

FCC PART 15.249 TEST REPORT

For

CHANGSHA SUNVOTE LIMITED

Room1024, Building A, Biaozi Business Center No. 198 Xiang Fu Road, Changsha, China

FCC ID: 2AMJJSUNVOTEKEYS5P

Report Type: Original Report	Product Type: Voting Keypad
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Report Number: RSHD190605001-00AM1	
Report Date: 2019-08-15	
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REPORT REVISION

Report Number	Report Date	Contents
RSHD190605001-00A	2019-07-12	Original Report
RSHD190605001-00AM1	2019-08-15	Update Channel Number

The items used black in italics in the report was revised due to the applicant's requirements.

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	CHANGSHA SUNVOTE LIMITED
Tested Model	S52Plus
Product Type	Voting Keypad
Dimension	92mm(L)*54mm(W)* 8mm(H)
Power Supply	DC 3.0V

All measurement and test data in this report was gathered from production sample serial number: 20190605001. (Assigned by BACL, Kunshan). The EUT was received on 2019-06-05.

Objective

This type approval report is prepared on behalf of *CHANGSHA SUNVOTE LIMITED* 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, 15.209 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)	Channel	Frequency (MHz)
1	2404	41	2403
2	2406	42	2405
3	2408	43	2407
4	2410	44	2409
5	2412	45	2411
6	2414	46	2413
7	2416	47	2415
8	2418	48	2417
9	2420	49	2419
10	2422	50	2421
11	2424	51	2423
12	2426	52	2425
13	2428	53	2427
14	2430	54	2429
15	2432	55	2431
16	2434	56	2433
17	2436	57	2435
18	2438	58	2437
19	2440	59	2439
20	2442	60	2441
21	2444	61	2443
22	2446	62	2445
23	2448	63	2447
24	2450	64	2449
25	2452	65	2451
26	2454	66	2453
27	2456	67	2455
28	2458	68	2457
29	2460	69	2459
30	2462	70	2461
31	2464	71	2463
32	2466	72	2465
33	2468	73	2467
34	2470	74	2469
35	2472	75	2471
36	2474	76	2473

37	2476	77	2475
38	2478	78	2477
39	2480	79	2479
40	/	80	2481

EUT was tested with Channel 41, 61 and 80.

EUT Exercise Software

RF test tool: Engineering mode

Support Equipment List and Details

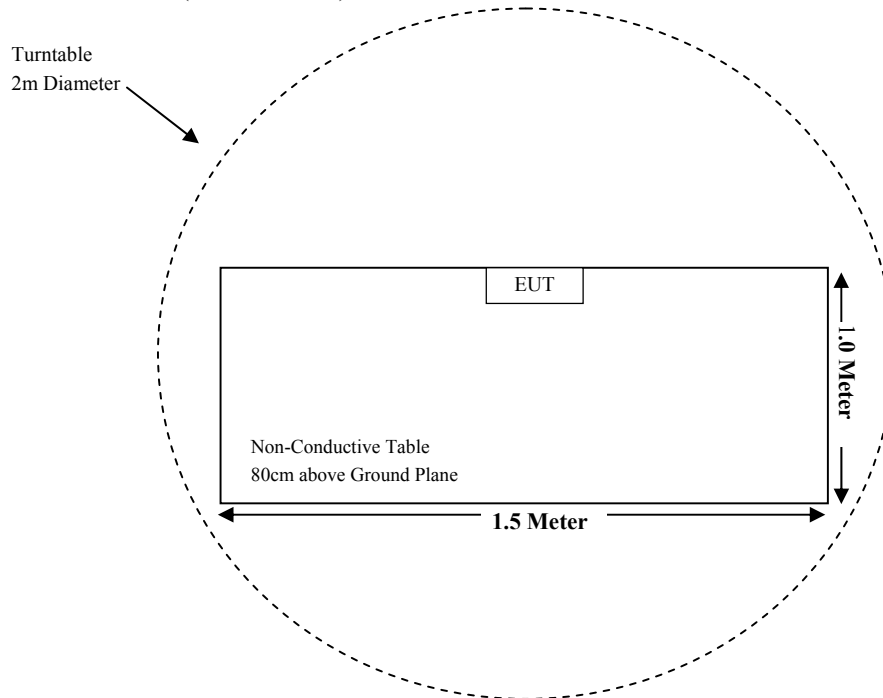
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

