Test Report

Report No.:	HQ200414EL04-FI
FCC ID:	2AGJ43KM
Applicant:	Specialty Technologies LLC
Address:	340 Victoria Road Youngstown, OH 44515 United States
Product:	Powered Subwoofer
Brand:	N/A
Test model(s):	3000 Micro
Series model(s):	N/A
Test Date:	Apr.16, 2020 ~ Jun. 11, 2020
Issued By:	Hwa-Hsing (Dongguan) Testing Co., Ltd.
Address:	No.101, Bld N1,Yuyuan 2Rd, Yuyuan Industrial Park, HuangJiang Town, Dongguan, China
FCC Designation Number:	CN1255
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) ANSI C63.10:2013

The above equipmenthas been tested by **Hwa-Hsing (Dongguan) Testing Co., Ltd.**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Tank , **Date:** Aug 01, 2020

Tank Tan/Engineer

Approved by : Harry Li , **Date:** Sep. 09, 2020

Harry Li/ Supervisor

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Release Control Record

Issue No.	Description	Date Issued
HQ200414EL04-FI	Original Release	Sep. 09, 2020

1. Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247) ANSI C63.10:2013; KDB 558074 D01 15.247 Meas Guidance v05r02			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	Pass	Meet the requirement of limit.
15.205 & 209	Radiated Emissions	Pass	Meet the requirement of limit.
15.247(d)	Band Edge Measurement	Pass	Meet the requirement of limit.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.247(a)(2)	6dB Bandwidth	Pass	Meet the requirement of limit.
---	Occupied Bandwidth Measurement	Pass	Reference only
15.247(b)	Conducted power	Pass	Meet the requirement of limit.
15.247(e)	Power Spectral Density	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used. The device is professionally installed

1.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUTas specified in CISPR 16-4-2:

The listed uncertainties are the worst cases uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Frequency	Expended Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.66 dB
Radiated Emissions up to 1 GHz	9KHz ~ 30MHz	2.90dB
	30MHz ~ 1000MHz	3.47 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	4.84 dB
	18GHz ~ 40GHz	4.62 dB

1.2 Modification Record

There were no modifications required for compliance.

2. General Information

2.1 General Description of EUT

Product Name	Powered Subwoofer
Brand Name	N/A
Test Model	3000 Micro
FCC ID:	2AGJ43KM
Series Model	N/A
Model Difference	N/A
Status of EUT	Engineering prototype
Power Supply Rating	AC120V
Modulation Type	GFSK
Transfer Rate	1 Mbps
Operating Frequency	2402 ~ 2480MHz
Number of Channel	40
Maximum Output Power	2.685mW
Antenna Type	PCB antenna with 4.16dBi gain
Antenna Connector	N/A
Accessory Device	N/A
Data Cable Supplied	N/A

Note:

1. Please refer to the EUT photo document (Reference No. : HQ200414EL04) for detailed product photo.
2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.

2.2 Description of Test Channels

40 channels are provided to this EUT:

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

2.3 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable test items				Description
	RE≥1G	**RE<1G**	**PLC**	**APCM**	
-	√	√	√	√	-

Where **RE≥1G:** Radiated Emission above 1GHz **RE<1G:** Radiated Emission below 1GHz
PLC: Power Line Conducted Emission **APCM:** Antenna Port Conducted Measurement

Note: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Y-plane**.
Note: "-"means no effect.

Radiated Emission Test (Above 1GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data ratesand antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0, 19, 39	GFSK	1

Radiated Emission Test (Below 1GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data ratesand antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0	GFSK	1

Power Line Conducted Emission Test:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data ratesand antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0, 19, 39	GFSK	1

Antenna Port Conducted Measurement:

☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0, 19, 39	GFSK	1

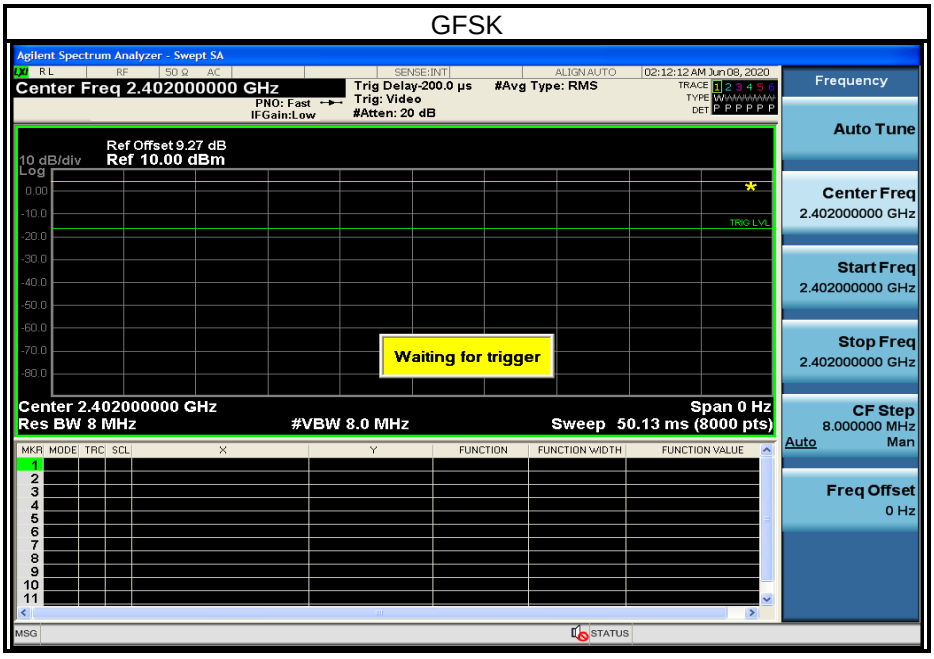
Test Condition:

Applicabletest items	Environmental Conditions	Power Supply	Tested by
RE≥1G	25deg. C, 65%RH	AC120V/60Hz	Tank Tan
RE<1G	25deg. C, 65%RH	AC120V/60Hz	Tank Tan
PLC	25 deg. C, 65 %RH	AC120V/60Hz	Tank Tan
APCM	25 deg. C, 65 %RH	AC120V/60Hz	Scott He

2.4 DutyCycleof Test Signal

GFSK: Duty cycle of test signal is 100 %, Duty cycle of test signal is > 98%

GFSK



2.5 Description of Support Units

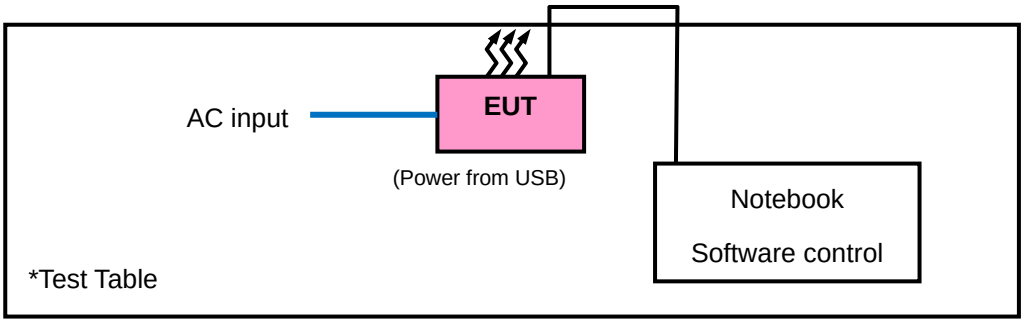
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

No.	Product	Brand	Model No.	Serial No.	FCC ID
1.	Notebook	Lenovo	TP0093A	PF-12HMBU	N/A
2.	Mouse	DELL	MS111-L	CN-09RRC7-44751-0C6-04TR	N/A
3.	N/A	N/A	N/A	N/A	N/A

Insert Cable Connections to/from EUT provided by test team.

No.	Signal Cable Description Of The Above Support Units
1.	USB Line: Un-shieldin 1.0m
2.	/
3.	/

2.6 Configuration of System under Test



2.7 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (15.247)
KDB 558074 D01 15.247 Meas Guidance v05r02
ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

Note: The EUT has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC). The test report has been issued separately.

3. Test types and results

3.1 Radiated Emission and Bandedge Measurement

3.1.1 Limits of radiated emission and bandedge measurement

Radiated emissions which fall in the restricted bandsmust comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

