHz)									
5800.00	46.83	PK	253	1.1	H	39.61	86.44	123.5	37.06
5800.00	44.17	Ave.	253	1.1	H	39.61	83.78	103.5	19.72
5800.00	45.89	PK	66	1.4	V	39.61	85.50	123.5	38.00
5800.00	42.07	Ave.	66	1.4	V	39.61	81.68	103.5	21.82
11600.00	46.79	PK	206	1.5	H	17.51	64.30	83.5	19.20
11600.00	42.90	Ave.	206	1.5	H	17.51	60.41	63.5	3.09
17400.00	45.83	PK	123	1.9	H	21.92	67.75	83.5	15.75
17400.00	37.24	Ave.	123	1.9	H	21.92	59.16	63.5	4.34
High Channel(5874MHz)									
5874.00	44.97	PK	145	1.8	H	39.87	84.84	123.5	38.66
5874.00	41.39	Ave.	145	1.8	H	39.87	81.26	103.5	22.24
5874.00	40.54	PK	353	1.0	V	39.87	80.41	123.5	43.09
5874.00	37.29	Ave.	353	1.0	V	39.87	77.16	103.5	26.34
5875.00	35.38	PK	180	2.1	H	39.87	75.25	83.5	8.25
5875.00	20.45	Ave.	180	2.1	H	39.87	60.32	63.5	3.18
11748.00	47.83	PK	74	2.3	H	16.18	64.01	83.5	19.49
11748.00	44.19	Ave.	74	2.3	H	16.18	60.37	63.5	3.13
17622.00	45.37	PK	74	1.9	H	24.26	69.63	83.5	13.87
17622.00	36.40	Ave.	74	1.9	H	24.26	60.66	63.5	2.84

Note:
Corrected Amplitude = Corrected Factor + Reading
Corrected Factor=Antenna factor (RX) +cable loss – amplifier factor
Margin = Limit- Corr. Amplitude
The emission more than20dB below the limit was not required to be recorded.

Pre-scan with Low channel Peak

Horizontal



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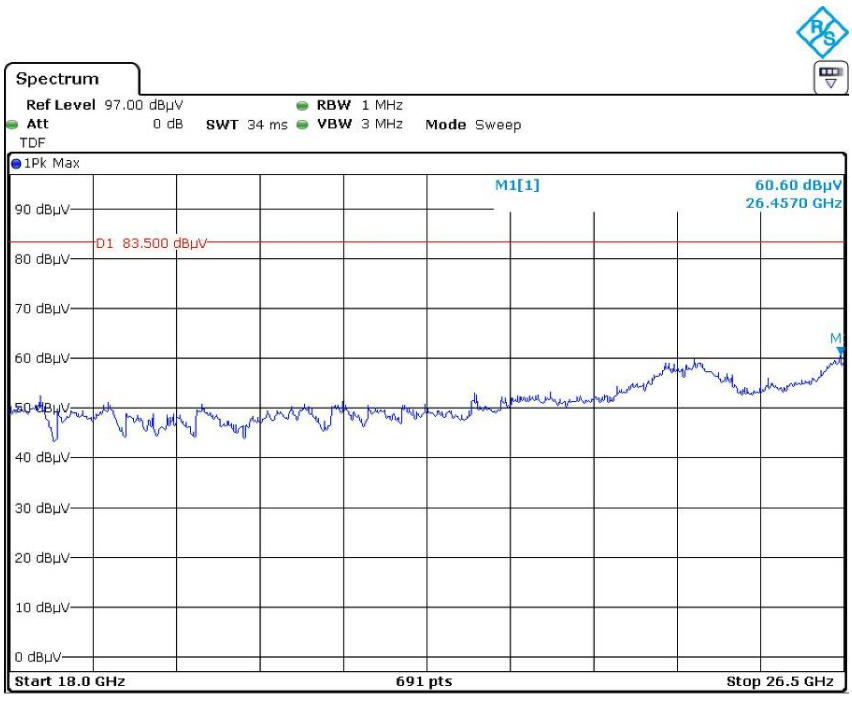