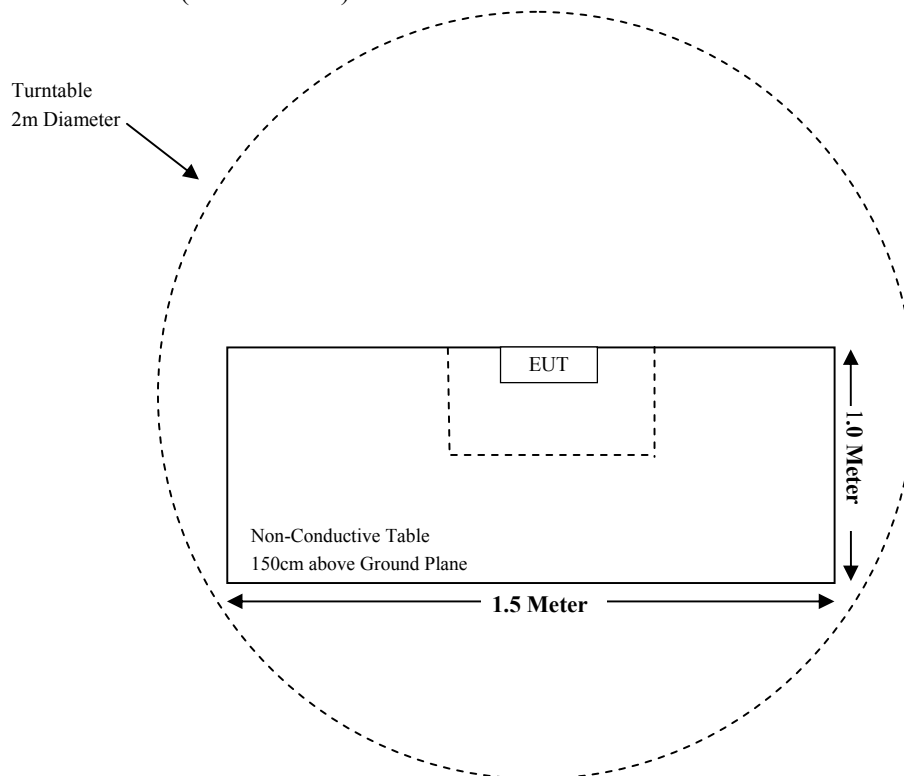
Cable Description	Length (m)	From Port	To
/	/	/	/

Block Diagram of Test Setup

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)	Conduction Emissions	Not Applicable
15.205, §15.209, §15.249	Radiated Emissions& Out of Band Emission	Compliant
§15.215 (c)	20 dB Bandwidth	Compliant

Note: The EUT is a battery operated device.

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	FSV40	101116	2018-07-23	2019-07-22
ETS-LINDGREN	Horn Antenna	3115	6229	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	FSIQ26	836131/009	2018-11-30	2019-11-29
Narda	Attenuator	10dB	010	2018-08-15	2019-08-14
SUNVOTE	RF Cable	SUNVOTEC01	C01	Each Time	/

* **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 -3.4dBi, which was permanently attached, fulfill the requirement of this section, please refer to the EUT photos.

Result: Compliant.