3.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
EMI Test Receiver Rohde&Schwarz	ESCI 7	100962	2020-5-14	2021-5-13
Broadband antenna Schwarzbeck	VULB 9168	00937	2019-10-20	2020-10-20
3m Semi-anechoic Chamber MAORUI	9m*6m*6m	NSEMC003	2020-04-16	2021-04-15
Signal Amplifier Com-power	PAM-103	18020051	2019-10-18	2020-10-17
Attenuator Rohde&Schwarz	TS2GA-6dB	18101101	N/A	N/A
Test software FARAD	FARAD	EZ_EMCV1.1.4.2	N/A	N/A
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-01	2019-10-18	2020-10-17
Loop Antenna	HLA 6121	45745	2019-10-18	2020-10-17
Preamplifier EMCI	EMC001340	980201	2019-10-18	2020-10-17
Digital Multimete FLUKE	15B+	43512617WS	2019-10-18	2020-10-17
Horn Antenna Schwarzbeck	BBHA 9170	01959	2019-10-19	2020-10-18
Spectrum Analyzer Rohde&Schwarz	FSV-40N	101783	2019-10-18	2020-10-17
Broadband Coaxial Preamplifier Schwarzbeck	BBV 9718	00025	2019-10-18	2020-10-17
Horn Antenna Schwarzbeck	BBHA 9170	BBHA9170242	2019-10-19	2020-10-18
Pre-Amplifier EMCI	EMC 184045	980102	2019-10-19	2020-10-18
Spectrum Keysight	N9020A	MY51240612	2019-10-18	2020-10-17
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower&Turn Table Controller MF	MF-7802	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA.

2. The test was performed in Chamber 1.

3.1.3 Test Procedures

a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
f. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

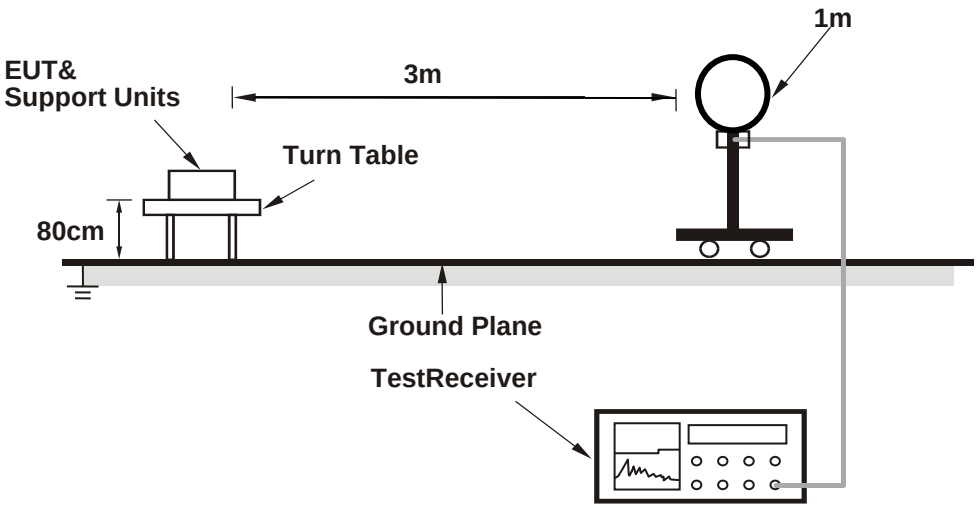
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1/T for Average (Duty cycle < 98 %) detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

3.1.4 Deviationfrom Test Standard

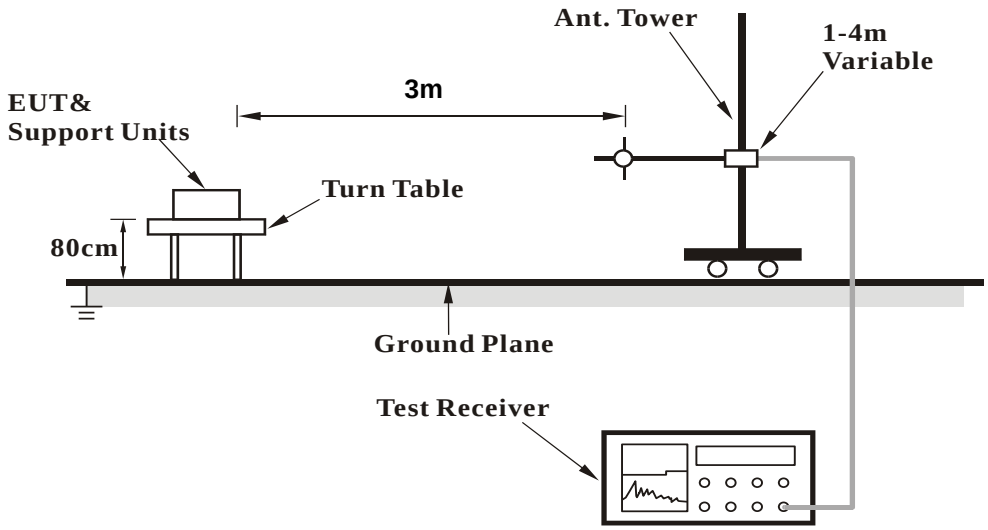
No deviation.

