FCC PART 15.247

TEST REPORT

For

Avi-on Labs, Inc.

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

FCC ID: 2AFZI-AVI1010B

Report Type:	**Product Type:**
Class II Permissive Change	AVI1010-B

Report Number: RSZ200505810-00A1

Report Date: 2020-06-05

Reviewed By: Jimmy Xiao RF Engineer

Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen)
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	AVI1010-B
Tested Model	AVI1010-B
Frequency Range	BLE: 2402~2480MHz
Modulation Technique	BLE: GFSK
Antenna Specification	3.4 dBi
Voltage	AC 120V/AC 277V/50Hz/60Hz
Date of Test	2020-05-12 to 2020-05-25
Sample serial number	RSZ200505810-RFA1-S1 (Assigned by BACL, Shenzhen)
Received date	2020-05-05
Sample/EUT Status	Good condition

Objective

This report is prepared on behalf of *Avi-on Labs, Inc.* in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's 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 15.247 rules.

This is a CIIPC application of the device; the differences between the original device and the current one are as follows:

1. Change the model number to "AVI1010-B".
2. Change the product name to "AVI1010-B".
3. Change the trade name to "Avi-on XPP".
4. Change the shape of the shielding cover of the module.
5. The module was limited to one platform board.
6. Change the monopole and dipole antennas to one PIFA antenna.

Based on above differences, it will affected partial test data, so the changed items were performed.

Related Submittal(s)/Grant(s)

No Related Submittal(s)/Grant(s).

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.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All 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.

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 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, 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 test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For BLE mode, 40 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

EUT was tested with Channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

“uEnergy Tools 2.5.0” software was used and power level is 7.

Support Equipment List and Details

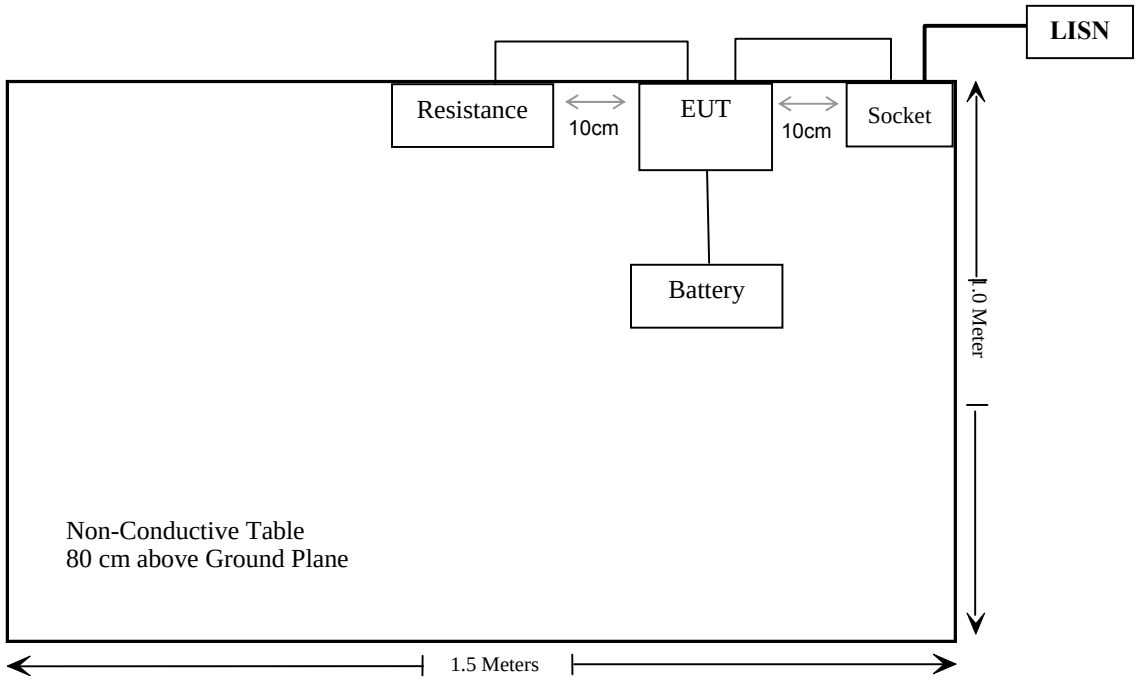
Manufacturer	Description	Model	Serial Number
Unknown	Resistance	Unknown	159456
Unknown	Battery	Unknown	159452

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielded Detachable AC cable	1.2	EUT	Socket
Un-shielded Detachable AC Power Cable	0.8	EUT	Resistance
Un-shielded Detachable DC Power Cable	0.8	EUT	Battery

Block Diagram of Test Setup

For conducted emission



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §2.1091	Maximum Permissible Exposure(MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance*
§15.247(b)(3)	Maximum Conducted Output Power	Compliance*
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance*
§15.247(e)	Power Spectral Density	Compliance*

Compliance*: Please referred to FCC ID: 2AFZI-AVI1010B granted on 2018-03-15.Report No.: BTL-FICP-1711C205, which was tested by BTL INC..

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2019/7/9	2020/7/8
Rohde & Schwarz	LISN	ENV216	101613	2020/1/22	2021/1/21
Rohde & Schwarz	Transient Limitor	ESH3Z2	DE25985	2019/11/29	2020/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2019/11/29	2020/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2019/7/9	2020/7/8
Sonoma instrument	Pre-amplifier	310 N	186238	2020/4/20	2021/4/20
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017/12/22	2020/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2019/11/29	2020/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2019/11/29	2020/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2019/7/22	2020/7/21
COM-POWER	Pre-amplifier	PA-122	181919	2019/11/29	2020/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2019/11/29	2020/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2019/11/29	2020/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2019/11/29	2020/11/28
SNSD	Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2020/4/20	2021/4/20
Ducommun Technolagies	Horn antenna	ARH-4223-02	1007726-02 1304	2017/12/6	2020/12/5

*** 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 §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (Minutes)**
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm2)
P = power input to the antenna (in appropriate units, e.g., mW).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Frequency (MHz)	**Antenna Gain**		**Maximum Tune Up Conducted Power**		**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**MPE Limit (mW/cm^2)**
	(dBi)	**(numeric)**	**(dBm)**	**(mW)**			
2402-2480	3.4	2.2	10	10	20	0.004	1.0

Note: To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: compliance.

FCC §15.203 - ANTENNA REQUIREMENT

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.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.
And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has a PIFA antenna arrangement which was permanently attached and the antenna gain is 3.4dBi, fulfill the requirement of this section. Please refer to the EUT photos.