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:

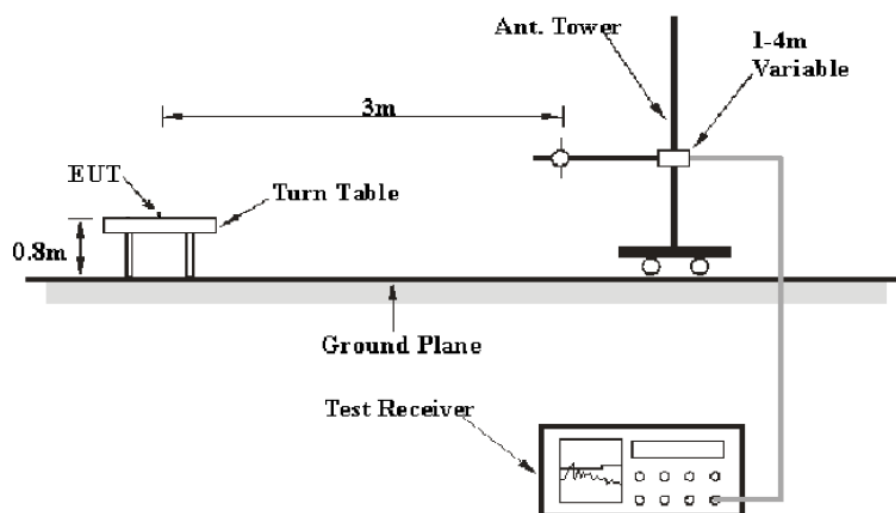
Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24GHz-24.25GHz	250	2500

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

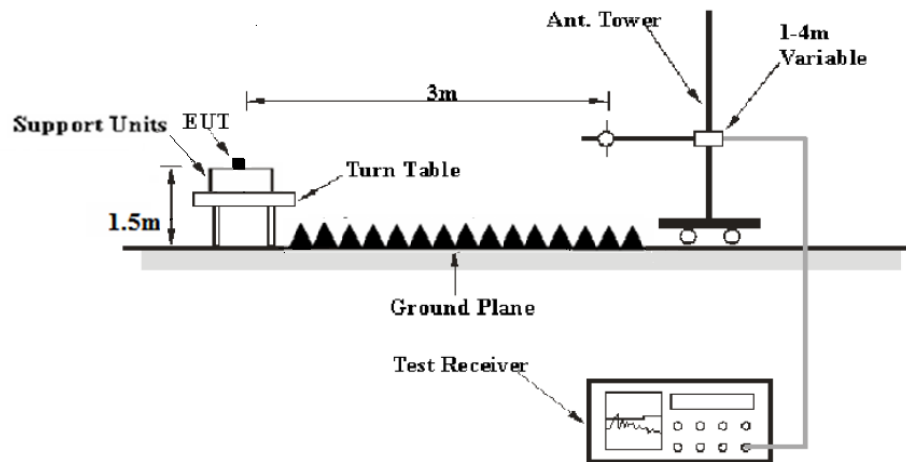
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

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

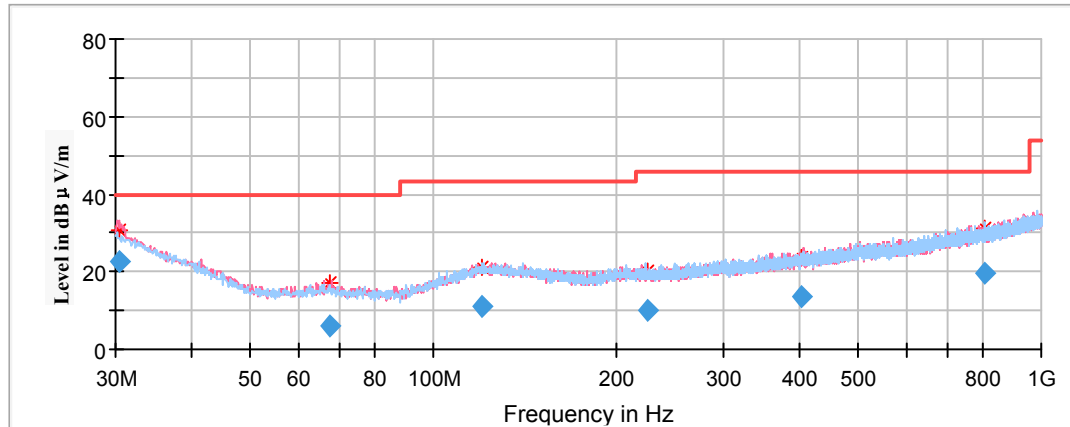
Temperature:	25°C
Relative Humidity:	52%
ATM Pressure:	102.0 kPa

The testing was performed by Wendy Wei on 2019-06-25.