3.1.5 Test Set up

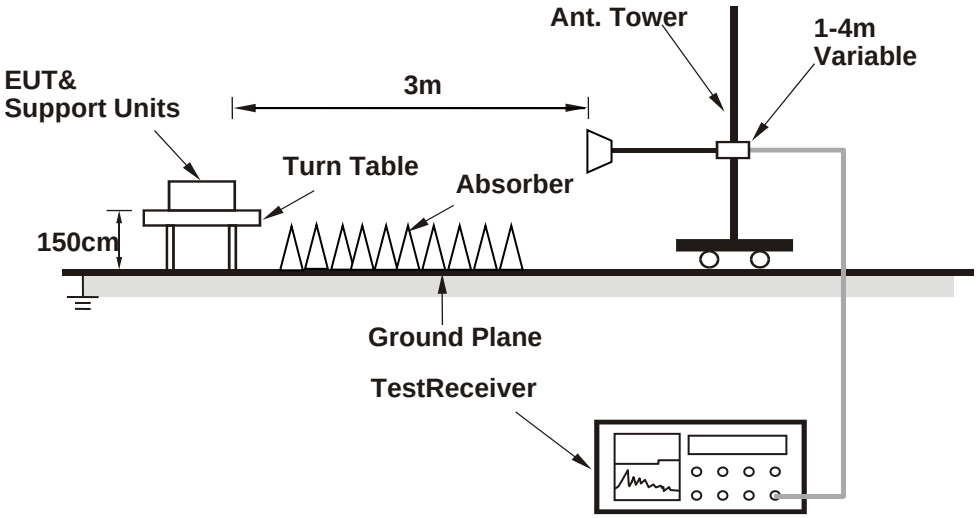
Radiated emission below 30MHz:



Frequency Range below 1GHz:



Frequency Range above 1GHz:



Directional antenna.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

3.1.6 EUT Operating Conditions

a. Placed the EUT on the testing table.

b. Set the EUT under transmission condition continuously at specific channel frequency.

3.1.7 Test Results

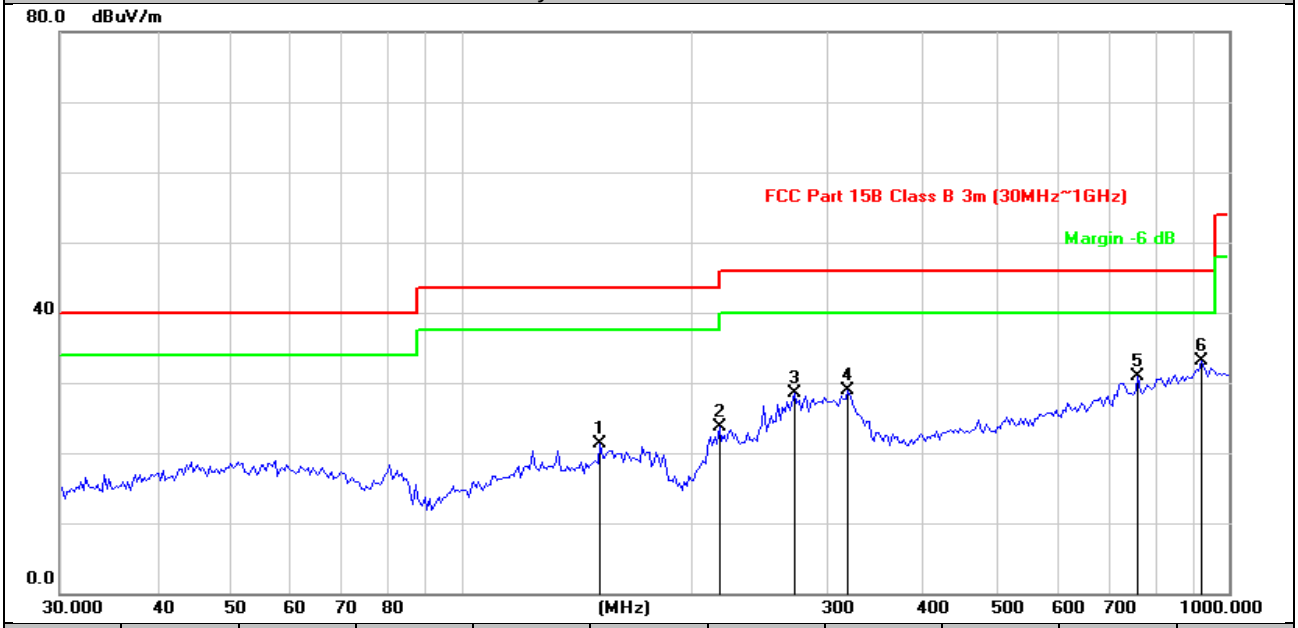
9kHz ~ 30MHz Data:

The amplitude of spurious emissions attenuated more than 20dB below the permissible value is not required to be report.

