ACCREDITED
TESTING LABORATORY
CERTIFICATE#4323.01

BACL
Bay Area Compliance Labs Corp.

FCC PART 15.249
TEST REPORT

For

Keeson Technology Corporation Limited

No. 158, Qiumao Road, Wangjiangjing Xiuzhou district Jiaxing, Zhejiang China

FCC ID: 2AK23MC220

Report Type:	**Product Type:**
Original Report	CONTROL BOX

Test Engineer:	Sam Ye
Report Number:	RSHA190614004-00B
Report Date:	2019-08-09
Reviewed By:	Kyle Xu RF Leader
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Kunshan) No.248 Chenghu Road,Kunshan,Jiangsu province,China Tel: +86-0512-86175000 Fax: +86-0512-88934268 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Keeson Technology Corporation Limited
Tested Model	MC220
Series Model	MC220BS, MC220TS, MC220SP, MC220KL, MC220LT, MC220BK
Model Difference	Model names
Product Type	CONTROL BOX
Dimension	146mm(L)*63 mm(W) *37mm(H)
Power Supply	AC100-240V/ DC 2*9V from batteries

All measurement and test data in this report was gathered from production sample serial number: 20190614004. (Assigned by BACL, Kunshan). The EUT was received on 2019-06-14.

Objective

This type approval report is prepared on behalf of *Keeson Technology Corporation Limited* in accordance with Part 2-Subpart J, and Part 15-Subparts A and C of the Federal Communication Commission 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.

Related Submittal(s)/Grant(s)

FCC Part 15.249 DXX grant with FCC ID: PCU-RF365B.

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 Lab Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19 dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
	18GHz~40GHz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0℃
Humidity		6%

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. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01 and CAB identifier CN0004 under the ISED requirement. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Justification

Channel list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2403	40	2442
2	2404	…	…
…	…	…	…
38	2440	77	2479
39	2441	78	2480

EUT was tested with Channel 1, 40 and 78.

EUT Exercise Software

RF test tool: Engineering mode.

Support Equipment List and Details

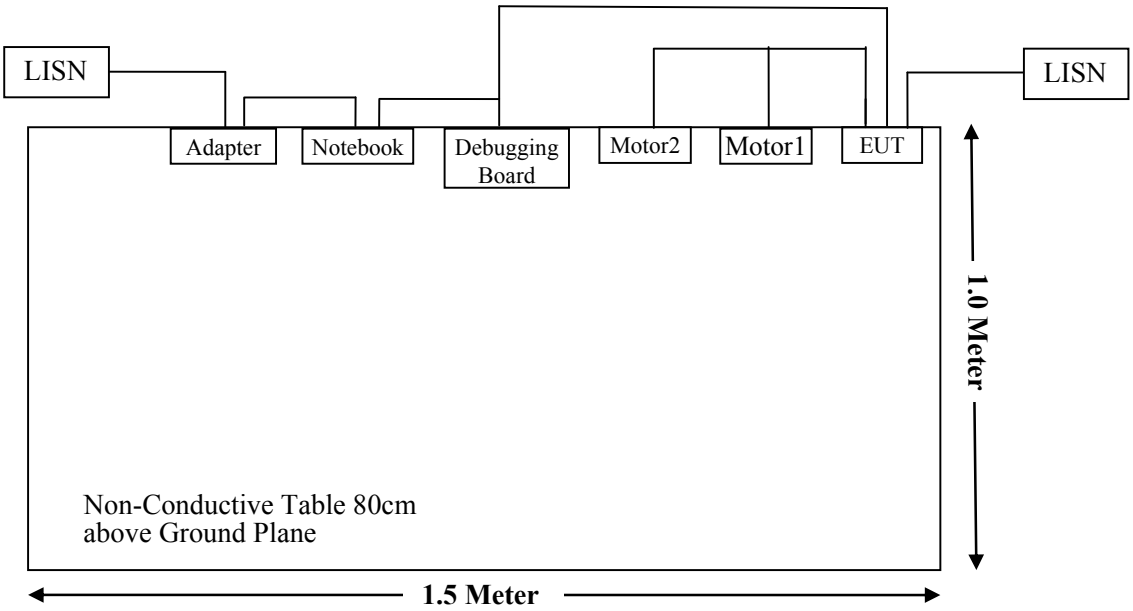
Manufacturer	Description	Model	Serial Number
KEESON	Motor1	E10068	68001097150186040004
KEESON	Motor2	JLDQ.10.381.93	68000313150189110336
KEESON	Debugging Board	/	/
DELL	Notebook	GX620	D65874152
DELL	Adapter	LA65NS0-00	DF263