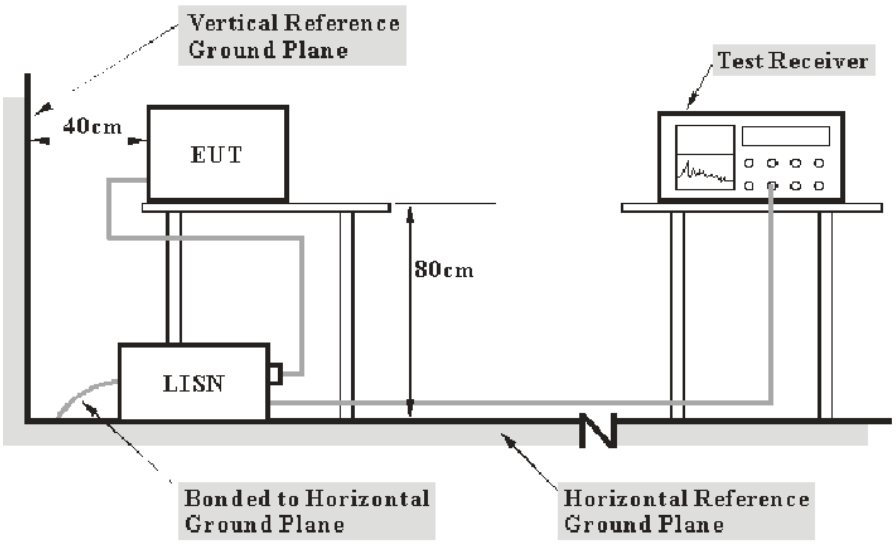
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

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.

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 LISN.

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

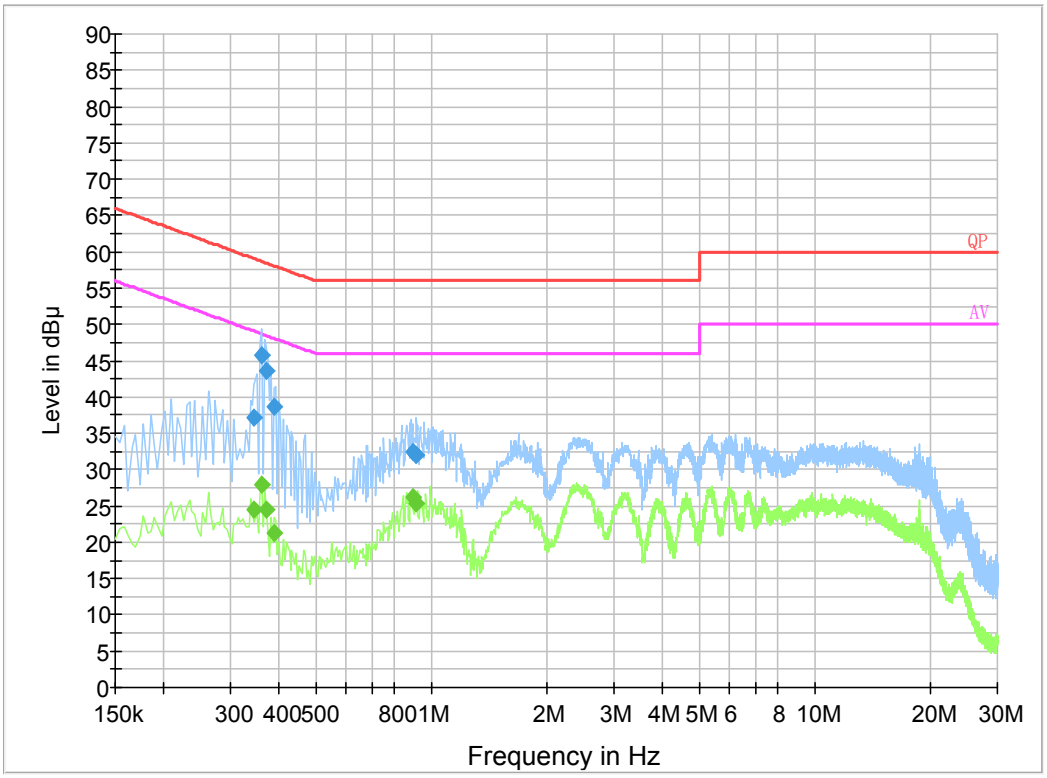
Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	65 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2020-05-25.

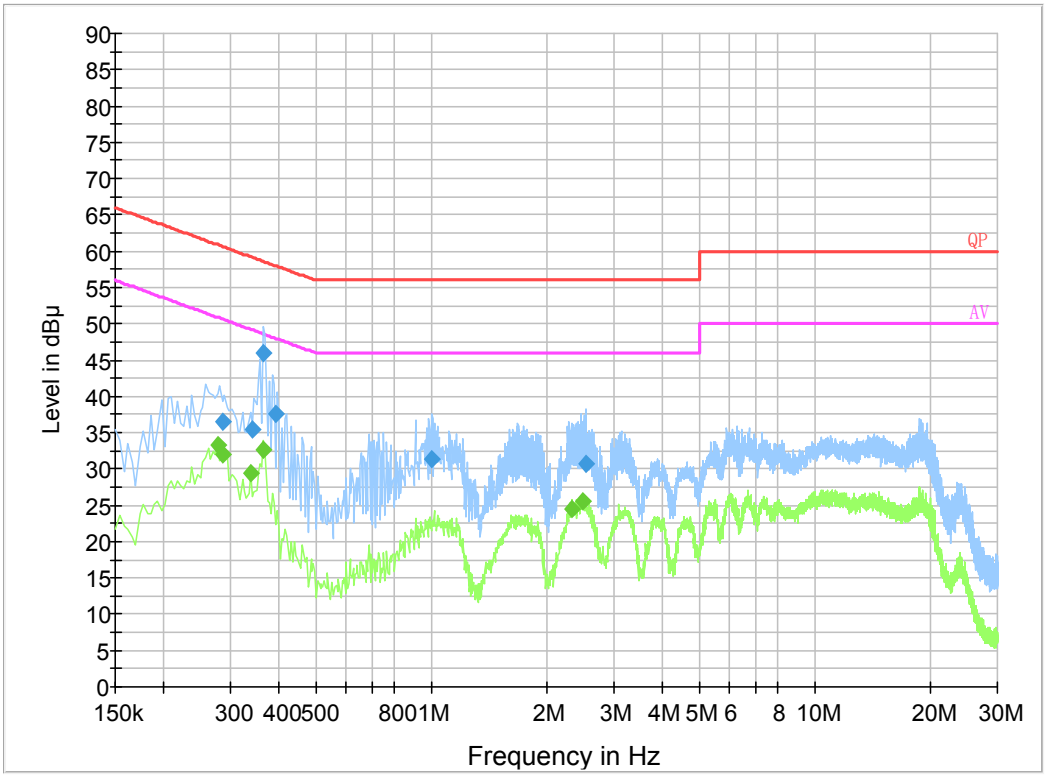
EUT operation mode: Transmitting (Worst case at middle channel)