Test Mode: Transmitting

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 **high** channel of operation in Y-axis of orientation was recorded.)



Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	Quasi-peak (dB μ V/m)	Height (cm)	Polar (H/V)				
30.459300	22.71	101.0	V	0.0	-4.2	40.00	17.29
67.614100	5.99	101.0	V	13.0	-17.4	40.00	34.01
120.224550	10.88	200.0	H	101.0	-11.2	43.50	32.62
225.027150	9.84	101.0	H	57.0	-12.2	46.00	36.16
404.368050	13.48	101.0	V	352.0	-8.1	46.00	32.52
807.526400	19.86	200.0	H	188.0	-1.6	46.00	26.14

1GHz-18GHz

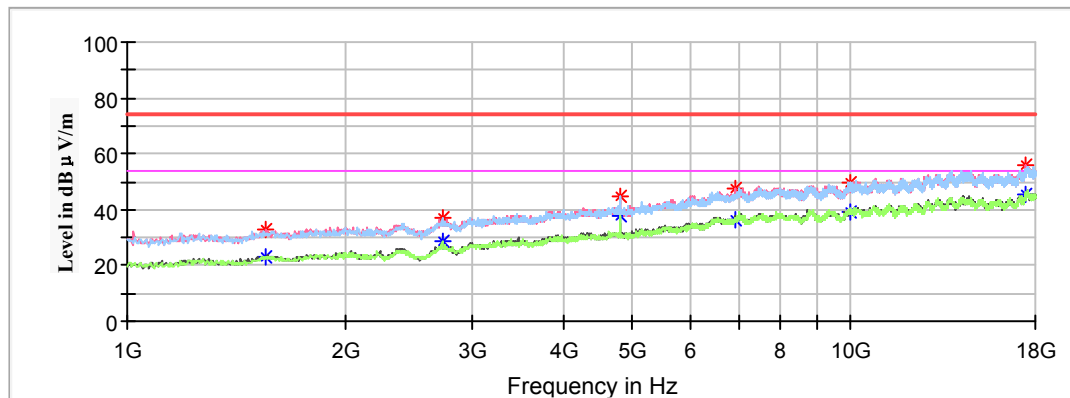
(Pre-scan in the X,Y and Z axes of orientation, the worst case **Y-axis of orientation** was recorded.)