External I/O Cable

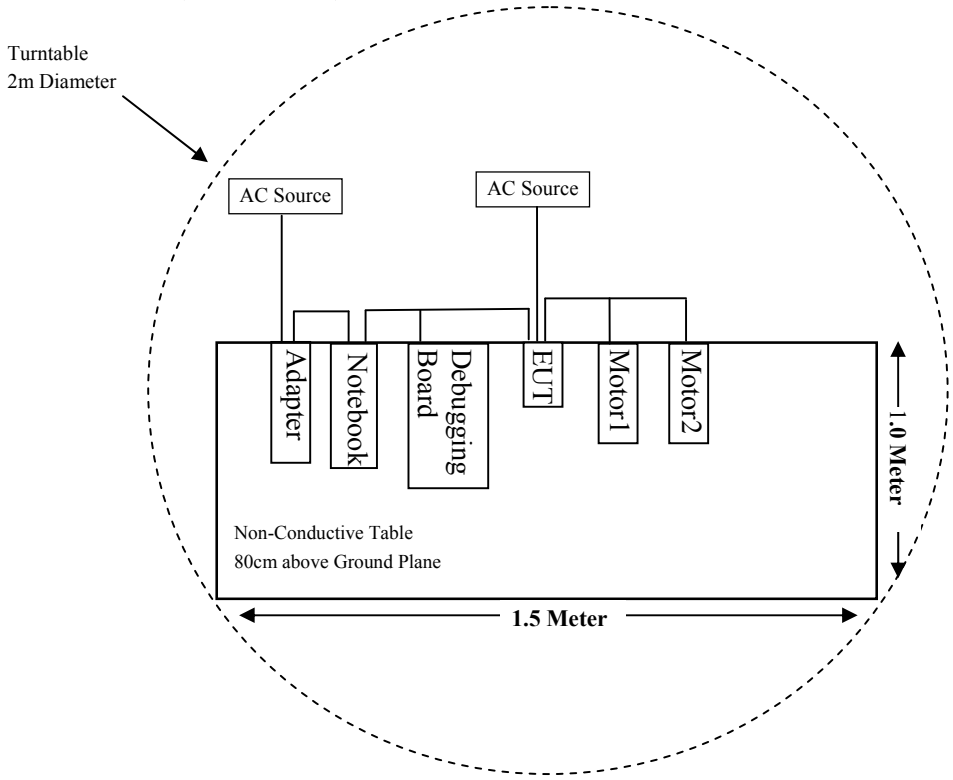
Cable Description	Length (m)	From Port	To
SYNC Cable	1.5	Debugging Board	Notebook
			EUT
Power Cable	1.0	Adapter	AC Source
Power Cable	1.0	EUT	AC Source

Block Diagram of Test Setup

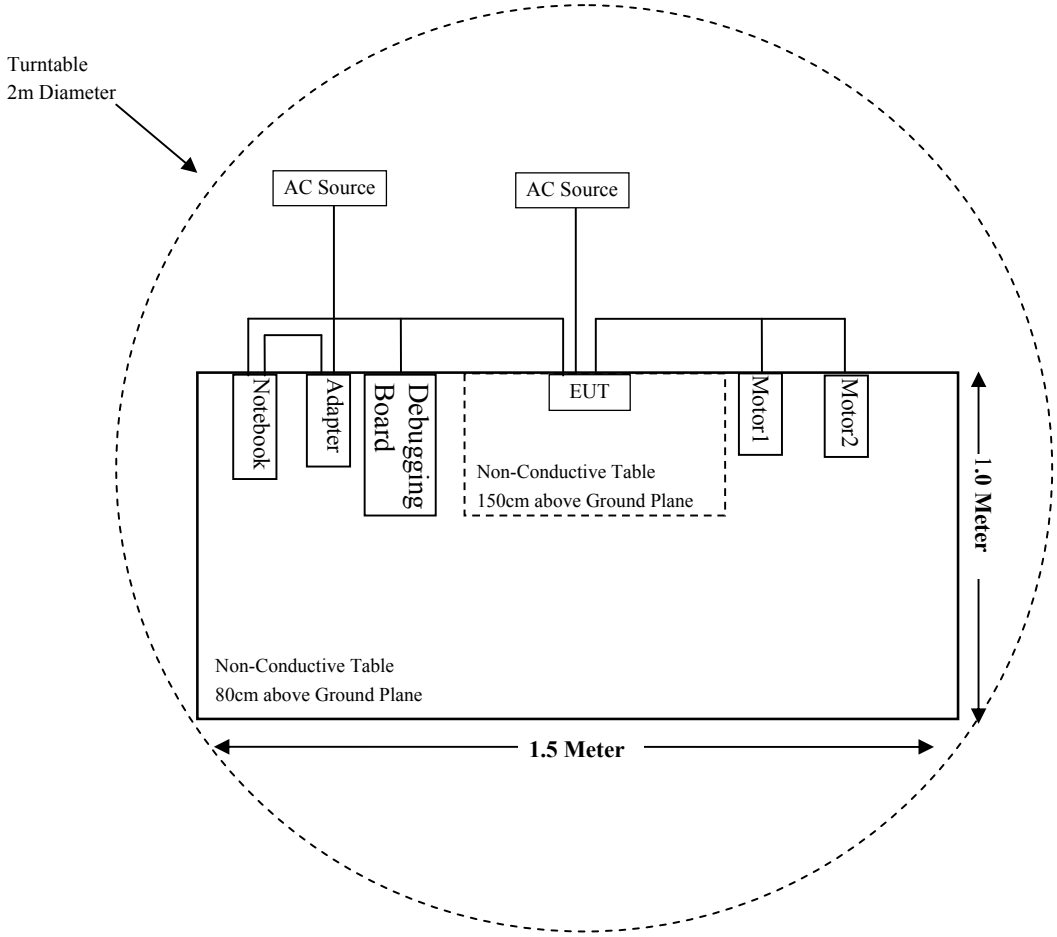
For Conducted Emissions



For Radiated Emissions(Below 1GHz):



For Radiated Emissions(Above 1GHz):