AC 120V/60 Hz, Line



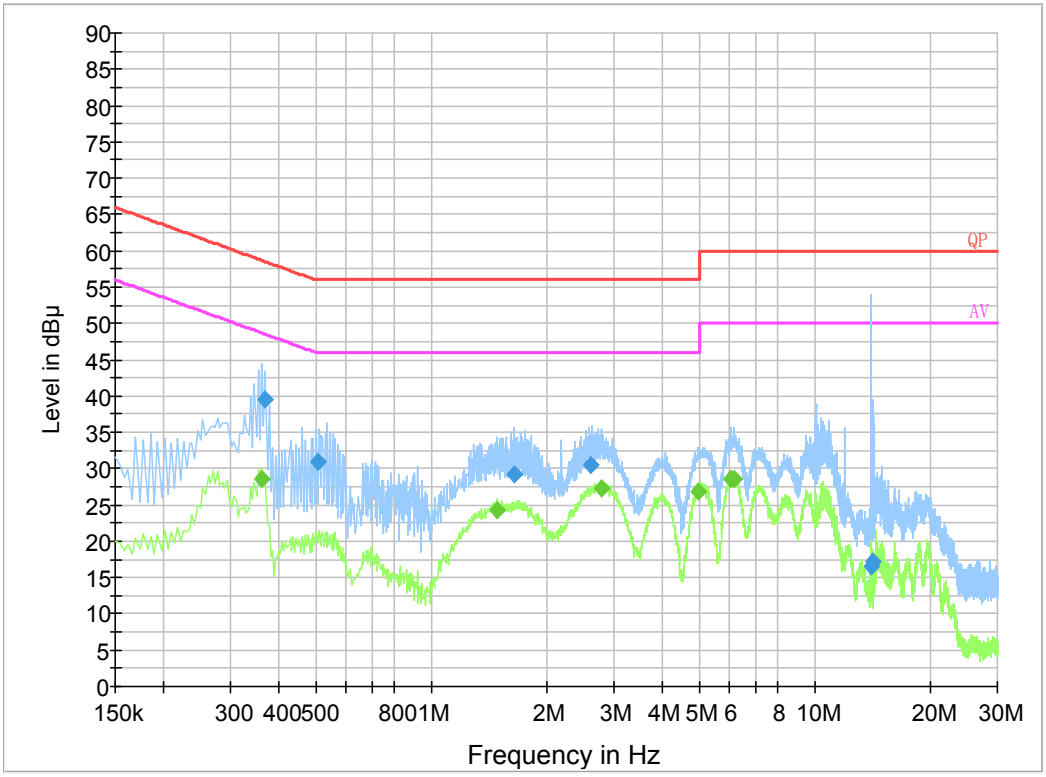
Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.344750	37.3	19.9	59.1	21.8	QP
0.360570	45.7	19.9	58.7	13.0	QP
0.372450	43.7	19.9	58.4	14.7	QP
0.388090	38.6	19.9	58.1	19.5	QP
0.892710	32.5	19.8	56.0	23.5	QP
0.916290	32.0	19.8	56.0	24.0	QP
0.344750	24.4	19.9	49.1	24.6	Ave.
0.360570	27.8	19.9	48.7	20.9	Ave.
0.372450	24.5	19.9	48.4	24.0	Ave.
0.388090	21.2	19.9	48.1	26.9	Ave.
0.892710	26.1	19.8	46.0	19.9	Ave.
0.916290	25.2	19.8	46.0	20.8	Ave.

AC 120V/60 Hz, Neutral



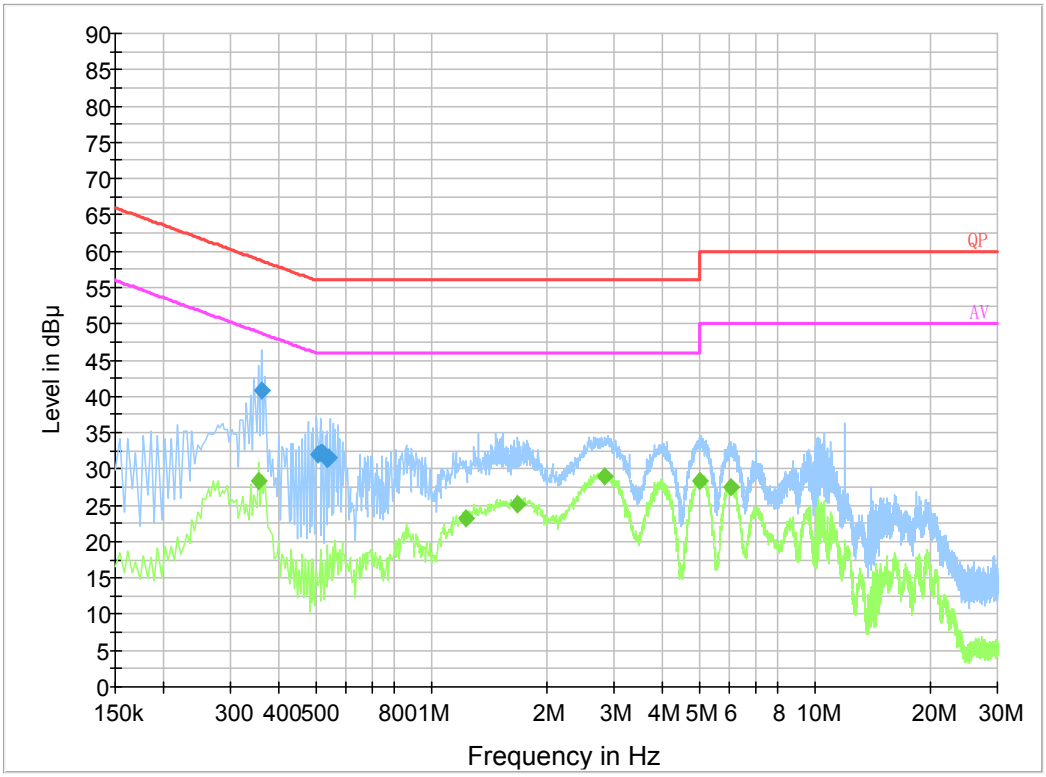
Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.286500	36.6	19.7	60.6	24.0	QP
0.340810	35.4	19.8	59.2	23.8	QP
0.364510	45.9	19.9	58.6	12.7	QP
0.392150	37.6	19.8	58.0	20.4	QP
0.998910	31.4	19.8	56.0	24.6	QP
2.535870	30.8	19.8	56.0	25.2	QP
0.278000	33.2	19.7	50.9	17.7	Ave.
0.286000	32.0	19.7	50.6	18.6	Ave.
0.338000	29.4	19.8	49.3	19.9	Ave.
0.366000	32.6	19.9	48.6	16.0	Ave.
2.330000	24.5	19.8	46.0	21.5	Ave.
2.498000	25.5	19.8	46.0	20.5	Ave.