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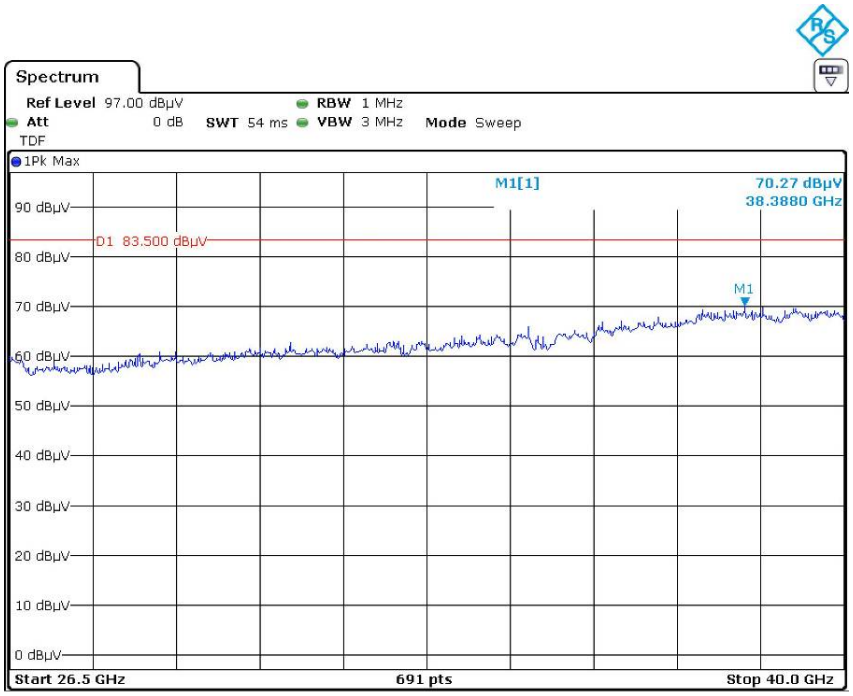

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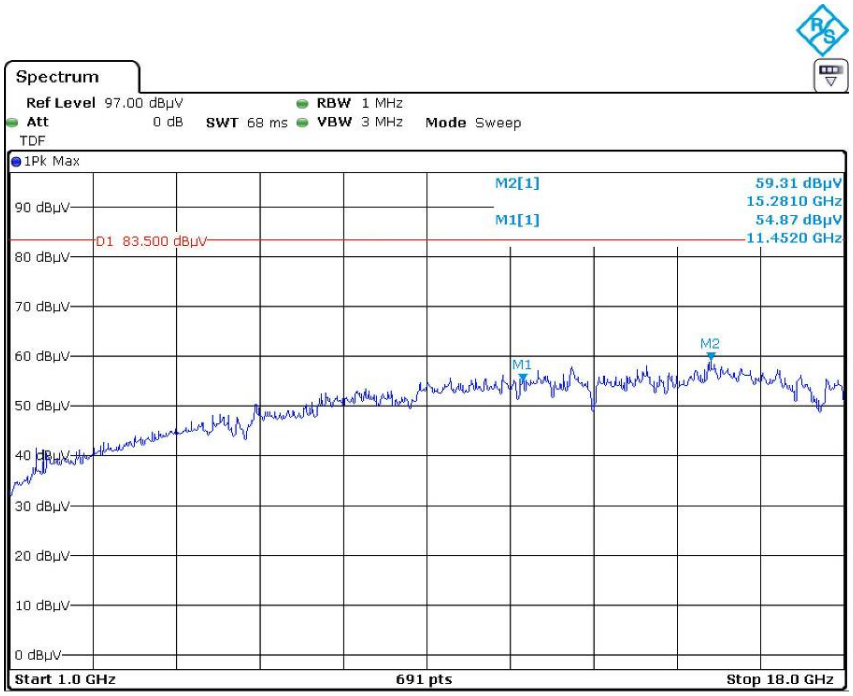
Vertical