SUMMARY OF TEST RESULTS

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

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test（Chamber 1#）					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2018-11-30	2019-11-29
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2016-12-26	2019-12-25
Sonoma Instrunent	Pre-amplifier	310N	171205	2018-08-14	2019-08-13
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2018-08-15	2019-08-14
Radiated Emission Test（Chamber 2#）					
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2018-11-30	2019-11-29
ETS-LINDGREN	Horn Antenna	3115	9207-3900	2017-07-15	2020-07-14
ETS-LINDGREN	Horn Antenna	3116	00084159	2016-12-12	2019-12-11
MICRO-TRONICS	Notch Filter	BRM50702	G024	2018-08-05	2019-08-04
A.H.Systems, inc	Amplifier	2641-1	491	2019-02-20	2020-02-19
SELECTOR	Amplifier	EM18G40G	060726	2019-03-22	2020-03-21
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2018-08-15	2019-08-14
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	ESIB26	100146	2018-11-30	2019-11-29
Narda	Attenuator	10dB	010	2018-08-15	2019-08-14
KEESON	RF Cable	KEESON C01	C01	Each Time	/
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2019-07-11	2020-07-10
ROHDE&SCHWARZ	LISN	ENV216	3560655016	2018-11-30	2019-11-29
Rohde & Schwarz	LISN	ESH3-Z5	862770/011	2018-11-30	2019-11-29
Audix	Test Software	e3	V9	/	/
Narda	Attenuator/6dB	10690812-2	26850-6	2019-01-10	2020-01-09
MICRO-COAX	Coaxial Cable	Cable-15	015	2018-08-15	2019-08-14

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) 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

For intentional device, 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.

Antenna Connector Construction

The EUT has a PCB antenna and antenna gain is 0dBi, which was permanently attached, fulfill the requirement of this section, please refer to the EUT photos.

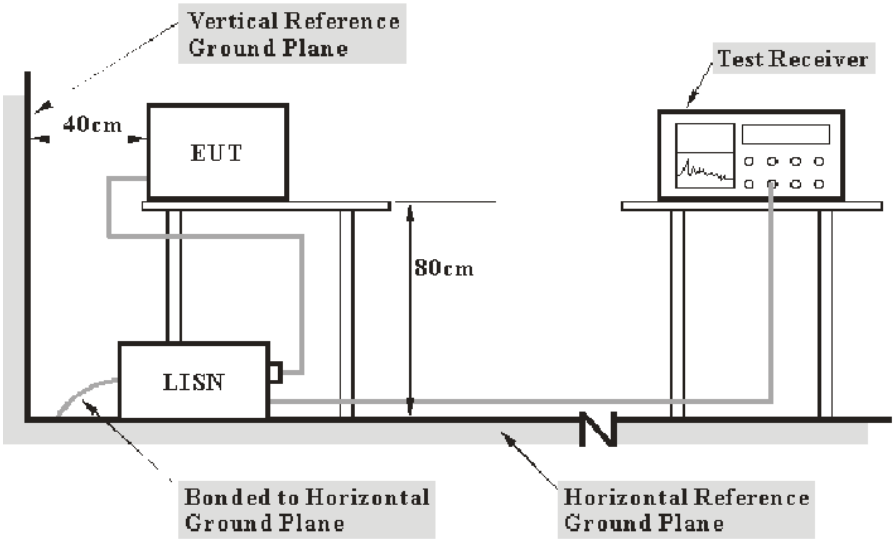
Result: Compliant.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

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.

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 LISN.

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

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

Corrected Factor & Over Limit 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:

Corrected Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)

The "**Over Limit**" 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 above the limit. The equation for margin calculation is as follows:

Over Limit (dB) = Read level (dBμV) + Factor (dB) - Limit (dBμV)

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207.

Test Data

Environmental Conditions

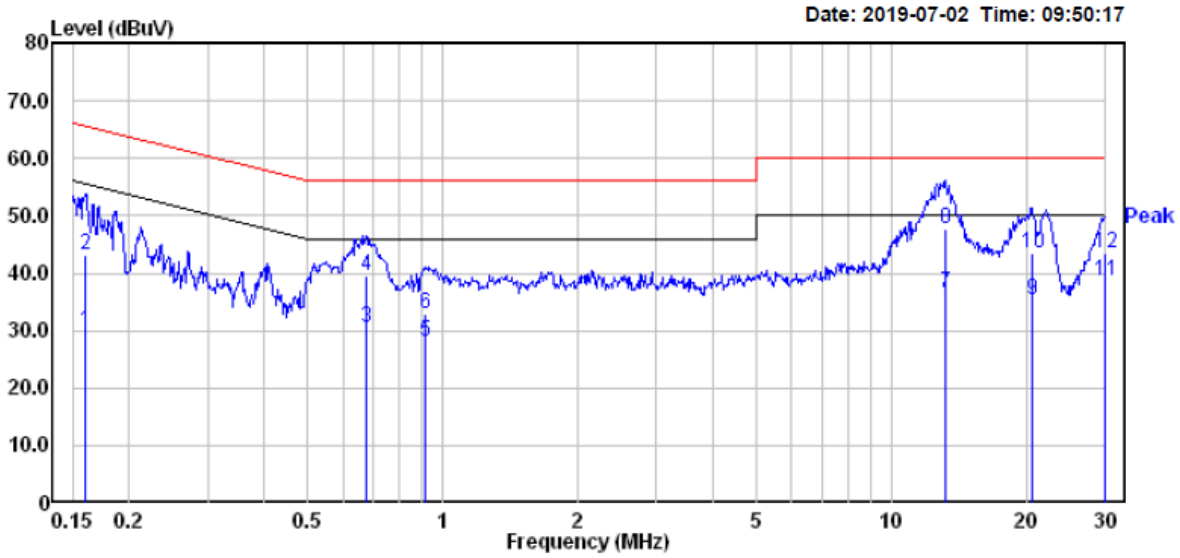
Temperature:	25.0℃
Relative Humidity:	48 %
ATM Pressure:	101.2 kPa

The testing was performed by Sam Ye on 2019-07-02.

Test Result: Compliant.