AC 277V/60 Hz, Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.368000	39.6	9.8	58.5	18.9	QP
0.508000	30.9	9.8	56.0	25.1	QP
1.648000	29.3	9.8	56.0	26.7	QP
2.612000	30.5	9.7	56.0	25.5	QP
14.120000	16.6	9.6	60.0	43.4	QP
14.192000	17.1	9.6	60.0	42.9	QP
0.362000	28.7	9.8	48.7	20.0	Ave.
1.486000	24.3	9.8	46.0	21.7	Ave.
2.790000	27.3	9.7	46.0	18.7	Ave.
4.990000	26.9	9.8	46.0	19.1	Ave.
6.066000	28.6	9.8	50.0	21.4	Ave.
6.174000	28.6	9.8	50.0	21.4	Ave.

AC 277V/60 Hz, Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.360000	40.8	9.8	58.7	17.9	QP
0.508000	32.0	9.8	56.0	24.0	QP
0.516000	32.1	9.8	56.0	23.9	QP
0.520000	32.1	9.8	56.0	23.9	QP
0.536000	31.4	9.8	56.0	24.6	QP
0.540000	31.7	9.8	56.0	24.3	QP
0.354000	28.3	9.8	48.9	20.5	Ave.
1.238000	23.3	9.8	46.0	22.7	Ave.
1.686000	25.1	9.8	46.0	20.9	Ave.
2.834000	28.9	9.7	46.0	17.1	Ave.
4.998000	28.4	9.8	46.0	17.6	Ave.
6.038000	27.6	9.8	50.0	22.4	Ave.

Note:

1) Correction Factor =LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
2) Corrected Amplitude = Reading + Correction Factor
3) Margin = Limit – Corrected Amplitude

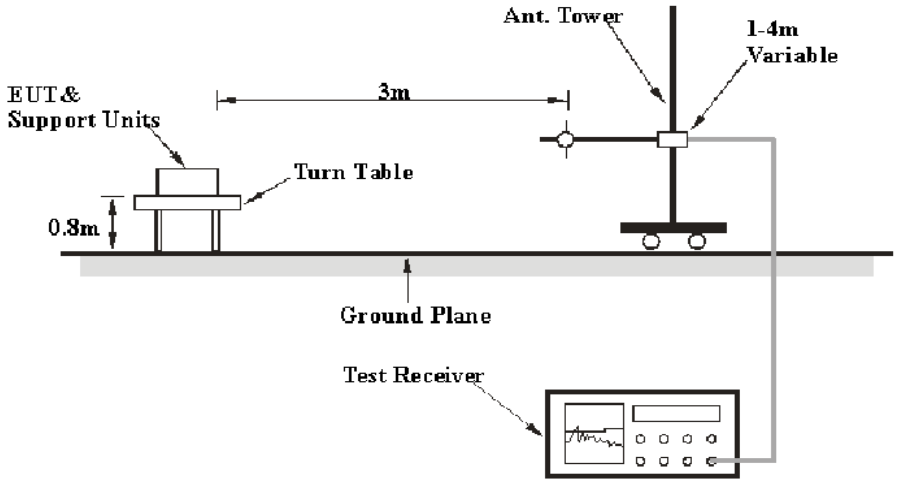
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

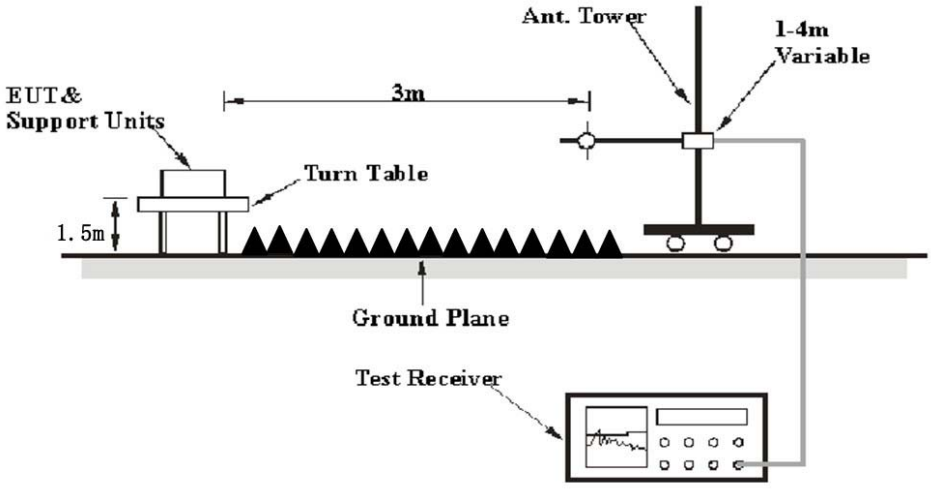
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



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 15.209, and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer 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	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz Note 1	/	Average
	1MHz	＞1/T Note 2	/	Average

Note 1: when duty cycle is no less than 98%
Note 2: when duty cycle is less than 98%

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:

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

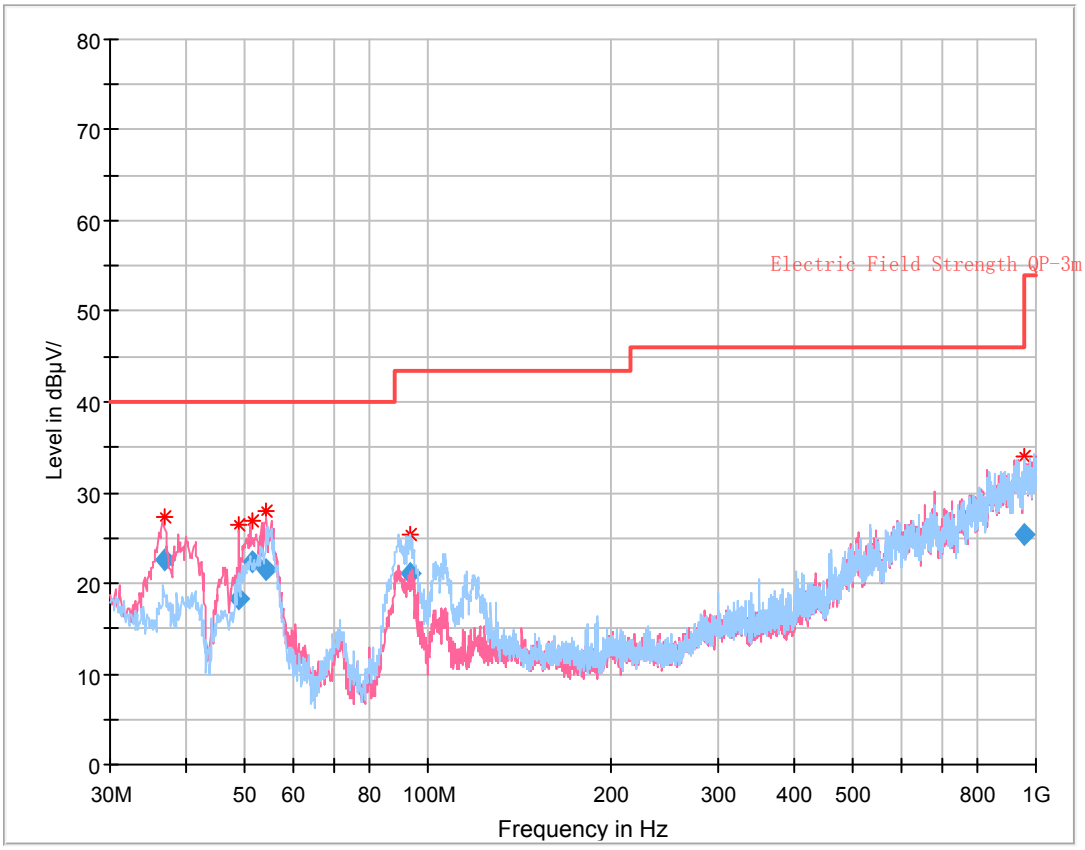
Environmental Conditions

Temperature:	23~25 ℃
Relative Humidity:	56~65 %
ATM Pressure:	101.0 kPa

The testing was performed by Holland Yang on 2020-05-23 for below 1G and Leo Huang on 2020-05-12 for above 1G and duty cycle.

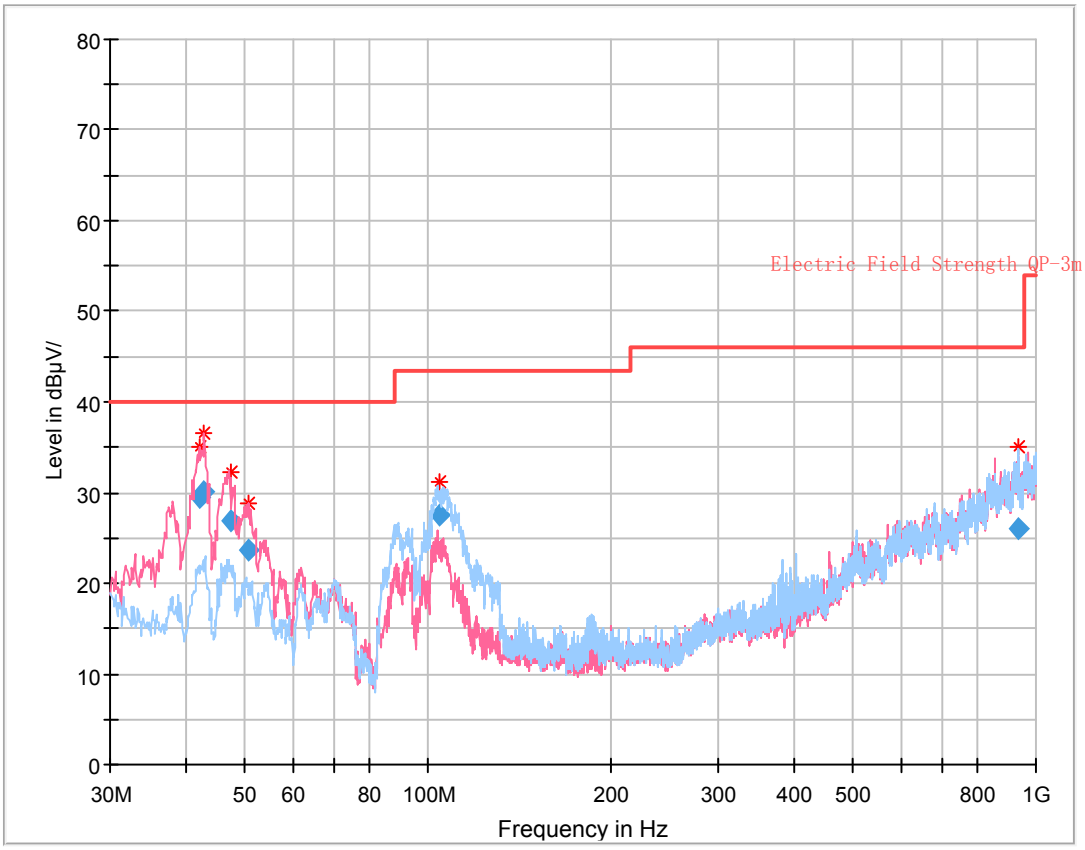
EUT operation mode: Transmitting

AC 120V/60 Hz, 30 MHz~1 GHz (worst case at middle channel):



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
36.871375	22.66	101.0	V	95.0	-11.8	40.00	17.34
48.692000	18.20	102.0	V	78.0	-19.0	40.00	21.80
51.326250	22.38	126.0	V	76.0	-19.7	40.00	17.62
54.117500	21.44	112.0	V	95.0	-19.9	40.00	18.56
93.739250	21.12	193.0	H	134.0	-18.3	43.50	22.38
955.680875	25.48	272.0	H	222.0	5.2	46.00	20.52

AC 277V/60 Hz, 30 MHz~1 GHz (worst case at middle channel):



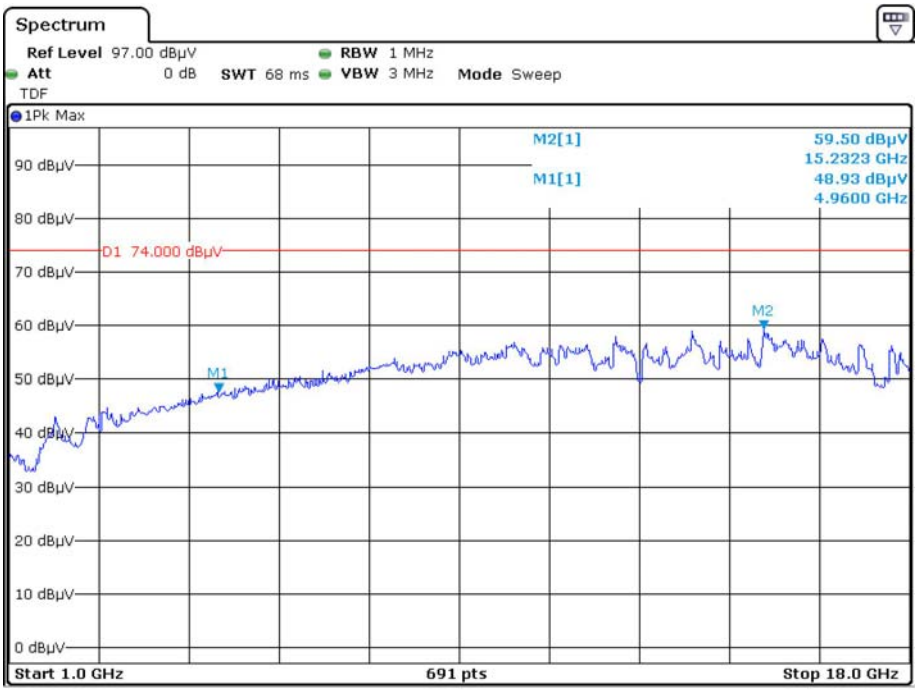
Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
42.000000	29.56	108.0	V	66.0	-15.5	40.00	10.44
42.852500	30.07	100.0	V	52.0	-15.8	40.00	9.93
47.539625	26.79	108.0	V	43.0	-18.5	40.00	13.21
50.759875	23.55	114.0	V	57.0	-19.7	40.00	16.45
104.135625	27.62	272.0	H	340.0	-16.5	43.50	15.88
935.013250	26.07	382.0	H	262.0	4.8	46.00	19.93