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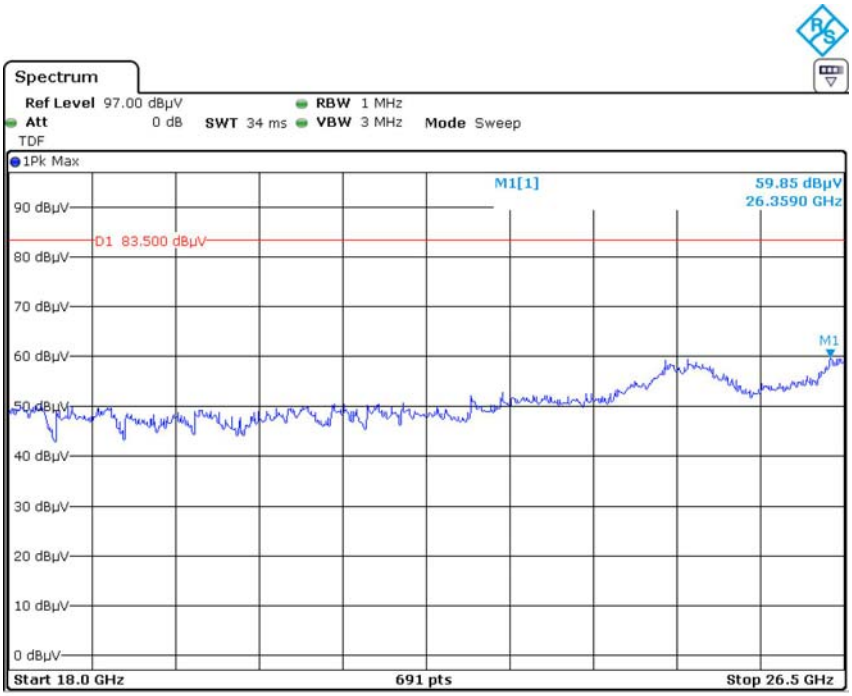

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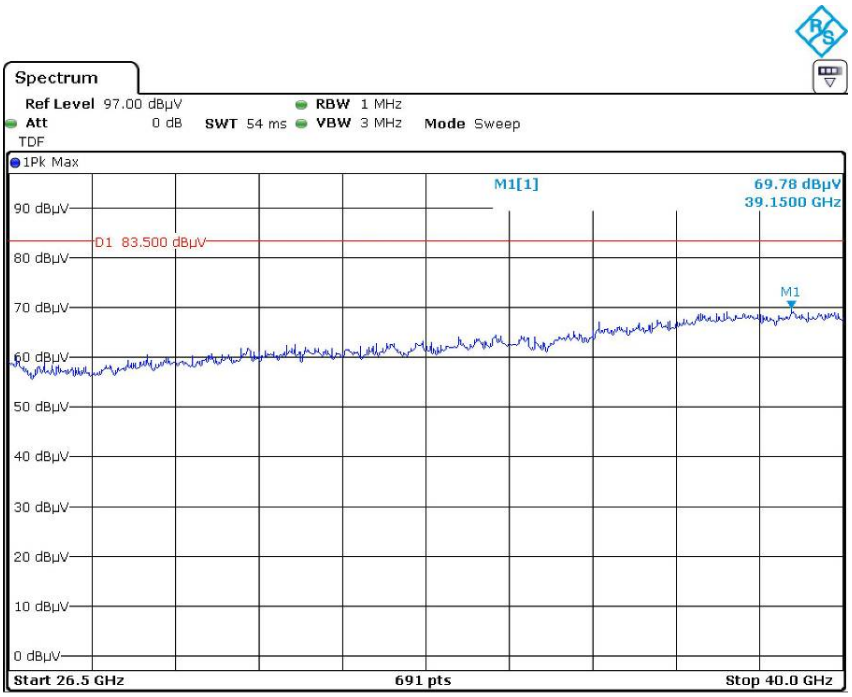