30MHz ~ 1GHz Worst-Case Data:

Test Channel	Channel 0	Frequency Range	30MHz ~ 1GHz
Power Supply	AC120V 60Hz	Detector Function	Peak (PK) Quasi-peak (QP)
Environmental Conditions	24deg. C, 57%RH	Tested By	Tank tan

Antennal Polarity&Test Distance: Horizontal at 3 m



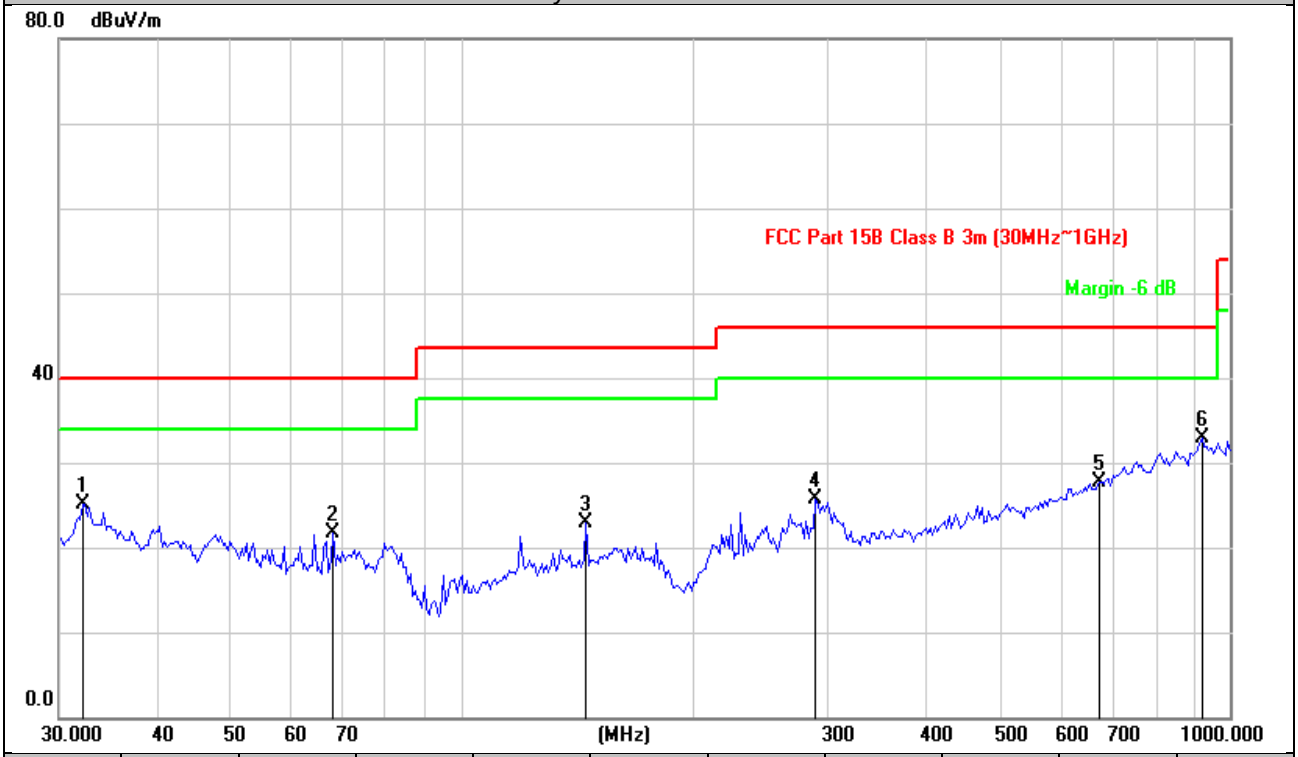
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	151.5971	34.56	-13.23	21.33	43.50	-22.17	QP	100	248	
2	216.7828	40.03	-16.25	23.78	46.00	-22.22	QP	200	228	
3	271.3245	41.74	-13.32	28.42	46.00	-17.58	QP	100	241	
4	318.8170	41.44	-12.49	28.95	46.00	-17.05	QP	100	281	
5	760.7036	32.20	-1.30	30.90	46.00	-15.10	QP	100	143	
6	919.2866	31.15	1.87	33.02	46.00	-12.98	QP	100	323	

