

FCC PART 15.249 TEST REPORT

For

Hoymiles Converter Technology Co., Ltd.

No. 18 Kangjing Road, HangZhou, Zhejiang Province, China

FCC ID: 2ARNB-HM2401

Report Type: Original Report	Product Type: 2.4G RF Module
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Report Number:	RSA191121001-00A
Report Date:	2019-12-16
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant:	Hoymiles Converter Technology Co., Ltd.
Tested Model:	HM2401
Series Model:	HM2401A
Model Difference:	Model name and antenna type
Product Type:	2.4G RF Module
Power Supply:	DC 3.3V
RF Function:	2.4G SRD
Operating Band/Frequency:	2403-2475MHz
Channel Number:	5
Antenna Type:	HM2401: PCB antenna HM2401A: PCB Antenna with IPEX connector
Maximum Antenna Gain:	2dBi

All measurement and test data in this report was gathered from production sample serial number: 20191121001. (Assigned by BACL, Kunshan). The EUT was received on 2019-11-21.

Objective

This type approval report is prepared on behalf of *Hoymiles Converter Technology Co., Ltd.* 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)

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.

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°C
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)
1	2403
2	2423
3	2440
4	2461
5	2475

EUT was tested with Channel 1, 3 and 5.

EUT Exercise Software

No software was used to test.

Support Equipment List and Details

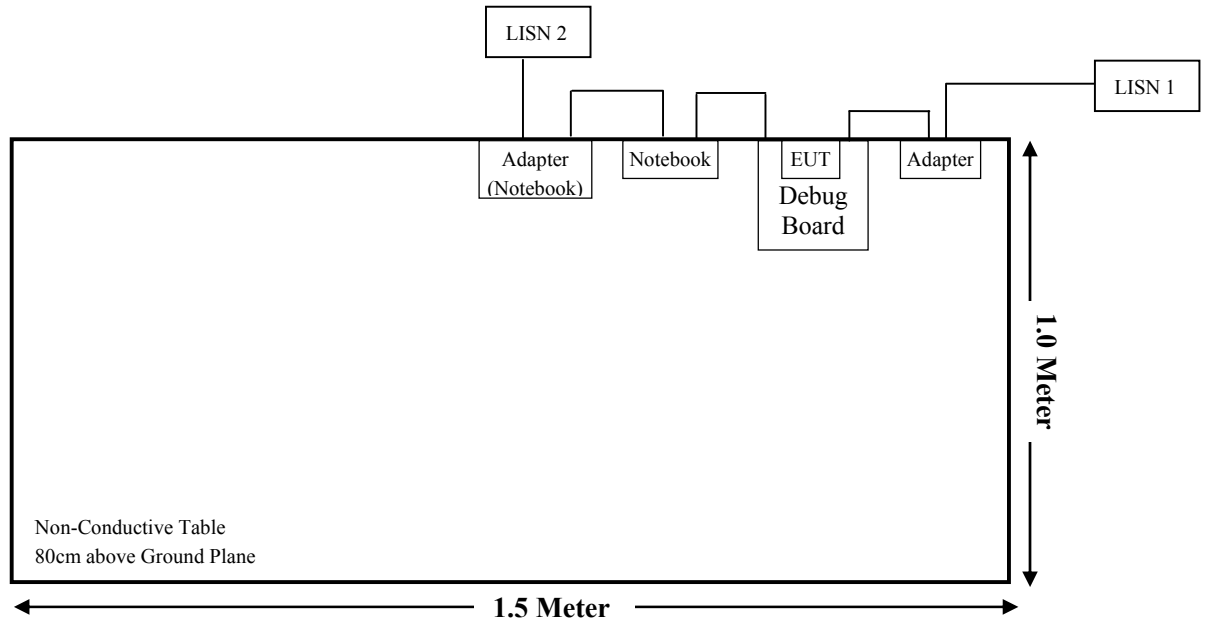
Manufacturer	Description	Model	Serial Number
DELL	Notebook	E6410	3094742521
DELL	Adapter(Notebook)	LA65NS0-00	DF263
LINKSYS	Adapter	PSM11R-050	/
Hoymiles	Debug Board	/	/

External I/O Cable

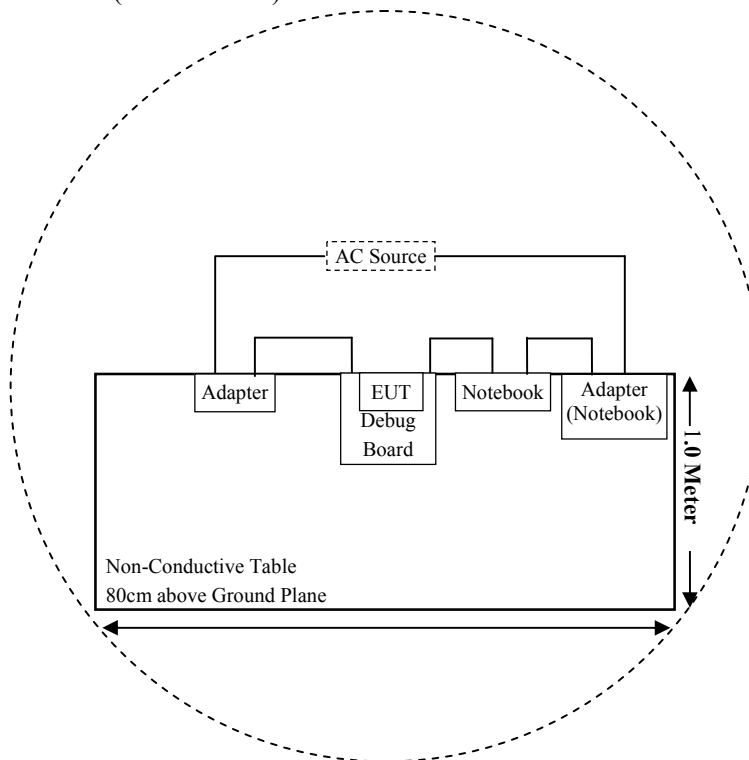
Cable Description	Length (m)	From Port	To
Power Cable	1.2	Adapter	Notebook
Power Cable	1.0	Adapter	Debug Board
Data Cable	1.8	EUT	Debug Board