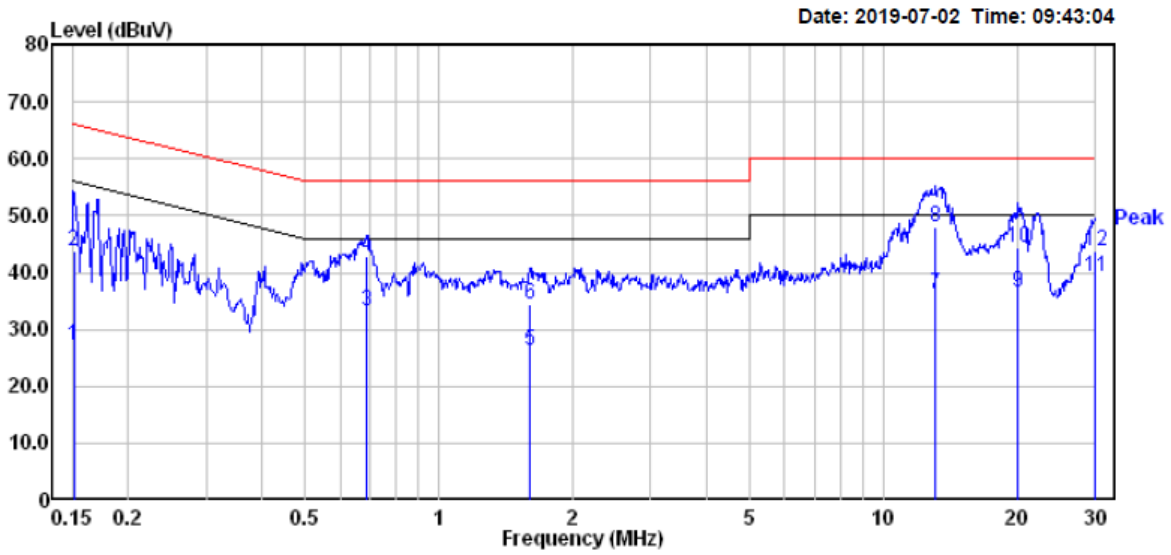
EUT operation mode: Transmitting in middle channel. (Worst case)

AC 120V/60Hz, Line



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.160	10.00	19.83	29.83	55.47	-25.64	Average
2	0.160	23.30	19.83	43.13	65.47	-22.34	QP
3	0.675	10.60	19.75	30.35	46.00	-15.65	Average
4	0.675	19.80	19.75	39.55	56.00	-16.45	QP
5	0.914	8.20	19.74	27.94	46.00	-18.06	Average
6	0.914	13.10	19.74	32.84	56.00	-23.16	QP
7	13.267	16.91	19.60	36.51	50.00	-13.49	Average
8	13.267	28.21	19.60	47.81	60.00	-12.19	QP
9	20.594	15.50	19.92	35.42	50.00	-14.58	Average
10	20.594	23.60	19.92	43.52	60.00	-16.48	QP
11	30.000	19.00	19.78	38.78	50.00	-11.22	Average
12	30.000	23.60	19.78	43.38	60.00	-16.62	QP

AC 120V/60Hz, Neutral



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.151	7.20	19.82	27.02	55.96	-28.94	Average
2	0.151	24.10	19.82	43.92	65.96	-22.04	QP
3	0.690	13.50	19.75	33.25	46.00	-12.75	Average
4	0.690	23.10	19.75	42.85	56.00	-13.15	QP
5	1.602	6.29	19.85	26.14	46.00	-19.86	Average
6	1.602	14.59	19.85	34.44	56.00	-21.56	QP
7	13.127	16.70	19.60	36.30	50.00	-13.70	Average
8	13.127	28.40	19.60	48.00	60.00	-12.00	QP
9	20.162	16.60	19.95	36.55	50.00	-13.45	Average
10	20.162	24.40	19.95	44.35	60.00	-15.65	QP
11	30.000	19.40	19.78	39.18	50.00	-10.82	Average
12	30.000	23.90	19.78	43.68	60.00	-16.32	QP

Note:

1) Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)
2) Over Limit (dB) = Read level (dBµV) + Factor (dB) - Limit (dBµV)

FCC§15.205, §15.209&§15.249- RADIATED EMISSIONS& OUT OF BAND EMISSION

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:

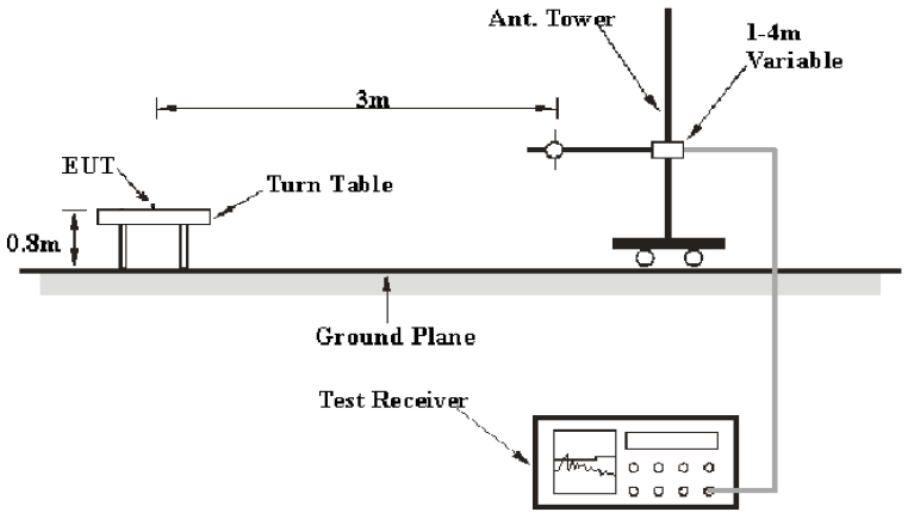
Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24GHz-24.25GHz	250	2500