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value

Channel	Channel 0	Frequency Range	30MHz ~ 1GHz
Power Supply	AC120V 60Hz	Detector Function	Peak (PK) Quasi-peak (QP)
Environmental Conditions	24deg. C, 57%RH	Tested By	Tank Tan

Antennal Polarity&Test Distance: Vertical at 3 m



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	32.1795	42.72	-17.53	25.19	40.00	-14.81	QP	100	11	
2	68.1514	37.33	-15.58	21.75	40.00	-18.25	QP	100	263	
3	145.3506	37.33	-14.35	22.98	43.50	-20.52	QP	100	135	
4	289.0021	39.16	-13.41	25.75	46.00	-20.25	QP	200	53	
5	675.2080	31.29	-3.51	27.78	46.00	-18.22	QP	100	11	
6	919.2866	30.98	1.87	32.85	46.00	-13.15	QP	100	355	

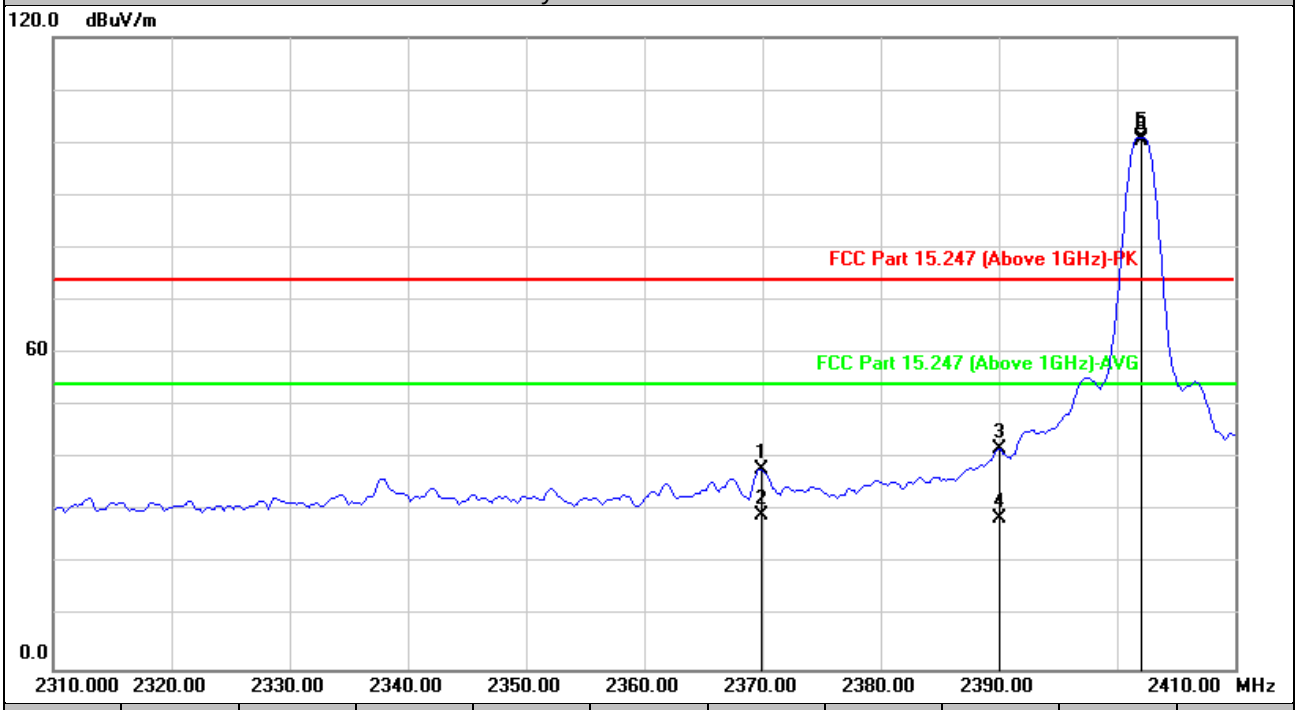
Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value

Above 1GHz Data:

Test Channel	Channel 0	Frequency Range	1GHz ~ 25GHz
Power Supply	AC120V 60Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	24deg. C, 57%RH	Tested By	Tank tan