Block Diagram of Test Setup

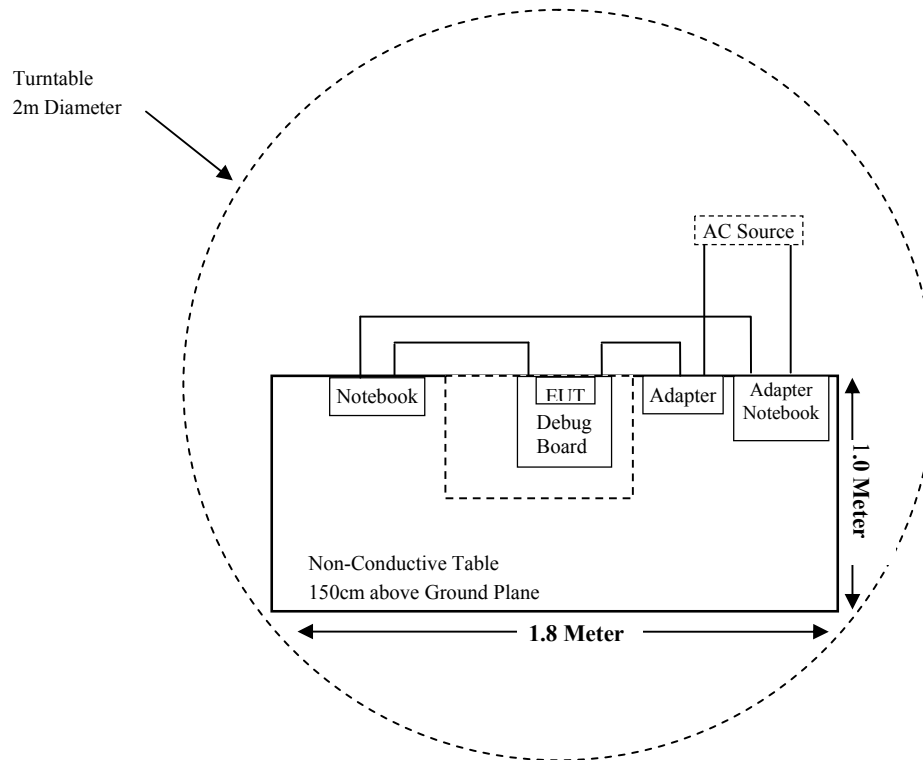
For Conducted Emissions



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	2019-01-09	2022-01-08
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2019-01-09	2022-01-08
Sonoma Instrument	Pre-amplifier	310N	171205	2019-08-14	2020-08-13
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2019-08-15	2020-08-14
Radiated Emission Test (Chamber 2#)					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2019-05-30	2020-05-29
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
ETS-LINDGREN	Horn Antenna	3116	00084159	2019-12-12	2022-12-11
MICRO-TRONICS	Notch Filter	BRM50702	G024	2019-08-05	2020-08-04
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	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2019-08-15	2020-08-14
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2019-08-14	2020-08-13
Narda	Attenuator	10dB	010	2019-08-15	2020-08-14
Hoymiles	RF Cable	Hoymiles C01	C01	Each Time	/
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2019-08-05	2020-08-04
Rohde & Schwarz	LISN	ENV216	3560655016	2019-08-05	2020-08-04
Rohde & Schwarz	LISN	ESH3-Z5	862770/011	2018-11-30	2019-11-29
Rohde & Schwarz	LISN	ESH3-Z5	862770/011	2019-11-30	2020-11-29
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	2018-09-15	2020-08-14

* **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.

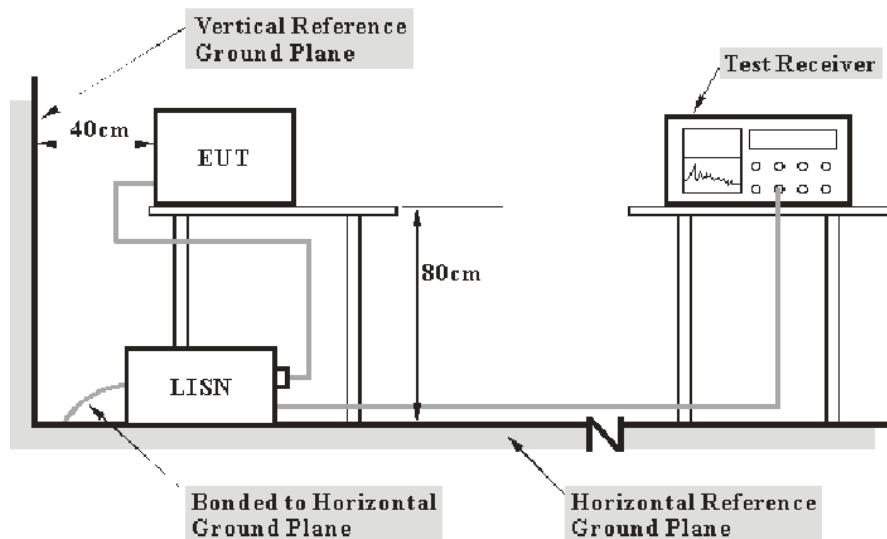
Antenna Connector Construction

The EUT has PCB antenna & PCB Antenna with IPEX connector and each antenna gain is 2 dBi, which was permanently attached to the EUT, 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 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.

Factor & Over Limit Calculation

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

$$\text{Factor (dB)} = \text{LISN VDF (dB)} + \text{Cable Loss (dB)} + \text{Transient Limiter Attenuation (dB)}$$

The “**Over Limit**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit of 7dB means the emission is 7 dB above the limit. The equation for Over Limit calculation is as follows:

$$\text{Over Limit (dB)} = \text{Read level (dB}\mu\text{V)} + \text{Factor (dB)} - \text{Limit (dB}\mu\text{V)}$$

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:	20 °C-22.3 °C
Relative Humidity:	50 %-51 %
ATM Pressure:	101.2 kPa-102 kPa

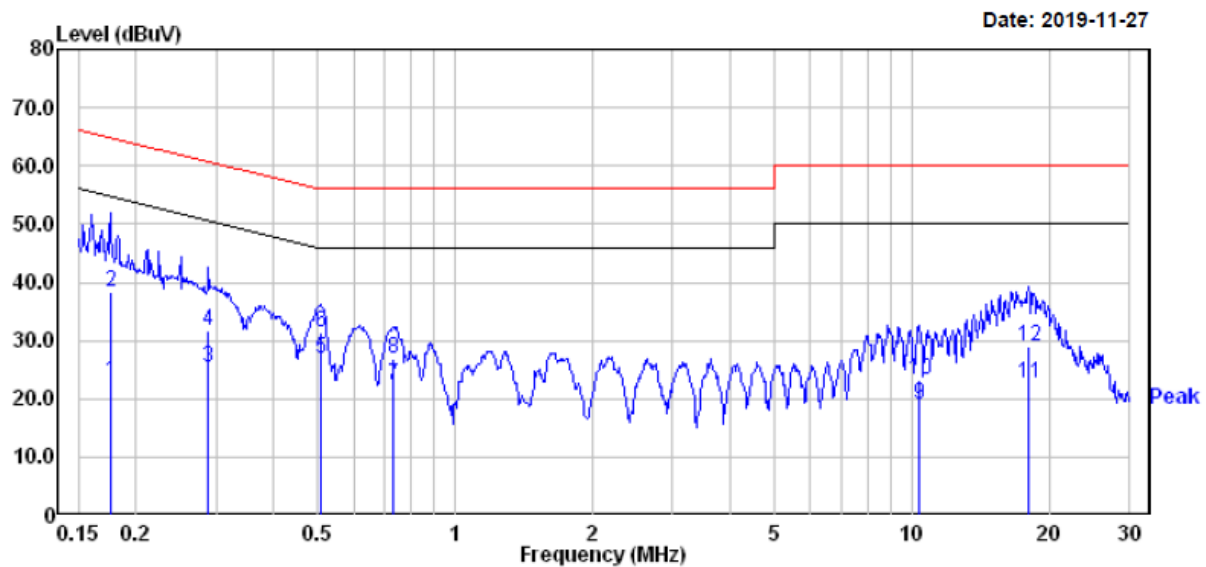
The testing was performed by Winnie Yang from 2019-11-27 to 2019-12-13.

Test Result: Compliant.