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Average value
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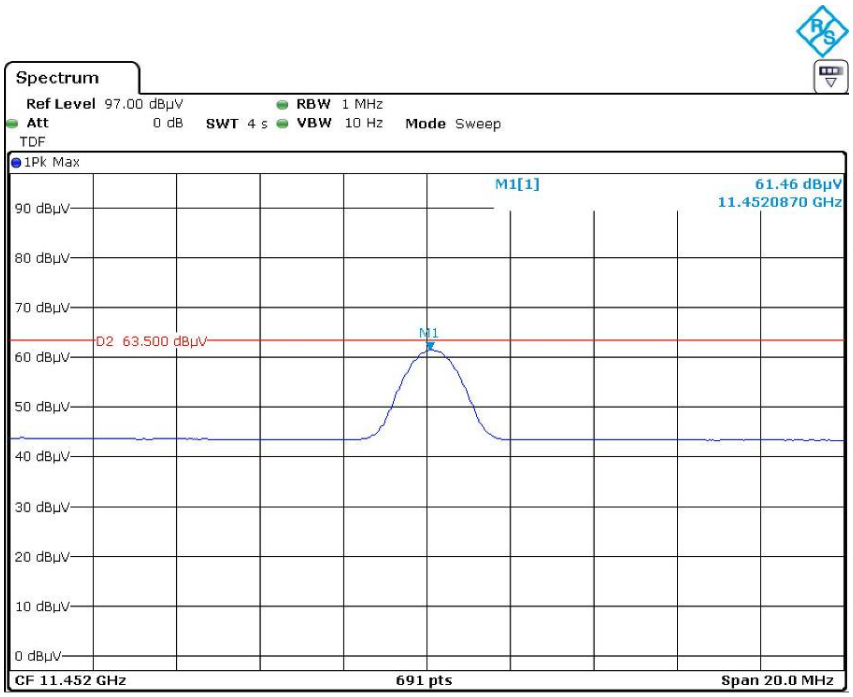

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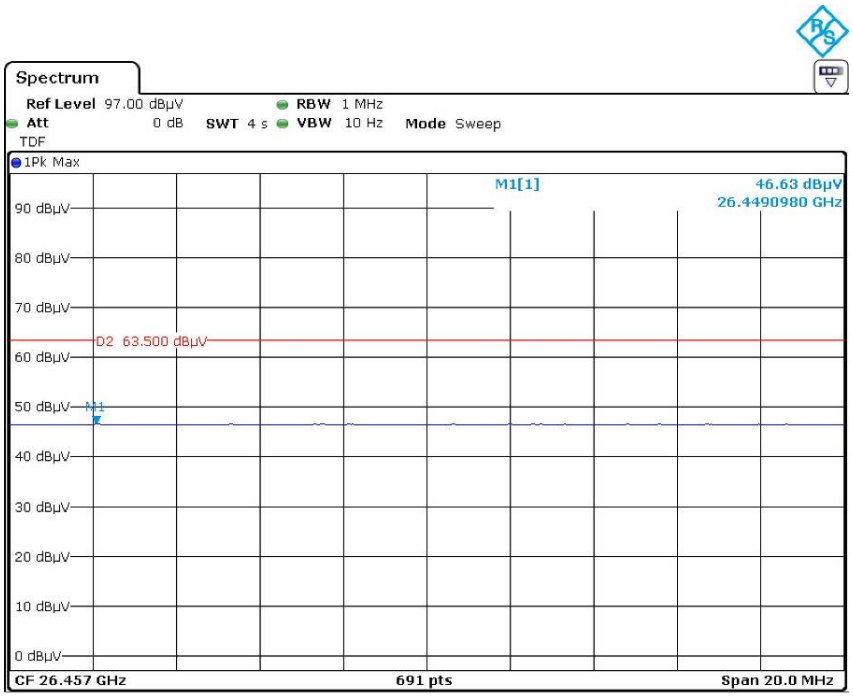