1 GHz-25 GHz: (AC 277V/60 Hz was worst case)

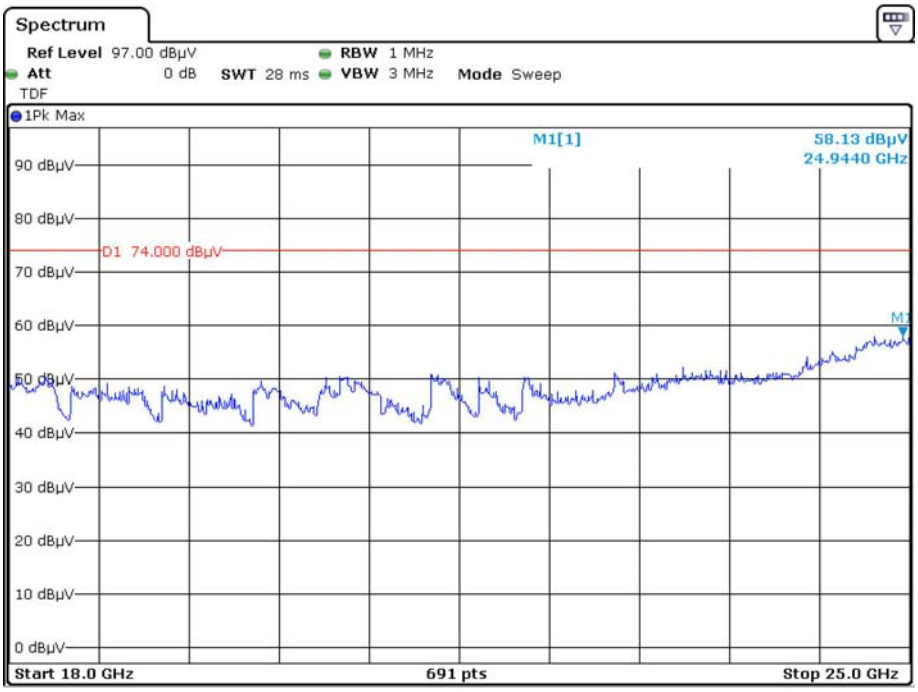
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2389.63	29.11	PK	61	2.1	H	31.87	60.98	74	13.02
2389.63	13.58	Ave.	61	2.1	H	31.87	45.45	54	8.55
2483.74	27.86	PK	184	2.2	H	32.13	59.99	74	14.01
2483.74	13.42	Ave.	184	2.2	H	32.13	45.55	54	8.45
4804.00	44.31	PK	185	1.9	H	6.28	50.59	74	23.41
4804.00	31.68	Ave.	185	1.9	H	6.28	37.96	54	16.04
Middle Channel (2440 MHz)									
4880.00	44.37	PK	42	1.4	H	6.76	51.13	74	22.87
4880.00	32.29	Ave.	42	1.4	H	6.76	39.05	54	14.95
High Channel (2480 MHz)									
2388.76	27.84	PK	170	1.3	H	31.87	59.71	74	14.29
2388.76	13.46	Ave.	170	1.3	H	31.87	45.33	54	8.67
2483.54	27.91	PK	86	2.2	H	32.13	60.04	74	13.96
2483.54	13.62	Ave.	86	2.2	H	32.13	45.75	54	8.25
4960.00	44.68	PK	2	1.5	H	6.80	51.48	74	22.52
4960.00	34.28	Ave.	2	1.5	H	6.80	41.08	54	12.92

Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is 20dB to the limit was not recorded.
And for the harmonic test, it is performed with the 2400-2483.5MHz band filter.