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

For Model HM2401:

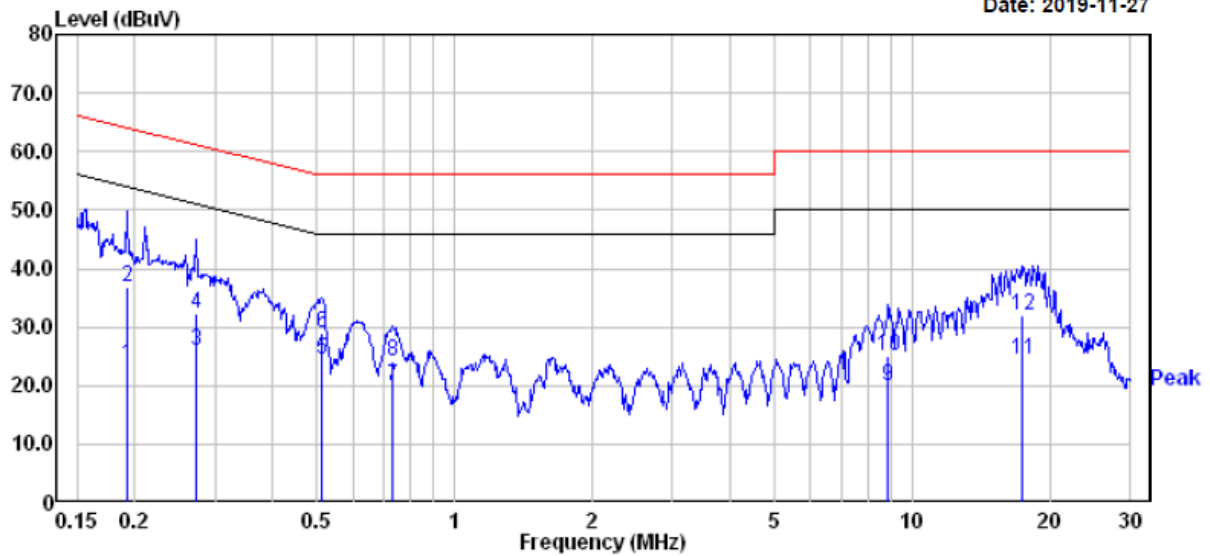
AC 120V/60Hz, Line



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.176	3.10	19.83	22.93	54.68	-31.75	Average
2	0.176	18.40	19.83	38.23	64.68	-26.45	QP
3	0.288	5.60	19.82	25.42	50.59	-25.17	Average
4	0.288	12.00	19.82	31.82	60.59	-28.77	QP
5	0.507	7.00	19.76	26.76	46.00	-19.24	Average
6	0.507	11.70	19.76	31.46	56.00	-24.54	QP
7	0.735	2.60	19.73	22.33	46.00	-23.67	Average
8	0.735	7.10	19.73	26.83	56.00	-29.17	QP
9	10.397	-0.40	19.56	19.16	50.00	-30.84	Average
10	10.397	3.80	19.56	23.36	60.00	-36.64	QP
11	18.039	2.90	19.84	22.74	50.00	-27.26	Average
12	18.039	9.00	19.84	28.84	60.00	-31.16	QP

AC 120V/60Hz, Neutral

Date: 2019-11-27



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.192	3.70	19.82	23.52	53.93	-30.41	Average
2	0.192	17.00	19.82	36.82	63.93	-27.11	QP
3	0.272	6.00	19.82	25.82	51.07	-25.25	Average
4	0.272	12.60	19.82	32.42	61.07	-28.65	QP
5	0.513	4.60	19.76	24.36	46.00	-21.64	Average
6	0.513	9.30	19.76	29.06	56.00	-26.94	QP
7	0.735	0.20	19.73	19.93	46.00	-26.07	Average
8	0.735	4.40	19.73	24.13	56.00	-31.87	QP
9	8.869	0.30	19.54	19.84	50.00	-30.16	Average
10	8.869	5.60	19.54	25.14	60.00	-34.86	QP
11	17.475	4.60	19.80	24.40	50.00	-25.60	Average
12	17.475	12.10	19.80	31.90	60.00	-28.10	QP

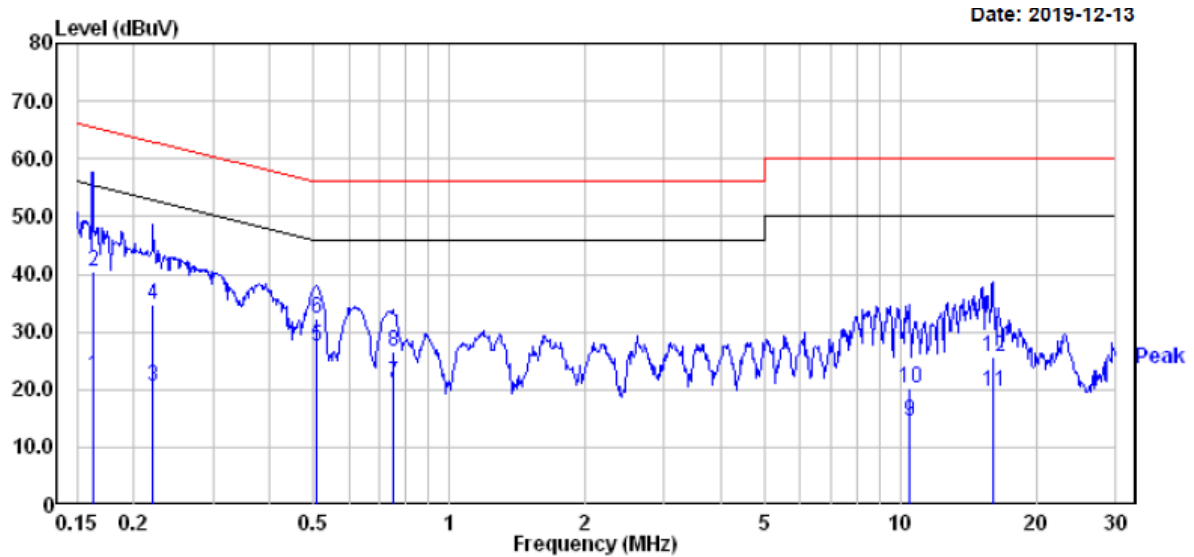
Note:

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

2) Over Limit (dB) = Read level (dBuV) + Factor (dB) - Limit (dBuV)

For Model HM2401A:

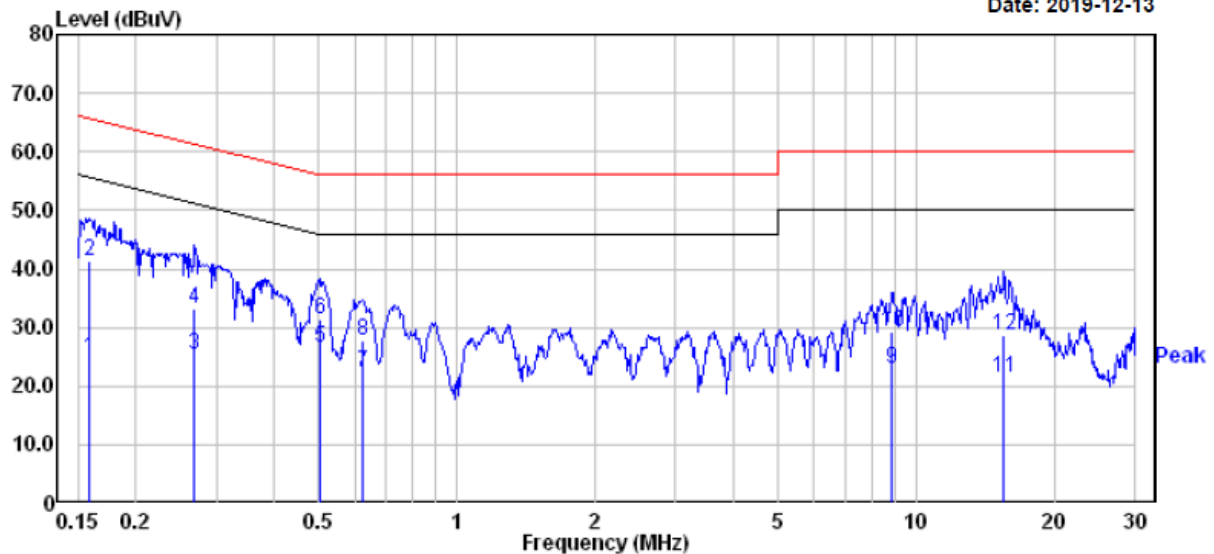
AC 120V/60Hz, Line



		Read			Limit	Over	
	Freq	Level	Factor	Level	Line	Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.162	2.40	19.83	22.23	55.34	-33.11	Average
2	0.162	20.50	19.83	40.33	65.34	-25.01	QP
3	0.221	0.60	19.82	20.42	52.79	-32.37	Average
4	0.221	14.90	19.82	34.72	62.79	-28.07	QP
5	0.507	7.70	19.76	27.46	46.00	-18.54	Average
6	0.507	12.60	19.76	32.36	56.00	-23.64	QP
7	0.751	1.50	19.72	21.22	46.00	-24.78	Average
8	0.751	6.70	19.72	26.42	56.00	-29.58	QP
9	10.452	-5.20	19.56	14.36	50.00	-35.64	Average
10	10.452	0.70	19.56	20.26	60.00	-39.74	QP
11	16.055	0.00	19.71	19.71	50.00	-30.29	Average
12	16.055	5.90	19.71	25.61	60.00	-34.39	QP

AC 120V/60Hz, Neutral

Date: 2019-12-13



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.158	4.90	19.82	24.72	55.56	-30.84	Average
2	0.158	21.50	19.82	41.32	65.56	-24.24	QP
3	0.269	5.50	19.82	25.32	51.16	-25.84	Average
4	0.269	13.30	19.82	33.12	61.16	-28.04	QP
5	0.505	6.80	19.76	26.56	46.00	-19.44	Average
6	0.505	11.70	19.76	31.46	56.00	-24.54	QP
7	0.624	2.70	19.75	22.45	46.00	-23.55	Average
8	0.624	7.90	19.75	27.65	56.00	-28.35	QP
9	8.869	3.30	19.54	22.84	50.00	-27.16	Average
10	8.869	9.60	19.54	29.14	60.00	-30.86	QP
11	15.552	1.79	19.68	21.47	50.00	-28.53	Average
12	15.552	8.89	19.68	28.57	60.00	-31.43	QP

Note:

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

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:

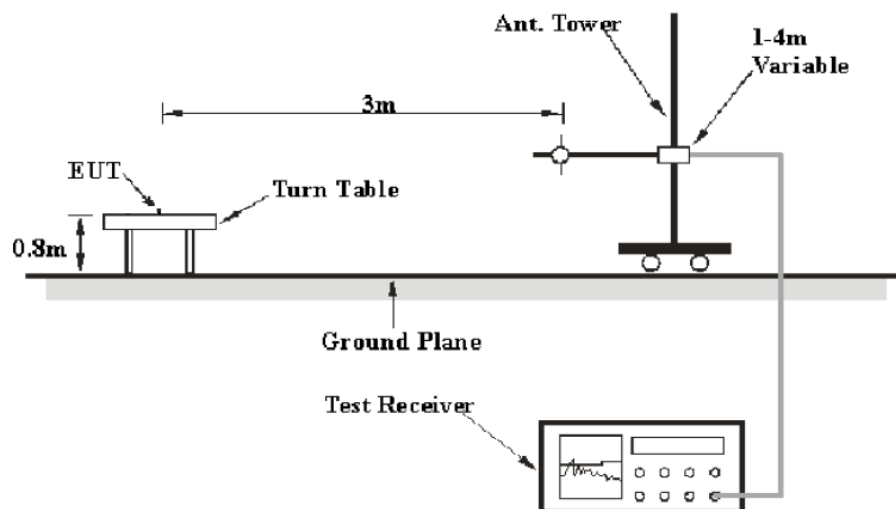
Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24GHz-24.25GHz	250	2500

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

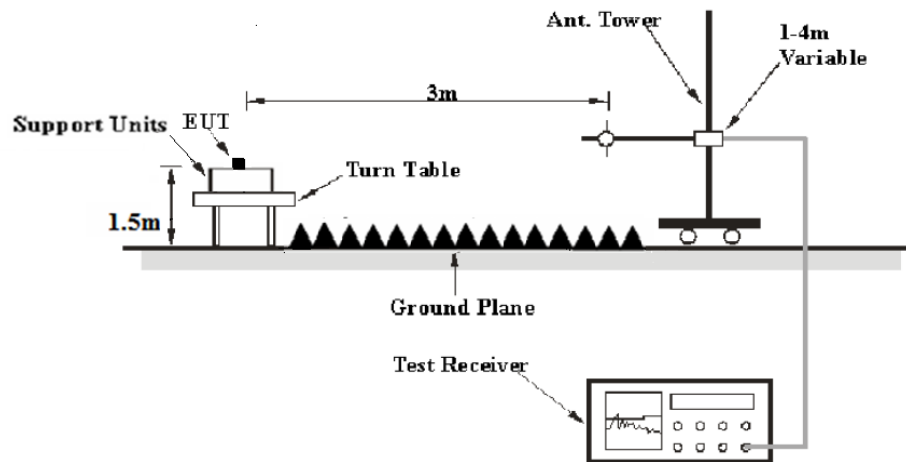
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

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:

$$\text{Corrected Amplitude (dB}\mu\text{V/m)} = \text{Meter Reading (dB}\mu\text{V)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} - \text{Amplifier Gain (dB)}$$

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:

$$\text{Margin (dB)} = \text{Limit (dB}\mu\text{V/m)} - \text{Corrected Amplitude (dB}\mu\text{V/m)}$$

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:	21.3~23.3°C
Relative Humidity:	48~50%
ATM Pressure:	101.2~102.1kPa

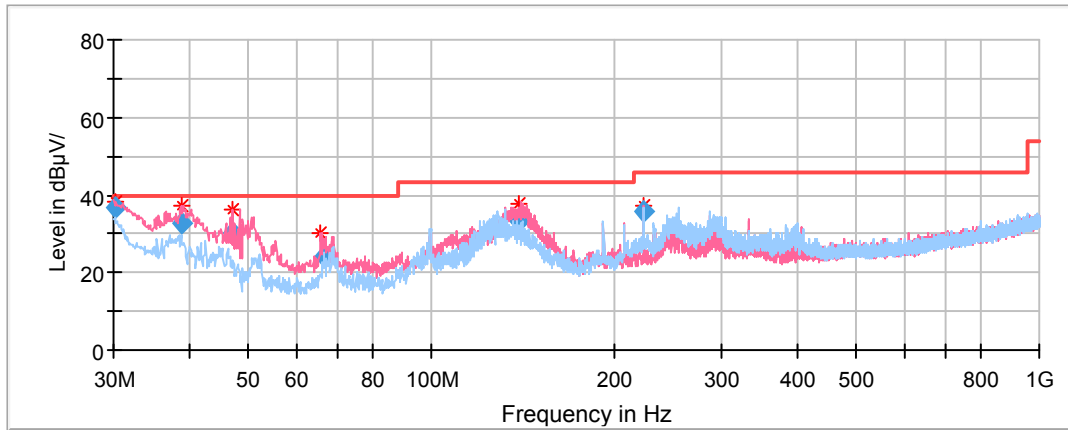
The testing was performed by Winnie Yang from 2019-11-27 to 2019-12-12.