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

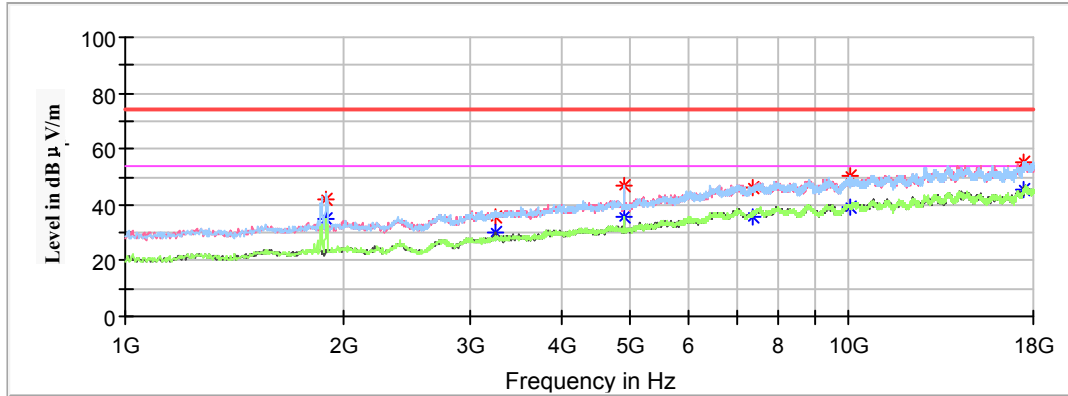
Full Spectrum



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)				
1557.600000	---	23.05	150.0	V	232.0	-9.7	54.00	30.95
1557.600000	32.98	---	150.0	V	232.0	-9.7	74.00	41.02
2723.800000	---	28.79	100.0	H	148.0	-5.8	54.00	25.21
2723.800000	37.29	---	100.0	H	148.0	-5.8	74.00	36.71
4806.000000	---	37.70	100.0	H	0.0	-0.6	54.00	16.30
4806.000000	44.67	---	100.0	H	0.0	-0.6	74.00	29.33
6943.200000	---	36.50	150.0	V	74.0	5.2	54.00	17.50
6943.200000	47.79	---	150.0	V	74.0	5.2	74.00	26.21
9999.800000	---	38.89	200.0	H	148.0	8.2	54.00	15.11
9999.800000	49.48	---	200.0	H	148.0	8.2	74.00	24.52
17500.200000	---	45.41	200.0	V	202.0	14.3	54.00	8.59
17500.200000	55.84	---	200.0	V	202.0	14.3	74.00	18.16

Middle Channel: 2443MHz

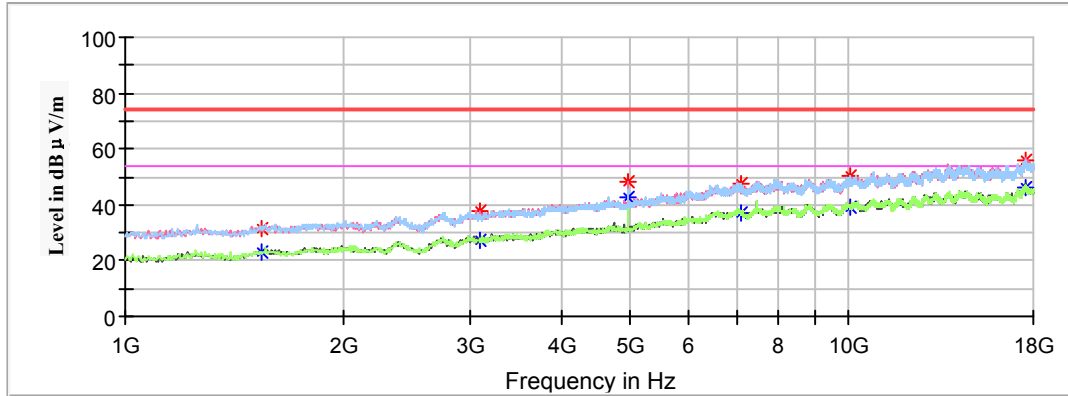
Full Spectrum



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)				
1894.200000	---	35.07	150.0	H	355.0	-8.6	54.00	18.93
1894.200000	41.68	---	150.0	H	355.0	-8.6	74.00	32.32
3250.800000	---	29.76	100.0	V	176.0	-4.0	54.00	24.24
3250.800000	35.42	---	100.0	V	176.0	-4.0	74.00	38.58
4886.000000	---	35.92	150.0	H	2.0	-0.4	54.00	18.08
4886.000000	46.92	---	150.0	H	2.0	-0.4	74.00	27.08
7347.800000	---	35.93	100.0	H	46.0	5.9	54.00	18.07
7347.800000	46.39	---	100.0	H	46.0	5.9	74.00	27.61
10057.600000	---	39.12	200.0	H	142.0	8.3	54.00	14.88
10057.600000	50.09	---	200.0	H	142.0	8.3	74.00	23.91
17493.400000	---	45.27	100.0	H	9.0	14.2	54.00	8.73
17493.400000	55.43	---	100.0	H	9.0	14.2	74.00	18.57