Pre-scan with High channel
Horizontal

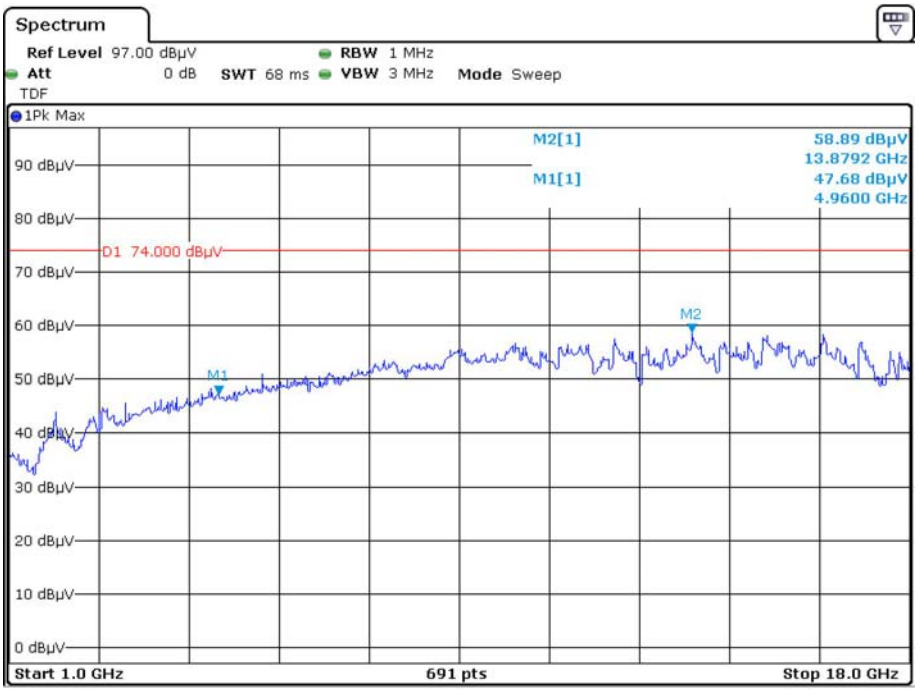


Date: 12.MAY.2020 08:45:40

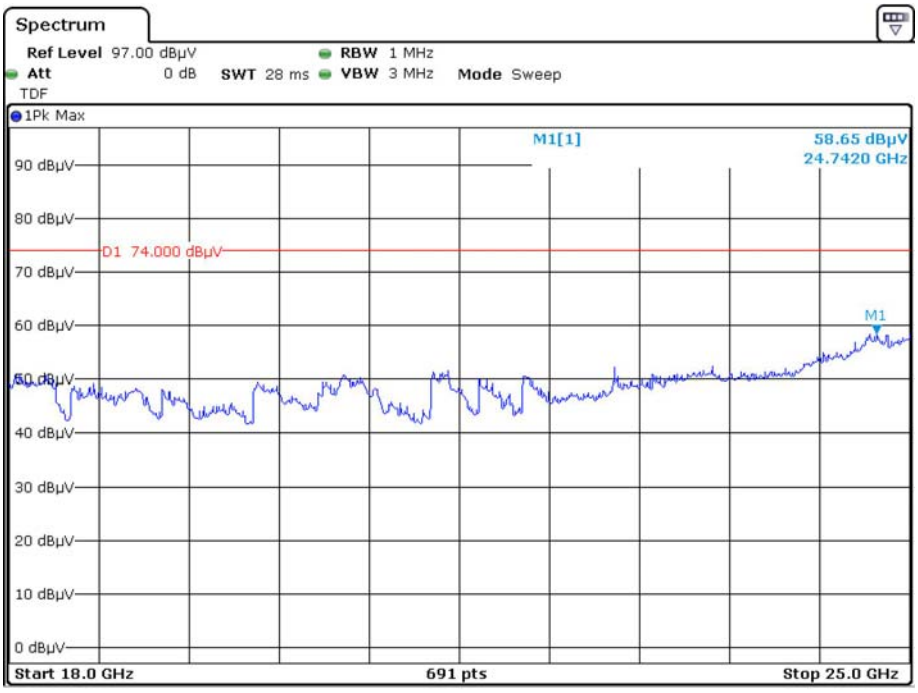


Date: 12.MAY.2020 09:33:18

Vertical

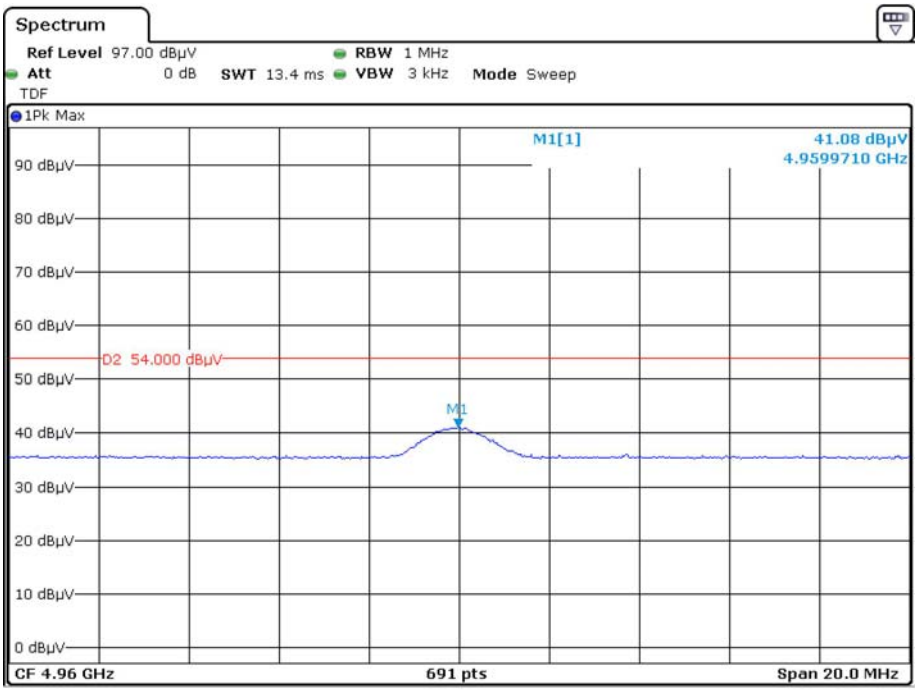


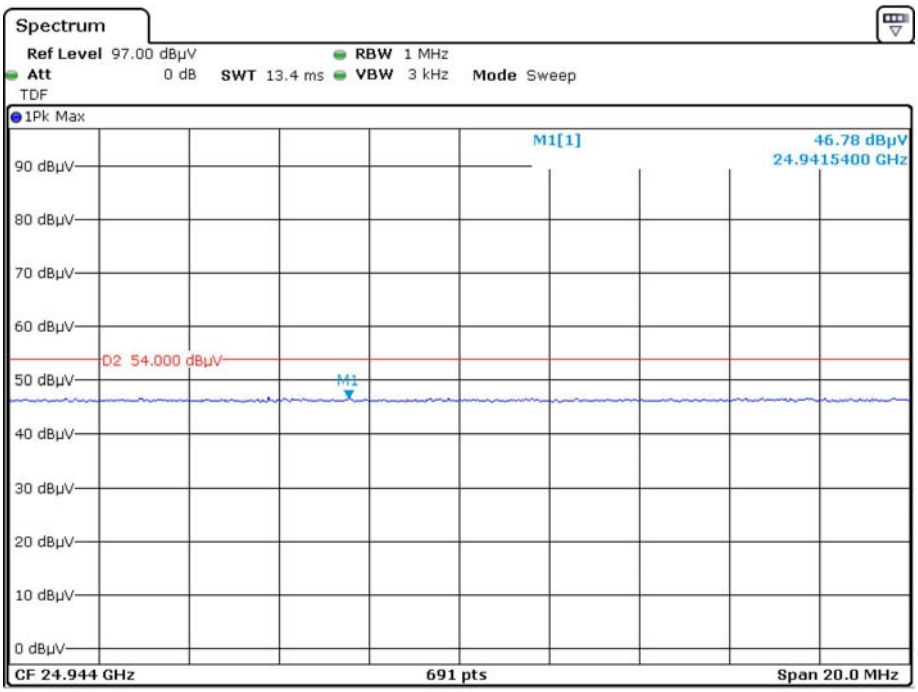
Date: 12.MAY.2020 08:52:49



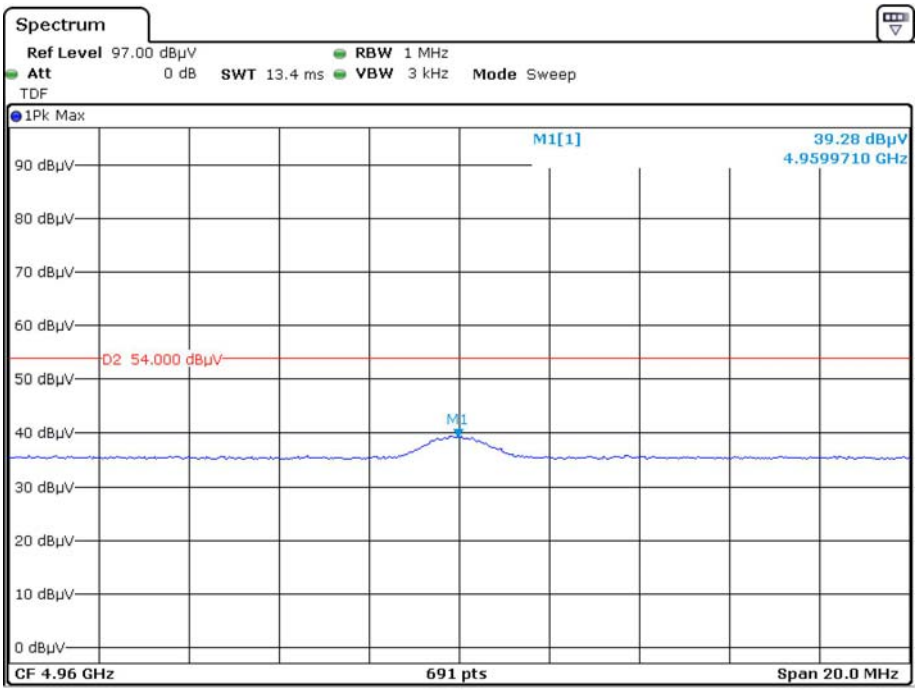
Date: 12.MAY.2020 09:27:05

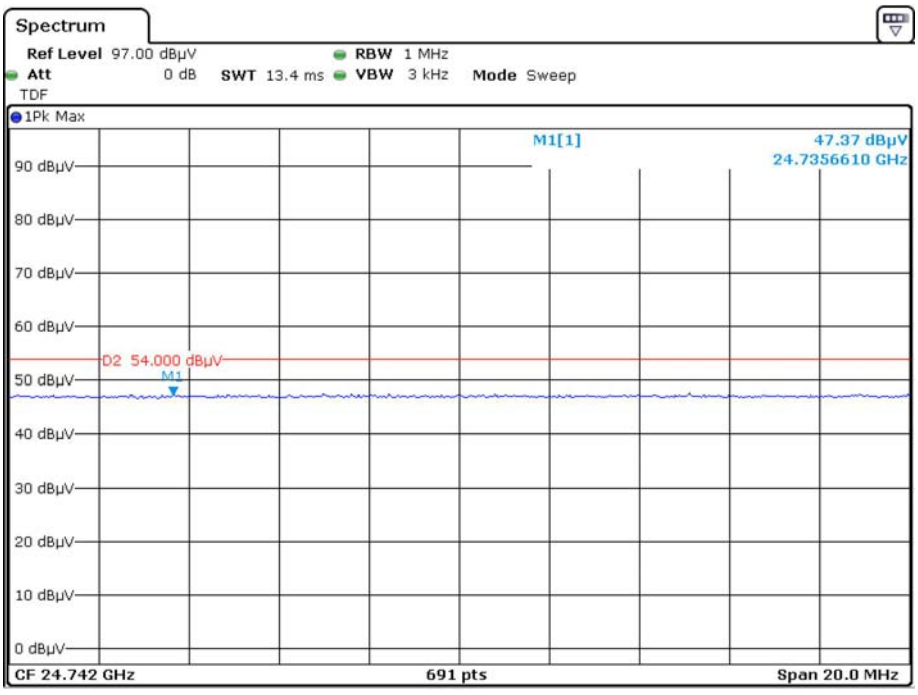
Pre-scan for Average
Horizontal



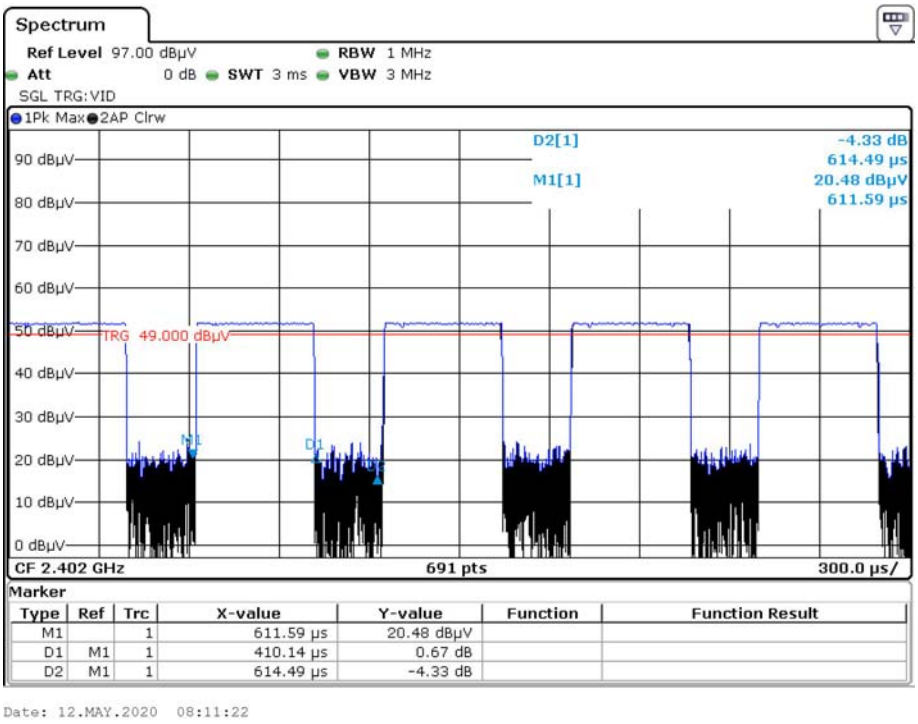


Vertical


Spectrum
Ref Level 97.00 dBµV
RBW 1 MHz
Att 0 dB
SWT 13.4 ms
VBW 3 kHz
Mode Sweep
TDF
1Pk Max
M1[1]
39.28 dBµV
4.9599710 GHz
90 dBµV
80 dBµV
70 dBµV
60 dBµV
D2 54.000 dBµV
50 dBµV
M1
40 dBµV
30 dBµV
20 dBµV
10 dBµV
0 dBµV
CF 4.96 GHz
691 pts
Span 20.0 MHz
Date: 12.MAY.2020 08:55:57


Spectrum
Ref Level 97.00 dBµV
RBW 1 MHz
Att 0 dB
SWT 13.4 ms
VBW 3 kHz
Mode Sweep
TDF
1Pk Max
M1[1]
47.37 dBµV
24.7356610 GHz
90 dBµV
80 dBµV
70 dBµV
60 dBµV
D2 54.000 dBµV
50 dBµV
M1
40 dBµV
30 dBµV
20 dBµV
10 dBµV
0 dBµV
CF 24.742 GHz
691 pts
Span 20.0 MHz
Date: 12.MAY.2020 09:30:45

Duty Cycle



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