Test Mode: Transmitting

For Model HM2401:

Spurious Emission Test:

30MHz-1GHz:



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)				
30.21	36.50	100.0	V	46.0	-4.1	40.00	3.50
38.73	32.49	100.0	V	67.0	-10.5	40.00	7.51
47.21	30.00	100.0	V	319.0	-15.2	40.00	10.00
66.60	24.27	200.0	V	180.0	-17.5	40.00	15.73
139.61	32.96	100.0	V	88.0	-11.9	43.50	10.54
223.99	35.60	100.0	V	237.0	-12.2	46.00	10.40

1GHz-18GHz

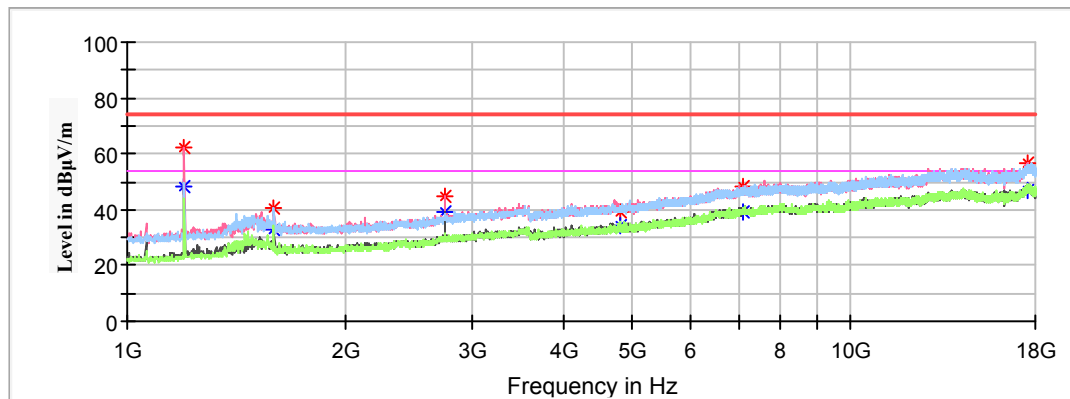
(Pre-scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded.)

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 (dB μ V/m) = Corrected Factor (dB/m) + Reading (dB μ V)
 Margin (dB) = Limit (dB μ V/m) – Corrected Amplitude (dB μ V/m)

Low Channel: 2403MHz

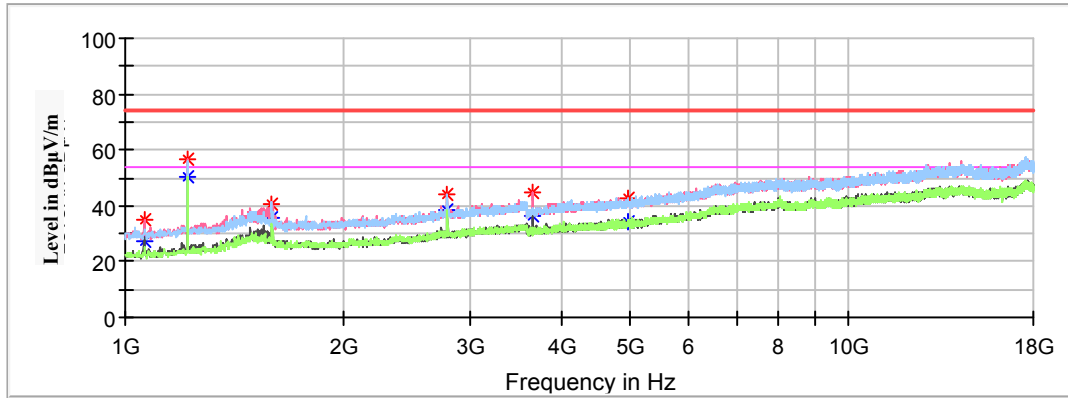
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	MaxPeak (dB μ V/m)	Average (dB μ V/m)	Height (cm)	Polar (H/V)				
1200.60	---	48.11	200.0	V	309.0	-11.6	54.00	5.89
1200.60	62.57	---	200.0	V	309.0	-11.6	74.00	11.43
1595.00	---	32.92	200.0	H	57.0	-9.6	54.00	21.08
1595.00	40.44	---	200.0	H	57.0	-9.6	74.00	33.56
2747.60	---	39.04	100.0	V	308.0	-5.7	54.00	14.96
2747.60	44.69	---	100.0	V	308.0	-5.7	74.00	29.31
4806.30	39.26	---	100.0	V	0.0	-0.6	74.00	34.74
4806.30	---	34.26	100.0	V	0.0	-0.6	54.00	19.74
7089.40	---	39.33	200.0	V	176.0	5.5	54.00	14.67
7089.40	48.58	---	200.0	V	176.0	5.5	74.00	25.42
17546.10	---	46.84	100.0	V	308.0	14.2	54.00	7.16
17546.10	56.93	---	100.0	V	308.0	14.2	74.00	17.07

Middle Channel: 2440MHz

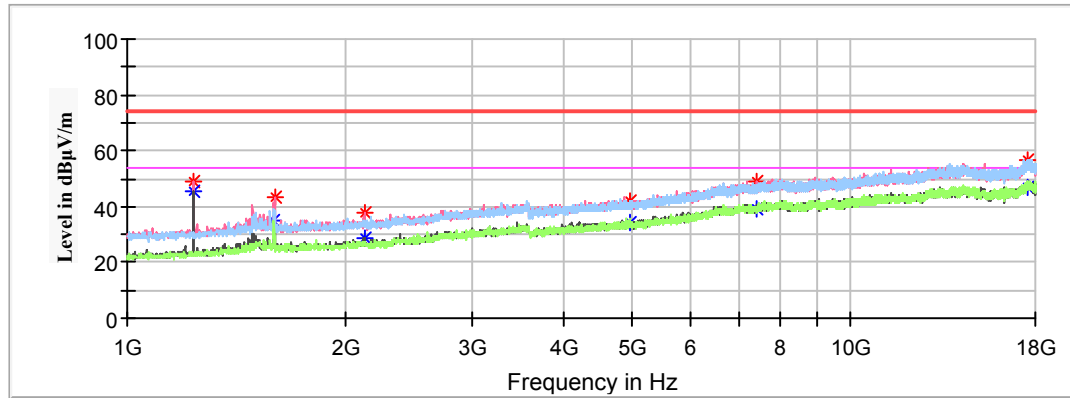
Full Spectrum



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)				
1064.60	---	27.05	200.0	V	56.0	-12.3	54.00	26.95
1064.60	35.22	---	200.0	V	56.0	-12.3	74.00	38.78
1219.30	---	50.61	150.0	H	264.0	-11.5	54.00	3.39
1219.30	56.49	---	150.0	H	264.0	-11.5	74.00	17.51
1596.70	40.31	---	200.0	V	85.0	-9.6	74.00	33.69
1596.70	---	35.32	200.0	V	85.0	-9.6	54.00	18.68
2790.10	43.89	---	200.0	H	218.0	-5.4	74.00	30.11
2790.10	---	38.69	200.0	H	218.0	-5.4	54.00	15.31
3658.80	44.89	---	100.0	V	0.0	-3.0	74.00	29.11
3658.80	---	36.10	100.0	V	0.0	-3.0	54.00	17.90
4961.00	---	34.49	150.0	H	131.0	-0.3	54.00	19.51
4961.00	42.45	---	150.0	H	131.0	-0.3	74.00	31.55