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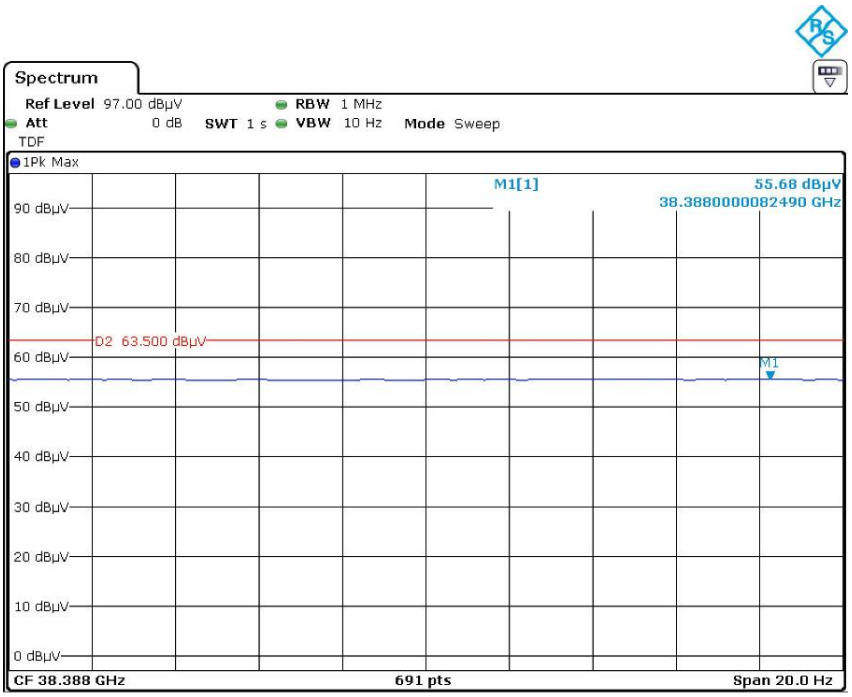

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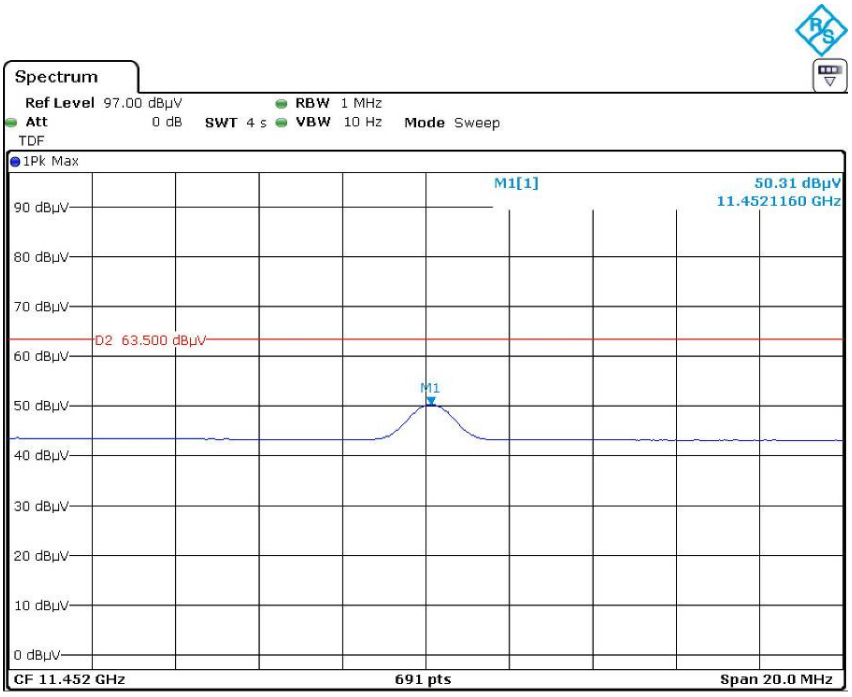
Vertical