High Channel: 2481MHz

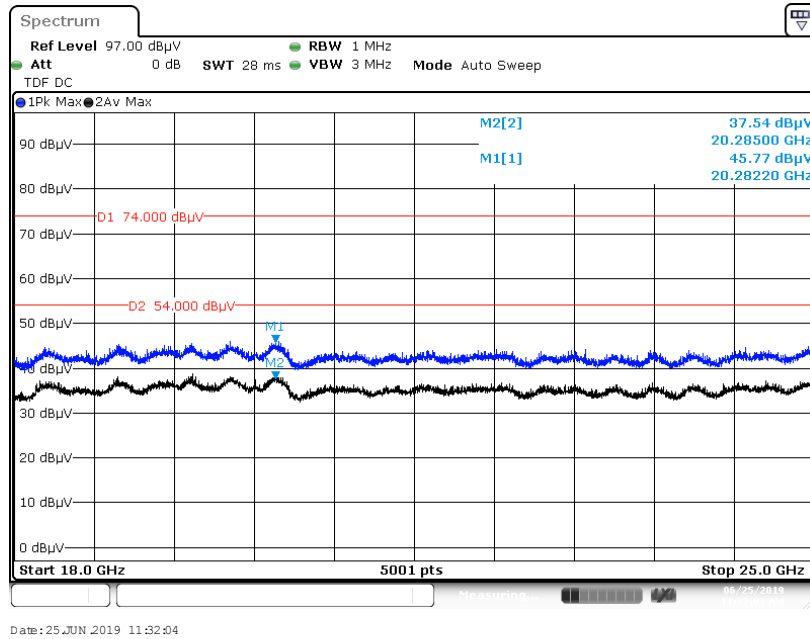
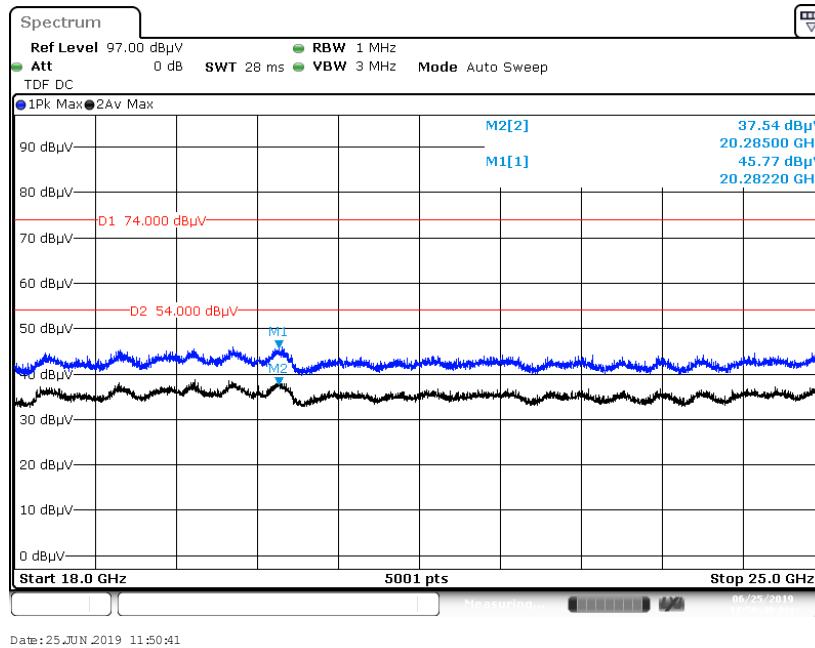
Full Spectrum



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)				
1547.400000	---	22.87	100.0	V	0.0	-9.8	54.00	31.13
1547.400000	31.70	---	100.0	V	0.0	-9.8	74.00	42.30
3101.200000	---	26.99	100.0	V	342.0	-4.2	54.00	27.01
3101.200000	37.92	---	100.0	V	342.0	-4.2	74.00	36.08
4962.000000	---	42.52	100.0	V	0.0	-0.3	54.00	11.48
4962.000000	48.18	---	100.0	V	0.0	-0.3	74.00	25.82
7099.600000	---	36.86	200.0	H	124.0	5.5	54.00	17.14
7099.600000	47.45	---	200.0	H	124.0	5.5	74.00	26.55
10033.800000	---	39.11	150.0	H	265.0	8.3	54.00	14.89
10033.800000	50.17	---	150.0	H	265.0	8.3	74.00	23.83
17609.000000	---	46.37	150.0	H	313.0	14.1	54.00	7.63
17609.000000	55.97	---	150.0	H	313.0	14.1	74.00	18.03

18GHz-25GHz:

(Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case **high** channel of operation in **Y-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 Y-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	87.53	---	200	H	311	2.8	114	26.47
2403.00	---	87.16	200	H	270	2.8	94	6.84
2403.00	86.92	---	100	V	139	2.8	114	27.08
2403.00	---	86.28	100	V	233	2.8	94	7.72
2390.00	45.43	---	150	H	308	2.8	74	28.57
2390.00	---	35.61	150	H	341	2.8	54	18.39
Middle Channel: 2443MHz								
2443.00	86.72	---	250	H	75	2.9	114	27.28
2443.00	---	86.31	250	H	242	2.9	94	7.69
2443.00	85.49	---	150	V	226	2.9	114	28.51
2443.00	---	84.98	150	V	7	2.9	94	9.02
High Channel: 2481MHz								
2481.00	85.93	---	100	H	285	3	114	28.07
2481.00	---	85.69	100	H	217	3	94	8.31
2481.00	84.67	---	150	V	355	3	114	29.33
2481.00	---	84.13	150	V	334	3	94	9.87
2483.50	47.56	---	150	H	127	3	74	26.44
2483.50	---	36.58	150	H	293	3	54	17.42

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:	23.2~25.0°C
Relative Humidity:	48~50%
ATM Pressure:	101.2~101.3kPa

The testing was performed by Wendy Wei from 2019-06-13 to 2019-06-14.

Test Result: Compliant.

Test Mode: Transmitting

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2403	0.782
Middle	2443	0.788
High	2481	0.794

Delta 1 [T1] -0.67 dB

RBW 30 kHz RF Att 30 dB

Ref Lvl 20 dBm VBW 100 kHz

20 dBm 781.56312626 kHz SWT 8.5 ms Unit dBm

10.5 dB Offset

▼ 1 [T1] -21.79 dBm

▲ 1 [T1] -0.67 dB

781.56312626 kHz

-D1 -21.79 dBm

1MAX

-D2 -22.21 dBm

Center 2.403 GHz 300 kHz/ Span 3 MHz

Date: 14.JUN.2019 20:12:02

Delta 1 [T1]

Ref Lvl 10 dBm

10 dB Offset

0.19 dB

787.57515030 kHz

RBW 30 kHz

VBW 100 kHz

SWT 8.5 ms

RF Att 10 dB

Unit dBm

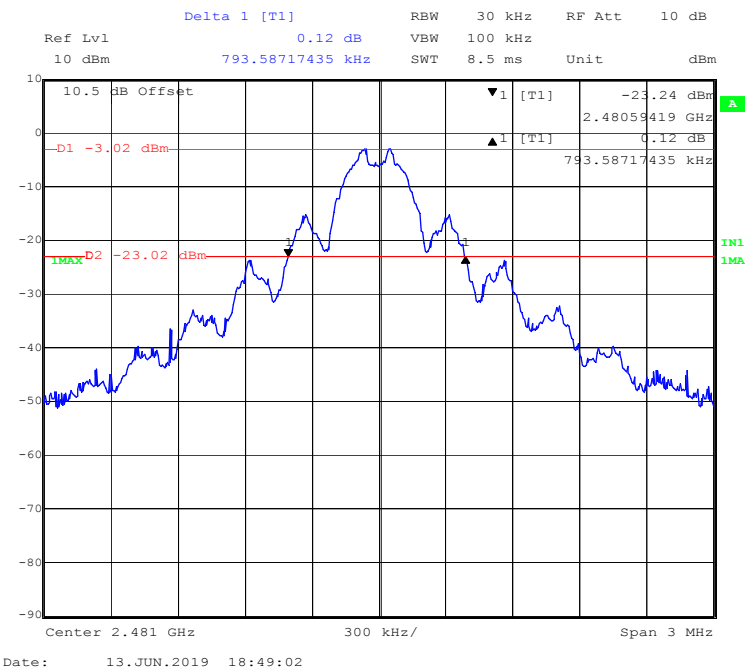
Center 2.443 GHz

300 kHz/

Span 3 MHz

Date: 13.JUN.2019 18:52:17

High Channel



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