High Channel: 2475MHz

Full Spectrum

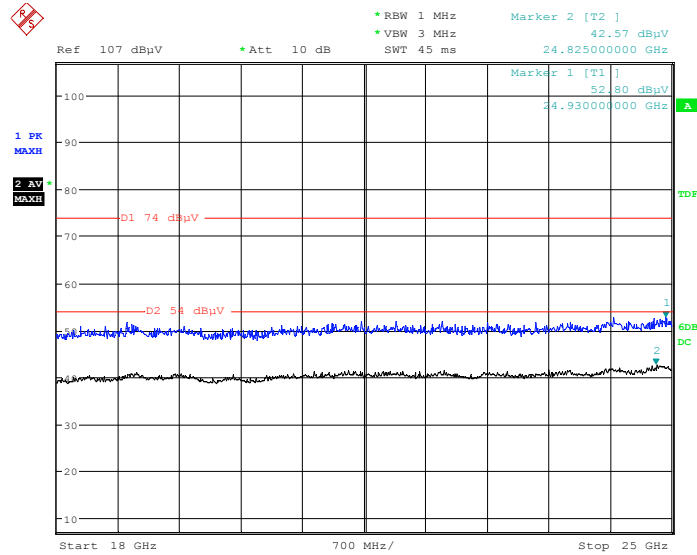


Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1236.30	49.26	---	100.0	V	3.0	-11.4	74.00	24.74
1236.30	---	45.13	100.0	V	3.0	-11.4	54.00	8.87
1596.70	---	35.12	200.0	V	125.0	-9.6	54.00	18.88
1598.40	43.46	---	200.0	V	125.0	-9.6	74.00	30.54
2130.50	37.57	---	100.0	V	154.0	-7.9	74.00	36.43
2130.50	---	29.01	100.0	V	154.0	-7.9	54.00	24.99
4961.00	---	34.22	150.0	V	346.0	-0.3	54.00	19.78
4961.00	42.02	---	150.0	V	346.0	-0.3	74.00	31.98
7434.50	---	39.29	100.0	V	95.0	6.0	54.00	14.71
7434.50	48.99	---	100.0	V	95.0	6.0	74.00	25.01
17532.50	---	46.93	200.0	H	245.0	14.2	54.00	7.07
17532.50	56.76	---	200.0	H	245.0	14.2	74.00	17.24

18GHz-25GHz:

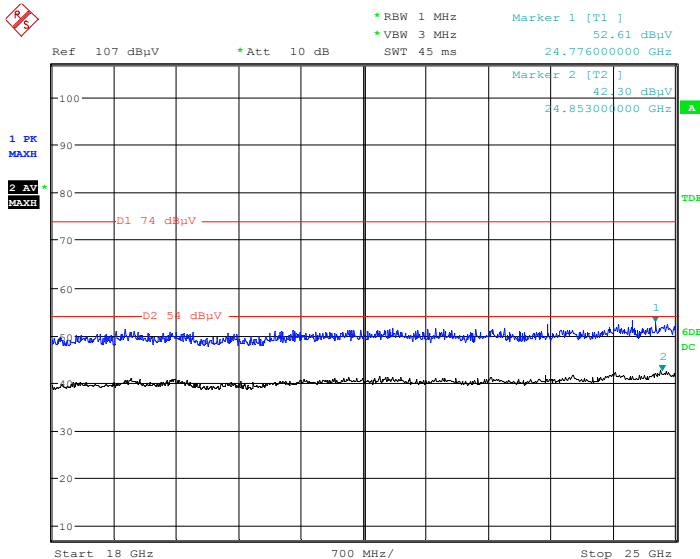
(Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case **middle** channel of operation in X-axis of orientation was recorded)

Horizontal



Date: 2.DEC.2019 10:58:59

Vertical



Date: 2.DEC.2019 11:21:13

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:

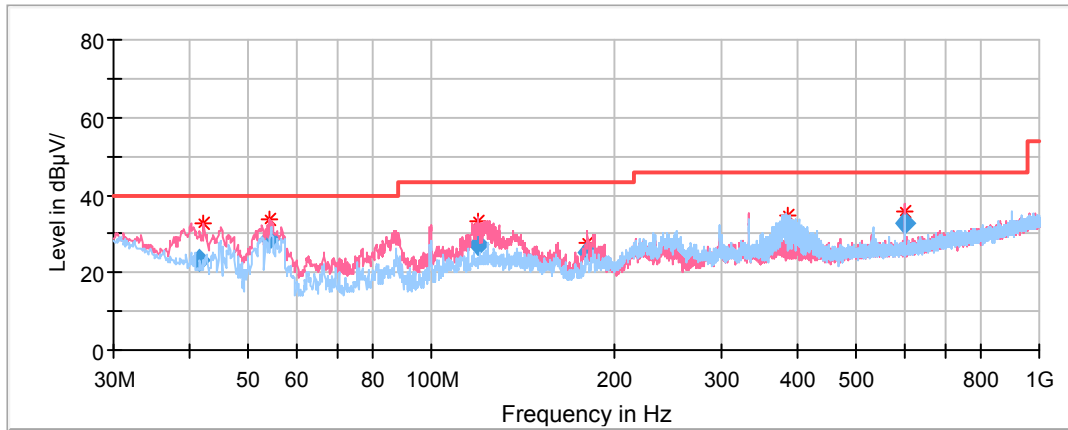
- Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
 Corrected Amplitude (dB μ V/m) = Corrected Factor (dB/m) + Reading (dB μ V)
 Margin (dB) = Limit (dB μ V/m) – Corrected Amplitude (dB μ V/m)

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	97.35	---	100.0	H	33.0	2.8	114.00	16.65
2403.00	---	92.19	100.0	H	33.0	2.8	94.00	1.81
2403.00	95.03	---	100.0	V	353.0	2.8	114.00	18.97
2403.00	---	90.04	100.0	V	353.0	2.8	94.00	3.96
2400.00	50.05	---	150.0	H	56.0	2.8	74.00	23.95
2400.00	---	37.28	150.0	H	56.0	2.8	54.00	16.72
Middle Channel: 2440MHz								
2440.00	97.77	---	150.0	H	90.0	2.9	114.00	16.23
2440.00	---	92.67	150.0	H	90.0	2.9	94.00	1.33
2440.00	95.52	---	150.0	V	340.0	2.9	114.00	18.48
2440.00	---	90.18	150.0	V	340.0	2.9	94.00	3.82
High Channel: 2475MHz								
2475.00	95.94	---	200.0	H	49.0	3.1	114.00	18.06
2475.00	---	89.97	200.0	H	49.0	3.1	94.00	4.03
2475.00	93.61	---	100.0	V	337.0	3.1	114.00	20.39
2475.00	---	87.74	100.0	V	337.0	3.1	94.00	6.26
2483.50	44.75	---	200.0	H	197.0	3.0	74.00	29.25
2483.50	---	37.07	200.0	H	197.0	3.0	54.00	16.93

For Model HM2401A:

Spurious Emission Test:

30MHz-1GHz:



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)				
41.37	23.22	100.0	V	235.0	-11.7	40.00	16.78
54.29	28.86	100.0	V	116.0	-17.7	40.00	11.14
119.72	27.02	100.0	V	90.0	-11.2	43.50	16.48
180.62	25.02	100.0	V	35.0	-13.6	43.50	18.48
385.13	31.61	100.0	H	1.0	-8.4	46.00	14.39
599.97	32.75	100.0	V	9.0	-5.2	46.00	13.25