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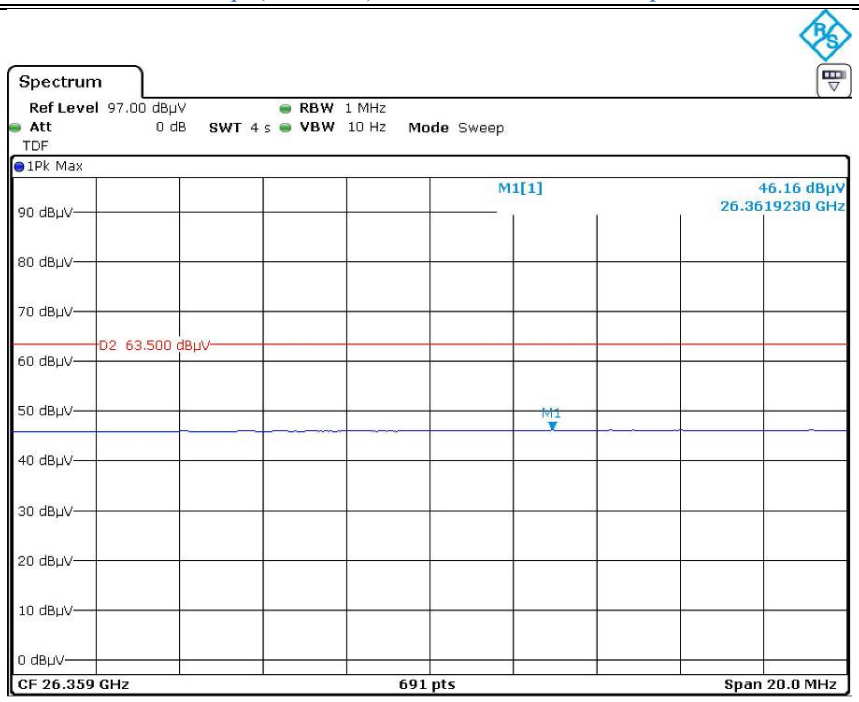
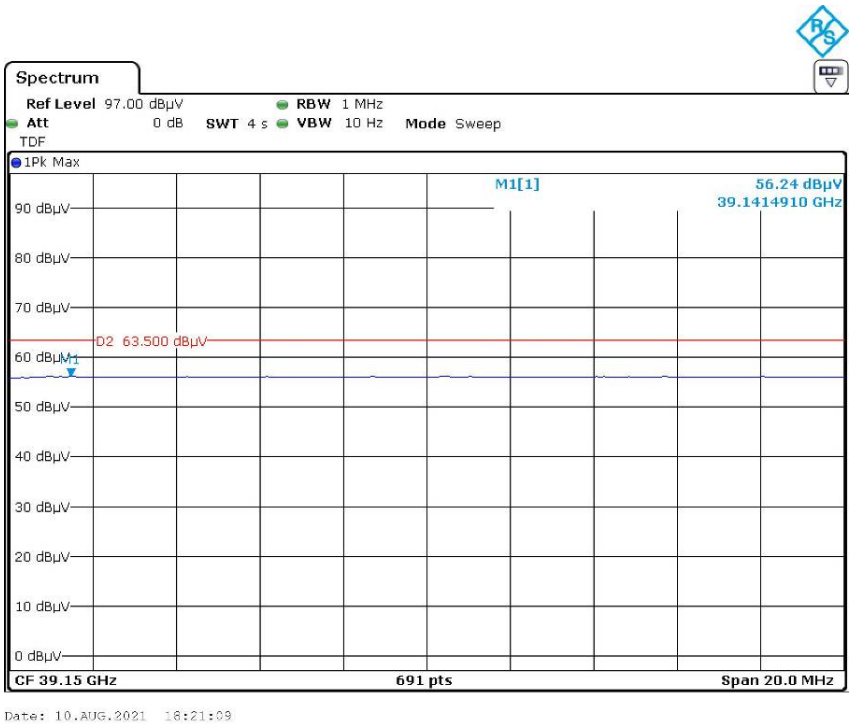