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

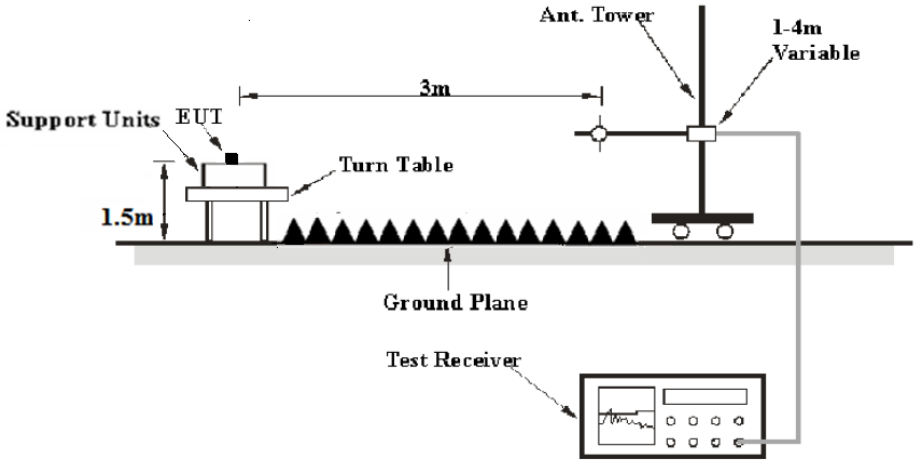
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

EUT Setup

Below 1 GHz:



Above 1 GHz:



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.
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

Test Equipment Setup

The system was investigated from 30 MHz to 25GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1GHz	1MHz	3 MHz	/	PK
	1MHz	3 MHz	/	Ave

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 (dBµV /m) = Meter Reading (dBµV) + Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB)

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 (dB) = Limit (dBµV/m) – Corrected Amplitude (dBµV /m)

Test Results Summary

According to the data in the following table, the EUT complied with the FCC Part 15.209 &15.205 & 15.249.

Test Data

Environmental Conditions

Temperature:	24°C
Relative Humidity:	50%
ATM Pressure:	101.1kPa

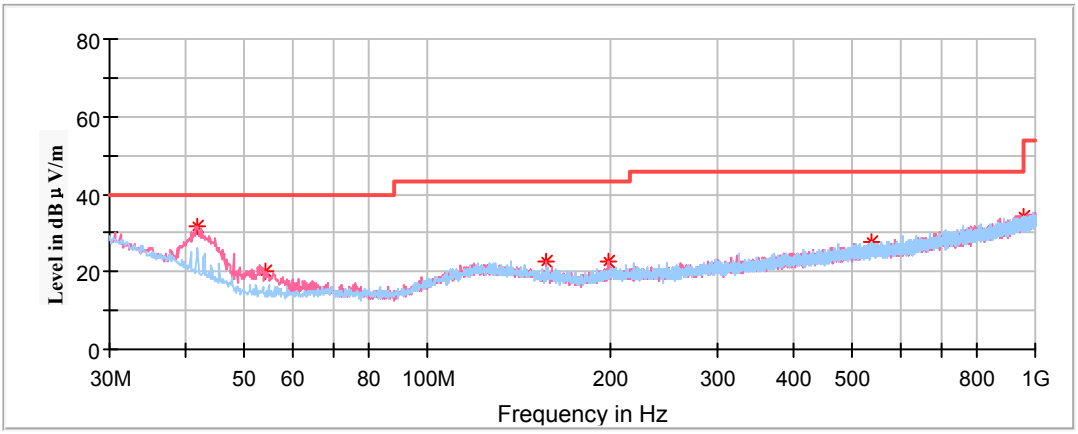
The testing was performed by Sam Ye on 2019-07-12.

Test Mode: Transmitting (AC power supply-worse case)

Spurious Emission Test:

30MHz-1GHz

*(Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case **middle channel of operation in X-axis of orientation** was recorded.)*



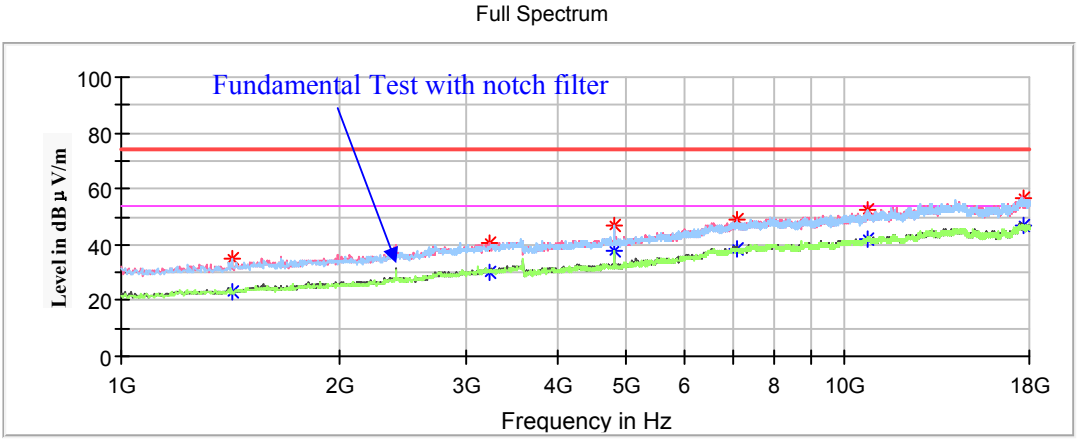
Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	Quasi-peak (dBµV/m)	Height (cm)	Polar (H/V)				
41.88	31.85	100	V	86	-12.0	40.00	8.15
54.25	20.09	100	V	253	-17.7	40.00	19.91
157.19	22.62	100	V	175	-12.6	43.50	20.88
198.05	22.56	200	V	341	-12.4	43.50	20.94
536.83	27.77	100	H	124	-5.8	46.00	18.23
953.44	34.30	200	V	54	1.4	46.00	11.70