1GHz-18GHz

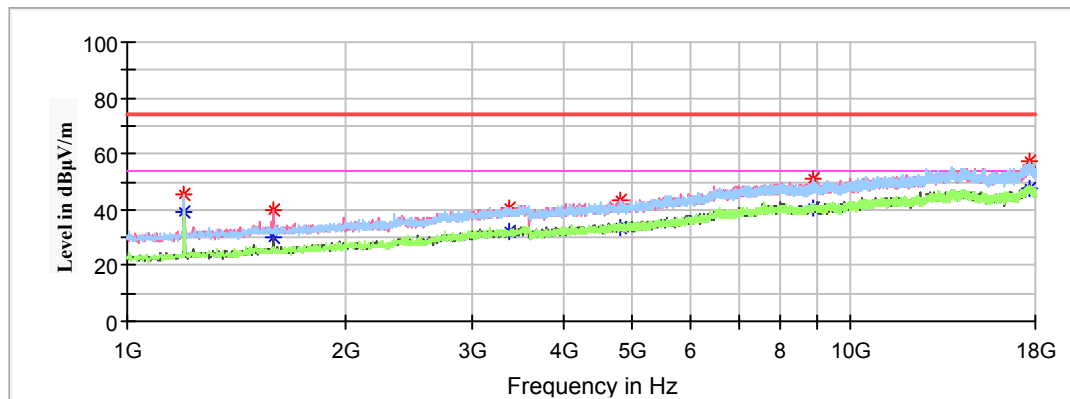
(Pre-scan in the X,Y and Z axes of orientation, the worst case X-axis of orientation was recorded.)

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

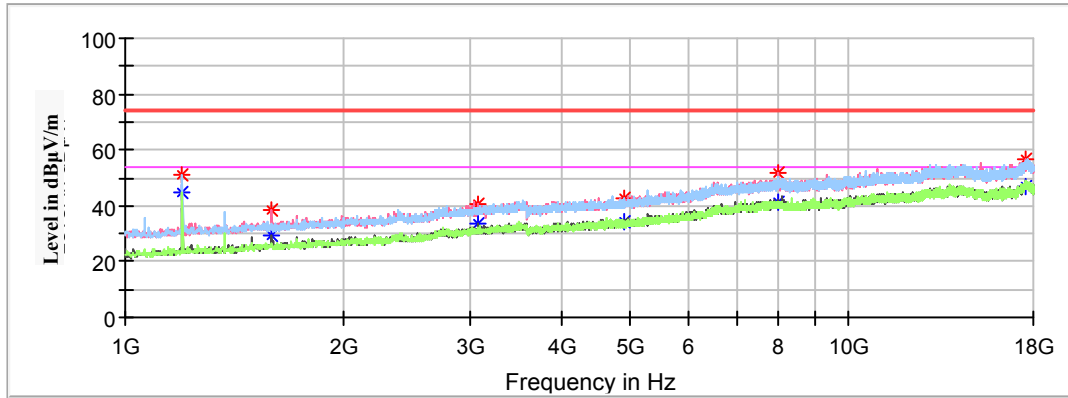
Full Spectrum



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)				
1200.60	---	39.06	200.0	H	344.0	-11.6	54.00	14.94
1200.60	45.55	---	200.0	H	344.0	-11.6	74.00	28.45
1595.00	---	29.77	150.0	V	262.0	-9.6	54.00	24.23
1595.00	40.04	---	150.0	V	262.0	-9.6	74.00	33.96
3380.00	---	32.04	200.0	V	97.0	-3.7	54.00	21.96
3380.00	40.76	---	200.0	V	97.0	-3.7	74.00	33.24
4806.00	---	33.51	150.0	H	209.0	-0.6	54.00	20.49
4806.00	43.48	---	150.0	H	209.0	-0.6	74.00	30.52
8899.90	---	40.47	200.0	H	287.0	7.4	54.00	13.53
8899.90	51.19	---	200.0	H	287.0	7.4	74.00	22.81
17673.60	---	47.73	150.0	V	139.0	14.0	54.00	6.27
17673.60	57.19	---	150.0	V	139.0	14.0	74.00	16.81

Middle Channel: 2440MHz

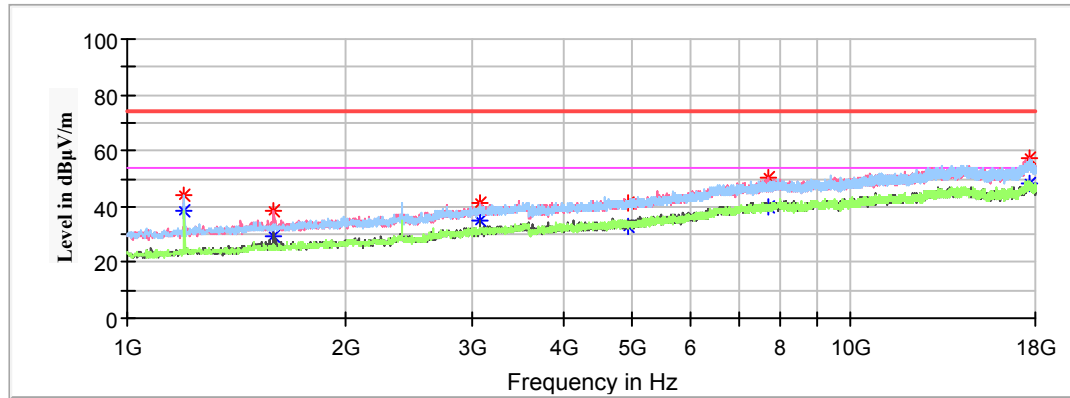
Full Spectrum



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)				
1219.30	---	44.92	150.0	H	0.0	-11.5	54.00	9.08
1219.30	51.05	---	150.0	H	0.0	-11.5	74.00	22.95
1595.00	---	29.32	200.0	V	264.0	-9.6	54.00	24.68
1595.00	38.31	---	200.0	V	264.0	-9.6	74.00	35.69
3070.60	---	33.71	150.0	V	204.0	-4.3	54.00	20.29
3070.60	40.74	---	150.0	V	204.0	-4.3	74.00	33.26
4880.00	---	34.34	150.0	H	175.0	-0.4	54.00	19.66
4880.00	42.93	---	150.0	H	175.0	-0.4	74.00	31.07
7975.10	---	40.97	200.0	V	264.0	7.0	54.00	13.03
7975.10	51.49	---	200.0	V	264.0	7.0	74.00	22.51
17568.20	---	47.20	150.0	V	296.0	14.2	54.00	6.80
17568.20	56.94	---	150.0	V	296.0	14.2	74.00	17.06