Spectrum
Ref Level 97.00 dBµV
RBW 1 MHz
Att 0 dB
SWT 4 s
VBW 10 Hz
Mode Sweep
TDF
1Pk Max
M1[1]
46.16 dBµV
26.3619230 GHz
90 dBµV
80 dBµV
70 dBµV
D2 63.500 dBµV
60 dBµV
50 dBµV
M1
40 dBµV
30 dBµV
20 dBµV
10 dBµV
0 dBµV
CF 26.359 GHz
691 pts
Span 20.0 MHz
Date: 10.AUG.2021 18:01:14


Spectrum
Ref Level 97.00 dBµV
RBW 1 MHz
Att 0 dB
SWT 4 s
VBW 10 Hz
Mode Sweep
TDF
1Pk Max
M1[1]
56.24 dBµV
39.1414910 GHz
90 dBµV
80 dBµV
70 dBµV
D2 63.500 dBµV
60 dBµV
M1
50 dBµV
40 dBµV
30 dBµV
20 dBµV
10 dBµV
0 dBµV
CF 39.15 GHz
691 pts
Span 20.0 MHz
Date: 10.AUG.2021 18:21:09

FCC§15.215(c) - 20dB EMISSION BANDWIDTH

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

Refer to ANSI C63.17-2017 section 6.9.

Test Data

Environmental Conditions

Temperature:	28 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

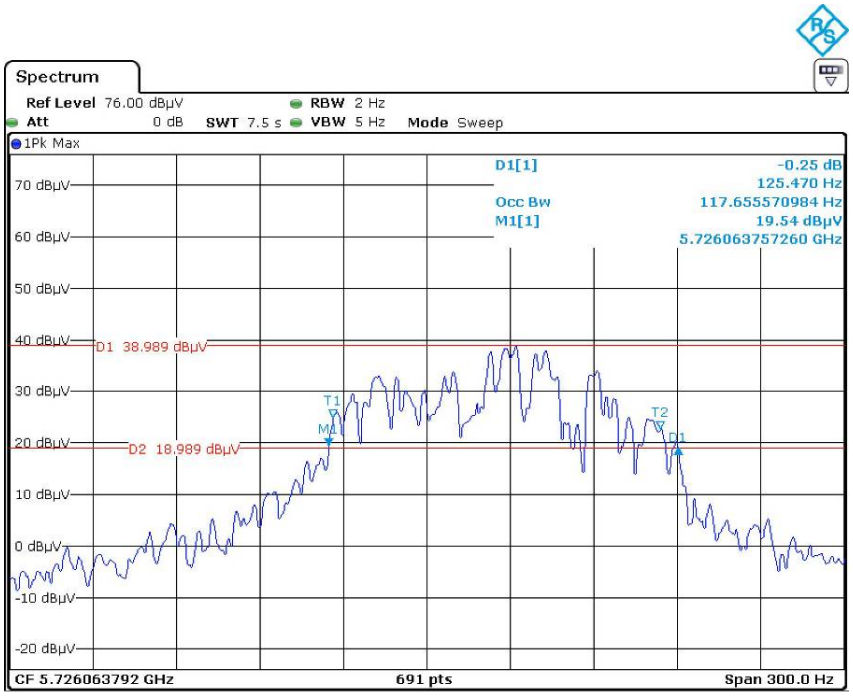
The testing was performed by Dio Ding on 2021-08-10.

Test Mode: Transmitting

Please refer to the following table and plots.