Antennal Polarity&TestDistance: Horizontal at 3 m

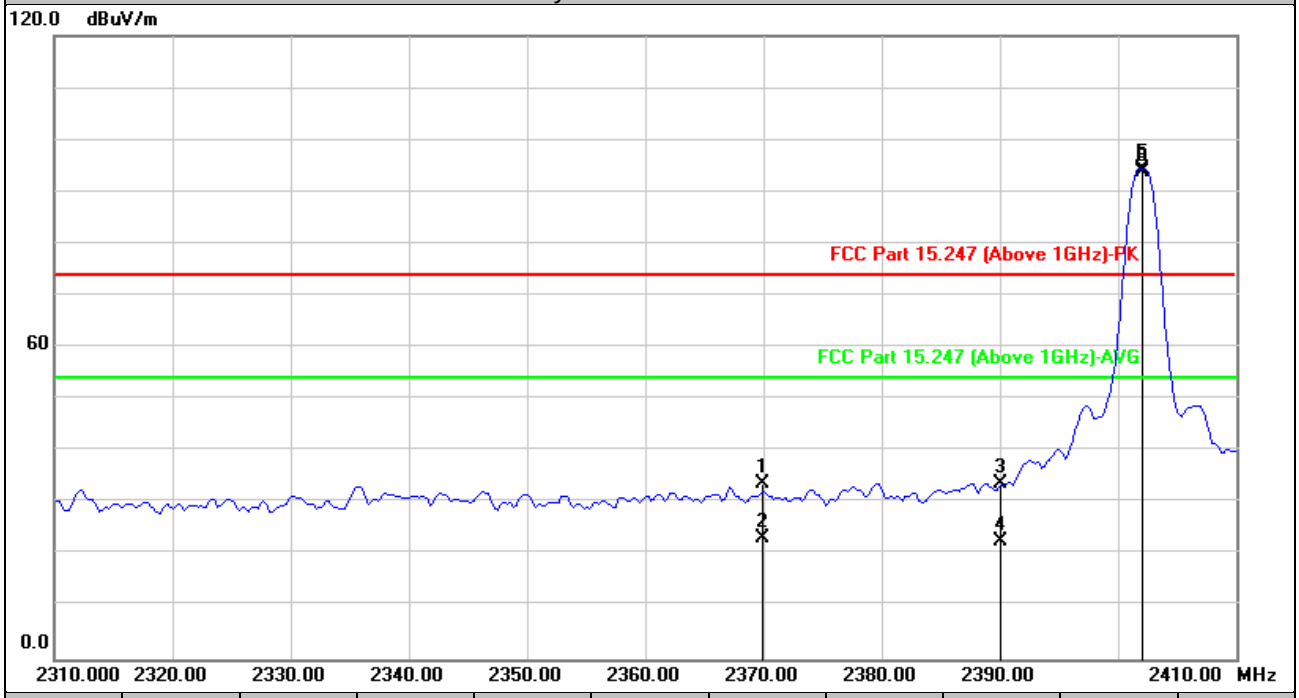


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2369.920	39.25	-1.26	37.99	74.00	-36.01	peak	123	95	
2	2370.000	30.64	-1.26	29.38	54.00	-24.62	AVG	123	95	
3	2390.000	42.97	-1.20	41.77	74.00	-32.23	peak	123	95	
4	2390.000	29.99	-1.20	28.79	54.00	-25.21	AVG	123	95	
5 *	2402.000	102.16	-1.18	100.98			peak	123	95	
6 *	2402.000	101.60	-1.18	100.42			AVG	123	95	
7	4804.000	42.01	5.36	47.37	74.00	-26.63	peak	100	107	
8	4804.000	36.90	5.36	42.26	54.00	-11.74	AVG	100	107	
9	7206.000	43.21	11.75	54.96	74.00	-19.04	peak	100	128	
10	7206.000	37.16	11.75	48.91	54.00	-5.09	AVG	100	128	worst

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. 2402MHz: Fundamental frequency.

Antennal Polarity&Test Distance: Vertical at 3 m



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2369.940	35.02	-1.26	33.76	74.00	-40.24	peak	113	216	
2	2369.940	24.58	-1.26	23.32	54.00	-30.68	AVG	113	216	
3	2390.000	35.00	-1.20	33.80	74.00	-40.20	peak	113	216	
4	2390.000	23.71	-1.20	22.51	54.00	-31.49	AVG	113	216	
5 *	2402.000	95.51	-1.18	94.33			peak	113	216	
6 *	2402.000	94.96	-1.18	93.78			AVG	113	216	
7	4804.000	44.67	5.36	50.03	74.00	-23.97	peak	244	75	
8	4804.000	41.12	5.36	46.48	54.00	-7.52	AVG	244	75	
9	7206.000	41.65	11.75	53.40	74.00	-20.60	peak	373	194	
10	7206.000	34.98	11.75	46.73	54.00	-7.27	AVG	373	194	

Remarks:

4. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
5. Margin value = Emission level – Limit value
6. 2402MHz: Fundamental frequency.