1GHz-18GHz

*(Pre-scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded.)*

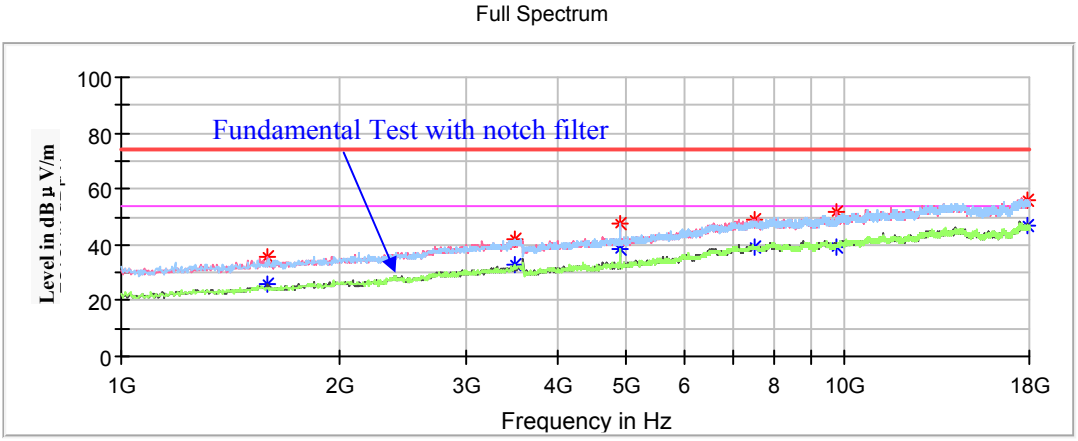
Note:
1. This test was performed with the 2.4-2.5GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
   Corrected Amplitude (dBµV /m) = Corrected Factor (dB/m) + Reading (dBµV)
   Margin (dB) = Limit (dBµV/m) – Corrected Amplitude (dBµV /m)

Low Channel: 2403MHz



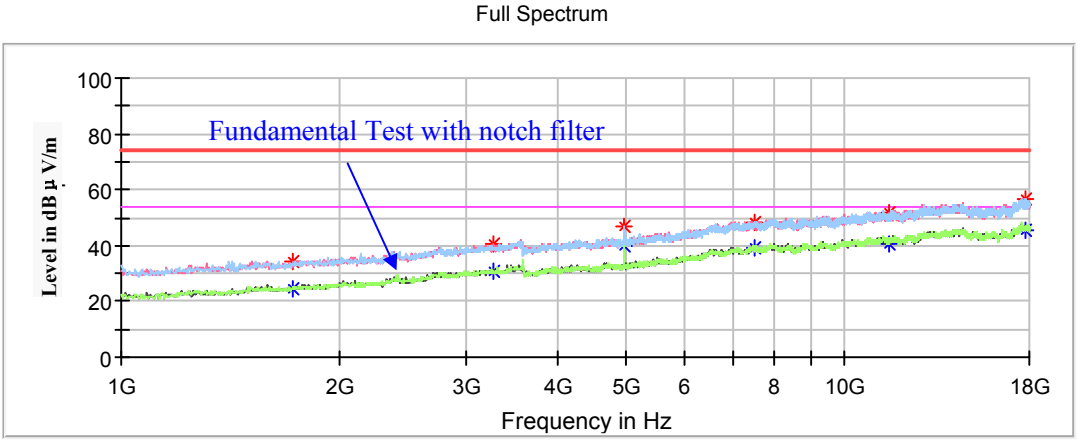
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV/m)	Average (dBµV/m)	Height (cm)	Polar (H/V)				
1421.60	---	23.32	150	H	2	-10.4	54.00	30.68
1421.60	34.76	---	150	H	2	-10.4	74.00	39.24
3227.00	---	30.25	250	V	0	-4.0	54.00	23.75
3227.00	40.78	---	250	V	0	-4.0	74.00	33.22
4806.00	---	37.51	200	H	220	-0.6	54.00	16.49
4806.00	46.94	---	200	H	220	-0.6	74.00	27.06
7089.40	---	38.38	250	V	227	5.5	54.00	15.62
7089.40	48.85	---	250	V	227	5.5	74.00	25.15
10724.00	---	41.90	150	H	130	9.3	54.00	12.10
10724.00	52.40	---	150	H	130	9.3	74.00	21.60
17711.00	---	46.79	100	V	294	13.9	54.00	7.21
17711.00	56.44	---	100	V	294	13.9	74.00	17.56

Middle Channel: 2442MHz



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV/m)	Average (dBµV/m)	Height (cm)	Polar (H/V)				
1595.00	---	25.60	250	V	218	-9.6	54.00	28.40
1595.00	35.35	---	250	V	218	-9.6	74.00	38.65
3492.20	---	33.01	150	H	174	-3.6	54.00	20.99
3492.20	41.81	---	150	H	174	-3.6	74.00	32.19
4884.00	---	38.38	100	H	221	-0.4	54.00	15.62
4884.00	47.31	---	100	H	221	-0.4	74.00	26.69
7497.40	---	39.27	200	V	305	6.1	54.00	14.73
7497.40	48.93	---	200	V	305	6.1	74.00	25.07
9731.20	---	39.50	250	V	312	7.9	54.00	14.50
9731.20	51.87	---	250	V	312	7.9	74.00	22.13
17938.80	---	47.03	200	H	330	13.6	54.00	6.97
17938.80	55.62	---	200	H	330	13.6	74.00	18.38