Channel	Frequency (MHz)	20dB Bandwidth (kHz)
Low	5726	0.125
Middle	5800	0.097
High	5874	0.120

Low Channel



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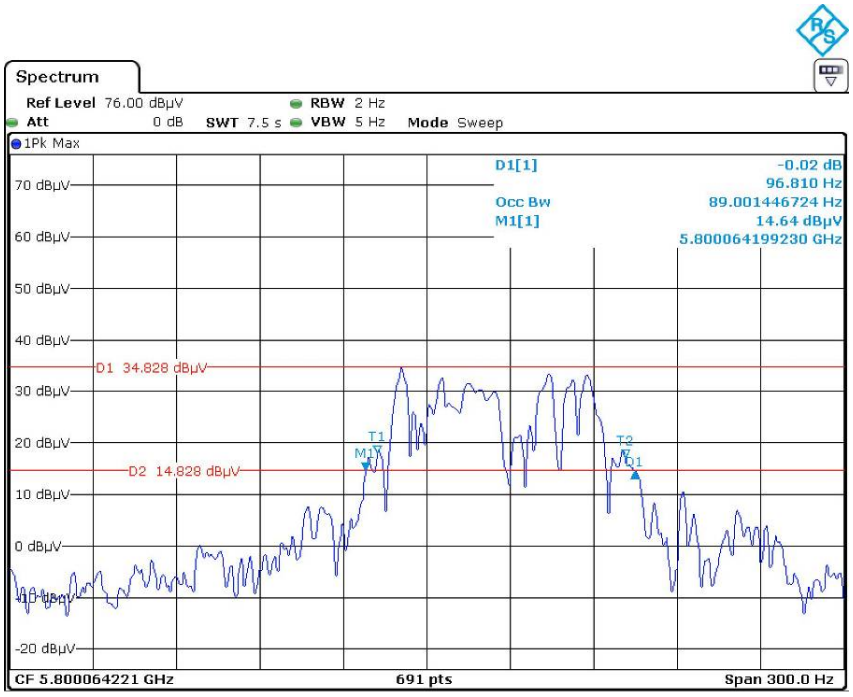
Middle Channel



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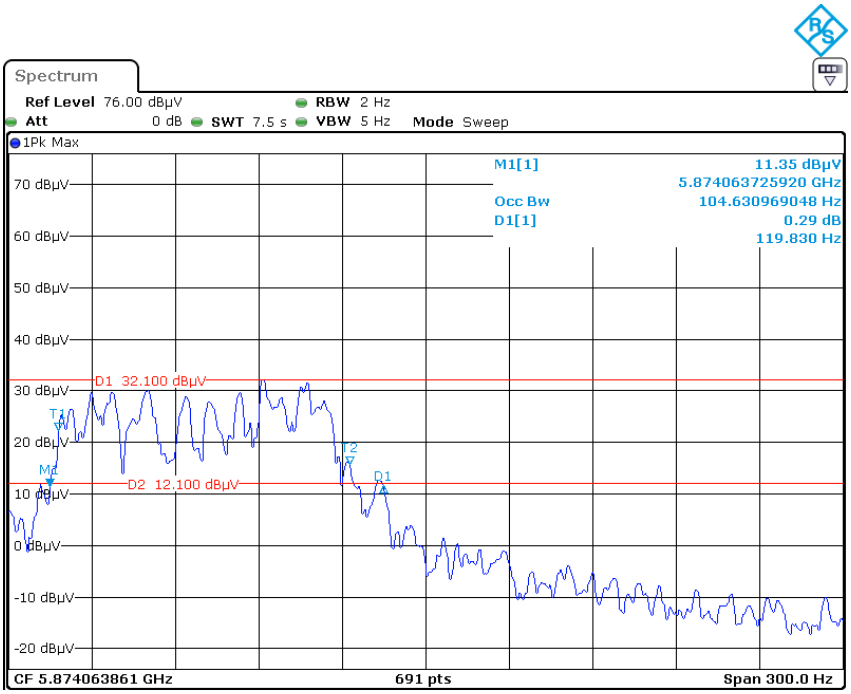
High Channel



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