High Channel: 2475MHz

Full Spectrum

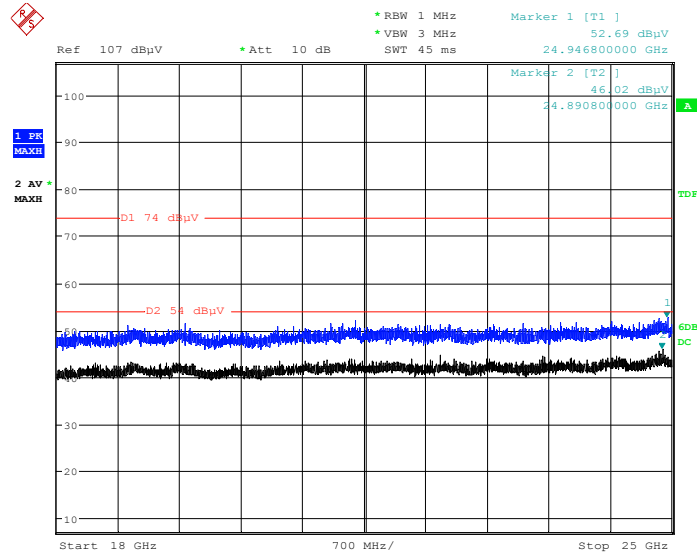


Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1236.30	---	38.55	200.0	H	63.0	-11.4	54.00	15.45
1236.30	44.30	---	200.0	H	63.0	-11.4	74.00	29.70
1593.30	---	29.68	150.0	V	291.0	-9.6	54.00	24.32
1593.30	38.24	---	150.0	V	291.0	-9.6	74.00	35.76
3070.60	---	35.14	200.0	V	4.0	-4.3	54.00	18.86
3070.60	40.91	---	200.0	V	4.0	-4.3	74.00	33.09
4914.00	---	33.13	150.0	V	347.0	-0.4	54.00	20.87
4914.00	41.15	---	150.0	V	347.0	-0.4	74.00	32.85
7713.30	---	39.58	150.0	V	218.0	6.5	54.00	14.42
7713.30	50.18	---	150.0	V	218.0	6.5	74.00	23.82
17711.00	---	48.26	200.0	V	140.0	13.9	54.00	5.74
17711.00	57.23	---	200.0	V	140.0	13.9	74.00	16.77

18GHz-25GHz:

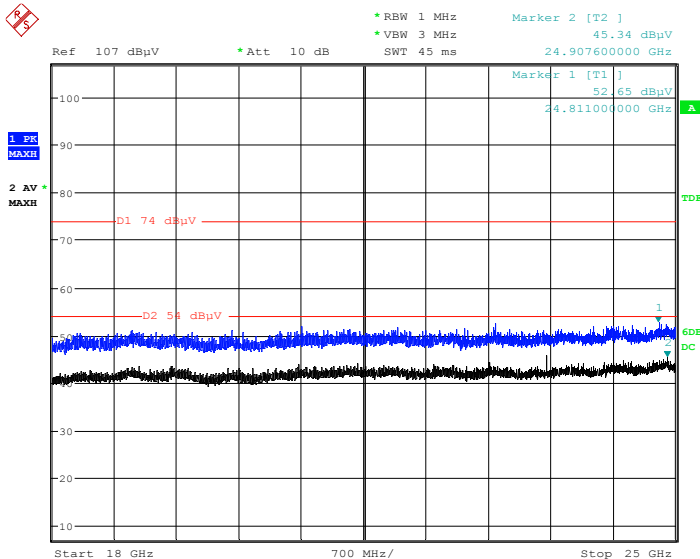
(Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case **middle** channel of operation in X-axis of orientation was recorded)

Horizontal



Date: 12.DEC.2019 20:19:15

Vertical



Date: 12.DEC.2019 20:50:57

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:

- Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
 Corrected Amplitude (dB μ V/m) = Corrected Factor (dB/m) + Reading (dB μ V)
 Margin (dB) = Limit (dB μ V/m) – Corrected Amplitude (dB μ V/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	97.66	---	200.0	H	290.0	2.8	114.00	16.34
2403.00	---	92.11	200.0	H	290.0	2.8	94.00	1.89
2403.00	95.26	---	150.0	V	160.0	2.8	114.00	18.74
2403.00	---	89.98	150.0	V	160.0	2.8	94.00	4.02
2400.00	---	37.61	200.0	H	85.0	2.8	54.00	16.39
2400.00	51.90	---	200.0	H	85.0	2.8	74.00	22.10
Middle Channel: 2440MHz								
2440.00	96.81	---	150.0	H	148.0	2.9	114.00	17.19
2440.00	---	91.13	150.0	H	148.0	2.9	94.00	2.87
2440.00	94.80	---	200.0	V	342.0	2.9	114.00	19.20
2440.00	---	88.71	200.0	V	342.0	2.9	94.00	5.29
High Channel: 2475MHz								
2475.00	96.30	---	150.0	H	25.0	3.1	114.00	17.70
2475.00	---	90.89	150.0	H	25.0	3.1	94.00	3.11
2475.00	94.28	---	200.0	V	241.0	3.1	114.00	19.72
2475.00	---	88.51	200.0	V	241.0	3.1	94.00	5.49
2483.50	53.33	---	200.0	H	47.0	3.0	74.00	20.67
2483.50	---	43.23	200.0	H	47.0	3.0	54.00	10.77

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:	22 °C
Relative Humidity:	48 %
ATM Pressure:	101.3 kPa

The testing was performed by Winnie Yang on 2019-11-28.

Test Result: Compliant.

Test Mode: Transmitting

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2403	1.437
Middle	2440	1.160
High	2475	1.226

Delta 1 [T1]

Ref Lvl -0.15 dB RBW 30 kHz RF Att 20 dB

20 dBm 1.43687375 MHz SWT 8.5 ms Unit dBm

11 dB Offset

▼1 [T1] -19.06 dBm

▲1 [T1] -0.15 dB

1.43687375 MHz

D1 1 dBm

1MAX

D2 -19 dBm

1

1MA

Center 2.403 GHz 300 kHz/ Span 3 MHz

Date: 28.NOV.2019 19:02:05

Ref Lvl 20 dBm Delta 1 [T1] -0.91 dB RBW 30 kHz RF Att 20 dB
 20 dBm 1.16032064 MHz VSWR 100 kHz Unit dBm

11 dB Offset
 -19.32 dBm
 2.43944990 GHz
 -0.91 dB
 1.16032064 MHz

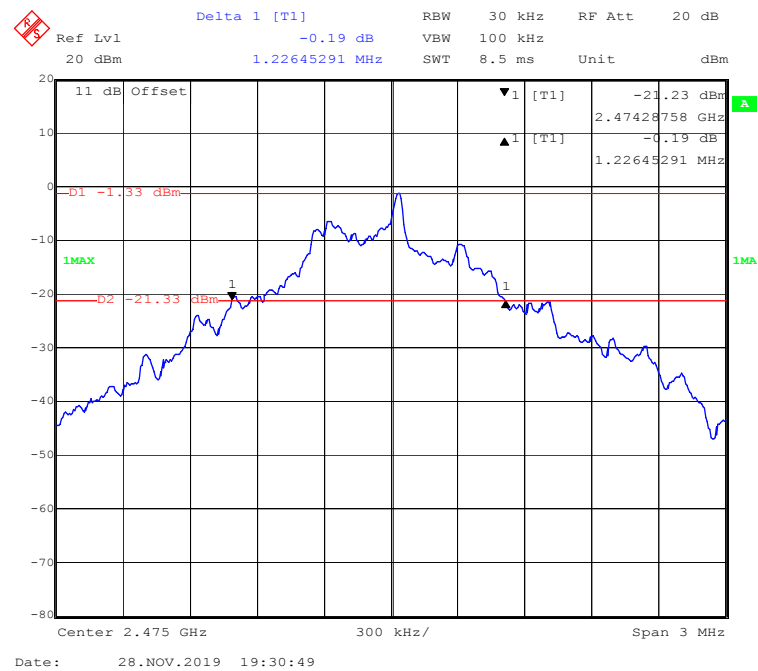
1 [T1]
 1 [T1]

1MAX
 1MAX

Center 2.44 GHz 300 kHz/ Span 3 MHz

Date: 28.NOV.2019 19:40:05

High Channel



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