High Channel: 2480MHz

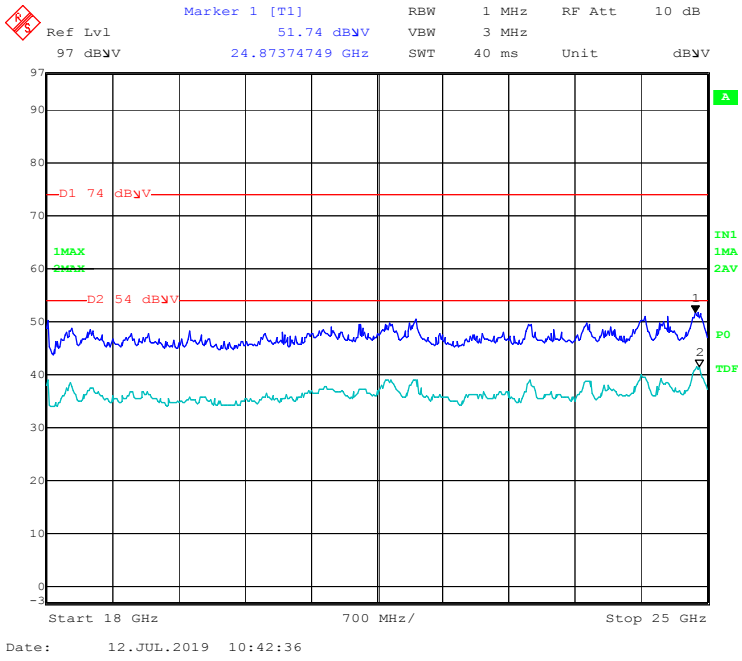


Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV/m)	Average (dBµV/m)	Height (cm)	Polar (H/V)				
1731.00	---	24.33	150	V	302	-9.1	54.00	29.67
1731.00	34.42	---	150	V	302	-9.1	74.00	39.58
3261.00	---	30.89	100	V	232	-3.9	54.00	23.11
3261.00	40.53	---	100	V	232	-3.9	74.00	33.47
4960.00	---	39.72	200	H	222	-0.3	54.00	14.28
4960.00	47.10	---	200	H	222	-0.3	74.00	26.90
7521.20	---	39.14	250	H	287	6.2	54.00	14.86
7521.20	48.28	---	250	H	287	6.2	74.00	25.72
11492.40	---	40.78	200	V	346	9.8	54.00	13.22
11492.40	51.64	---	200	V	346	9.8	74.00	22.36
17792.60	---	45.29	200	H	269	13.8	54.00	8.71
17792.60	56.85	---	200	H	269	13.8	74.00	17.15

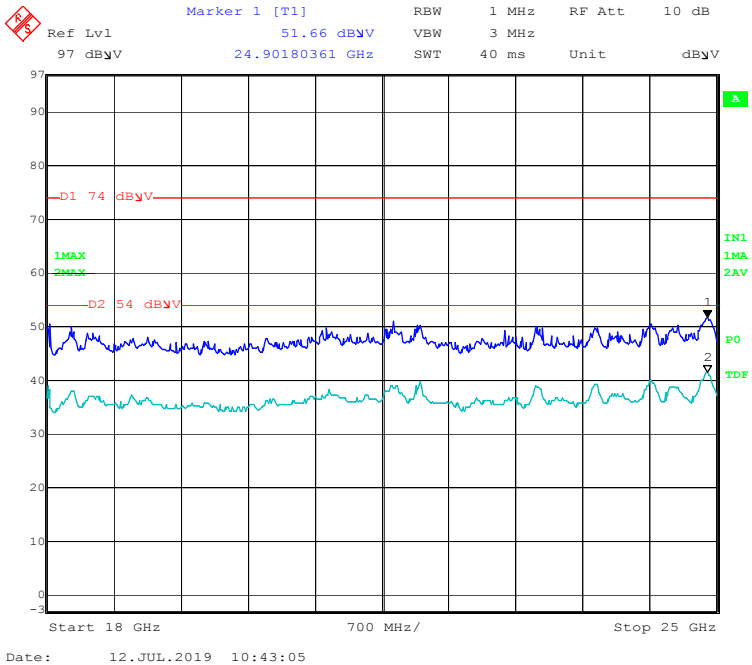
18GHz-25GHz:

*(Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case **middle channel of operation in X-axis of orientation** was recorded)*

Horizontal



Vertical



Fundamental Test & Restricted Bands Emissions Test:

*(Pre-scan in the X, Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded.)*

Note:
1. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
   Corrected Amplitude (dBμV /m) = Corrected Factor (dB/m) + Reading (dBμV)
   Margin (dB) = Limit (dBμV/m) – Corrected Amplitude (dBμV /m)

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)	Degree			
Low Channel: 2403MHz								
2403.00	---	93.56	150.0	H	176.0	2.8	94.00	0.44
2403.00	95.55	---	150.0	H	176.0	2.8	114.00	18.45
2403.00	---	91.09	100.0	V	51.0	2.8	94.00	2.91
2403.00	93.42	---	100.0	V	51.0	2.8	114.00	20.58
2400.00	---	40.82	200.0	H	172.0	2.8	54.00	13.18
2400.00	51.31	---	200.0	H	172.0	2.8	74.00	22.69
Middle Channel: 2442MHz								
2442.00	---	93.32	150.0	H	189.0	2.9	94.00	0.68
2442.00	95.36	---	150.0	H	189.0	2.9	114.00	18.64
2442.00	---	91.05	250.0	V	237.0	2.9	94.00	2.95
2442.00	93.23	---	250.0	V	237.0	2.9	114.00	20.77
High Channel: 2480MHz								
2480.00	---	92.46	150.0	H	261.0	3.1	94.00	1.54
2480.00	94.43	---	150.0	H	261.0	3.1	114.00	19.57
2480.00	---	90.12	250.0	V	313.0	3.1	94.00	3.88
2480.00	92.25	---	250.0	V	313.0	3.1	114.00	21.75
2483.50	---	45.54	150.0	V	208.0	3.1	54.00	8.46
2483.50	54.64	---	150.0	V	208.0	3.1	74.00	19.36

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. Position the EUT on the test table without connection to measurement instrument. Turn on the EUT. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Data

Environmental Conditions

Temperature:	24.4°C
Relative Humidity:	50%
ATM Pressure:	101.3kPa

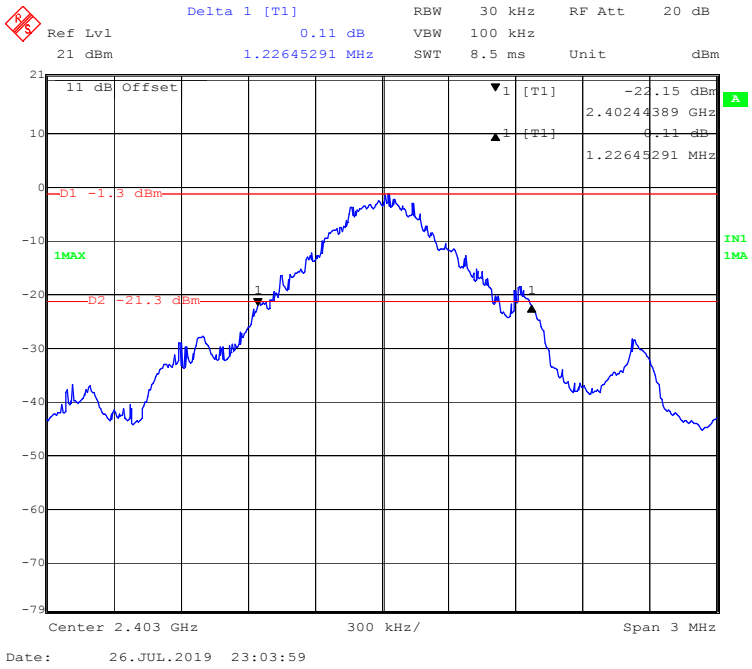
The testing was performed by Sam Ye on 2019-07-26.

Test Result: Compliant.

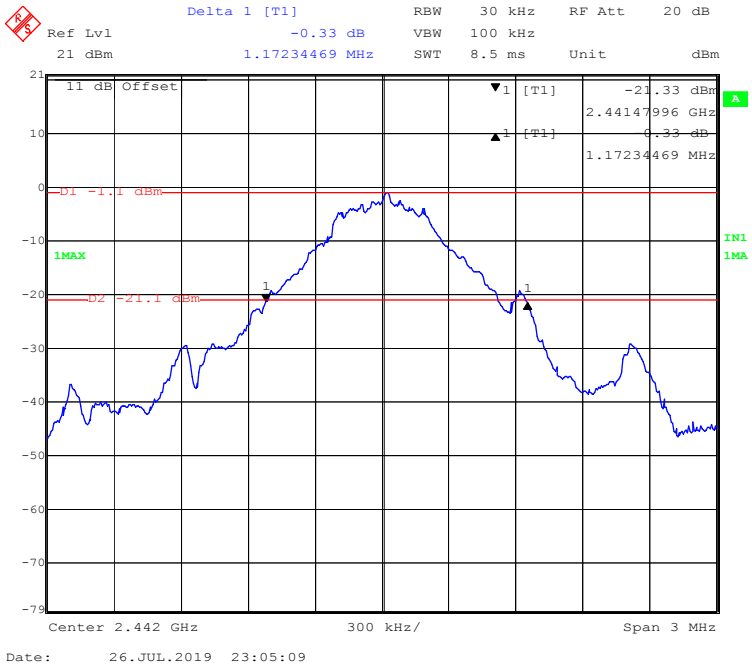
Test Mode: Transmitting

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2403	1.226
Middle	2442	1.172
High	2480	1.148

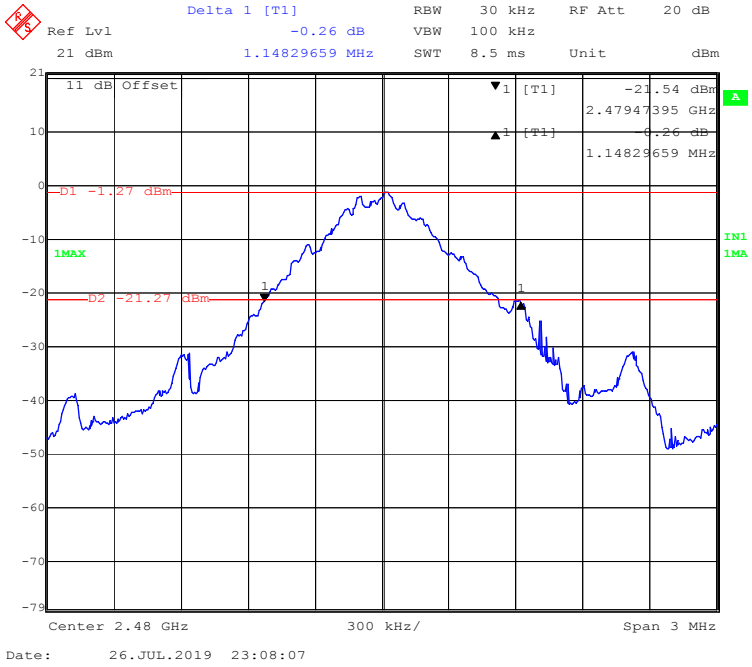
Low Channel



Middle Channel



High Channel



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