Test Channel	Channel 19	Frequency Range	1GHz ~ 25GHz
Power Supply	AC120V 60Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	24deg. C, 57%RH	Tested By	Tank tan

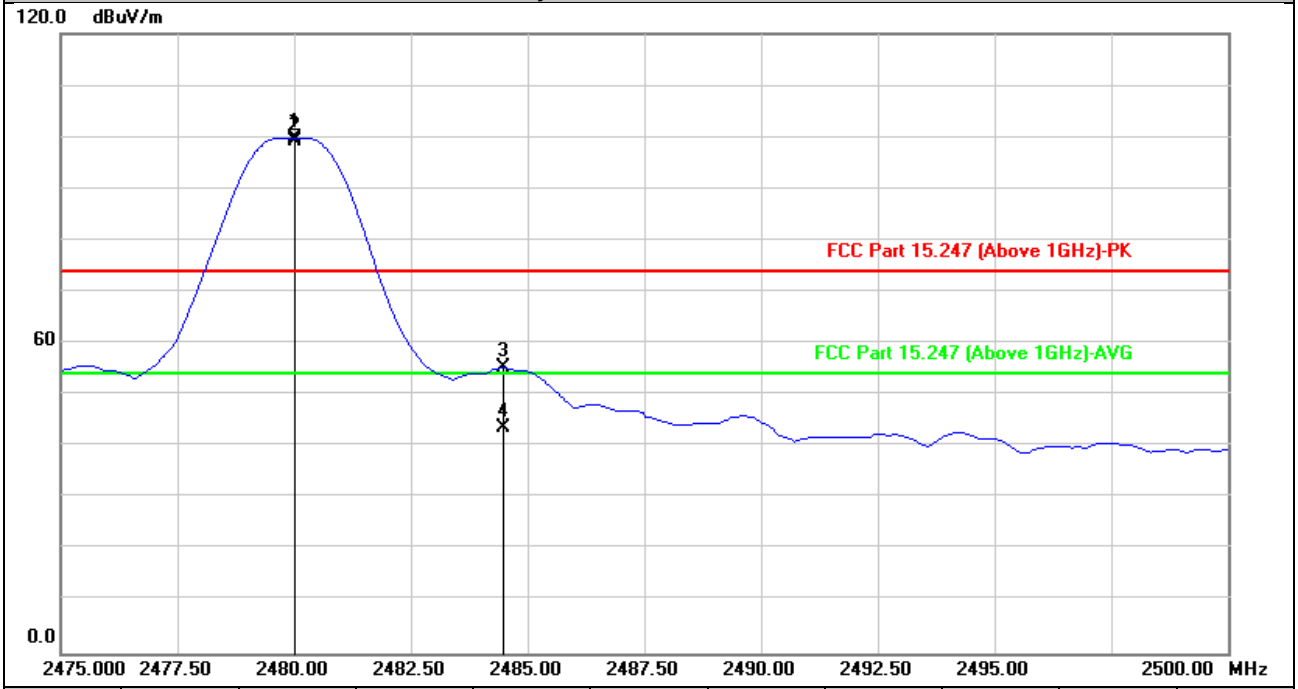
Antennal Polarity&Test Distance: Horizontal at 3 m										
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1 *	2440.000	94.93	-1.07	93.86			peak	142	238	
2 *	2440.000	93.82	-1.07	92.75			AVG	142	238	
3	4880.000	42.71	5.55	48.26	74.00	-25.74	peak	136	174	
4	4880.000	38.17	5.55	43.72	54.00	-10.28	AVG	136	174	
5	7320.000	43.51	11.17	54.68	74.00	-19.32	peak	400	156	
6	7320.000	36.69	11.17	47.86	54.00	-6.14	AVG	400	156	
Antennal Polarity&Test Distance: Vertical at 3 m										
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1 *	2440.000	101.21	-1.07	100.14			peak	286	231	
2 *	2440.000	100.64	-1.07	99.57			AVG	286	231	
3	4880.000	44.84	5.55	50.39	74.00	-23.61	peak	110	75	
4	4880.000	40.75	5.55	46.30	54.00	-7.70	AVG	110	75	
5	7320.000	41.48	11.17	52.65	74.00	-21.35	peak	162	193	
6	7320.000	35.98	11.17	47.15	54.00	-6.85	AVG	162	193	

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. 2440MHz: Fundamental frequency.

Test channel	Channel 39	Frequency Range	1GHz ~ 25GHz
Power Supply	AC120V 60Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	24deg. C, 57%RH	Tested By	Tank tan

Antennal Polarity&Test Distance: Horizontal at 3 m

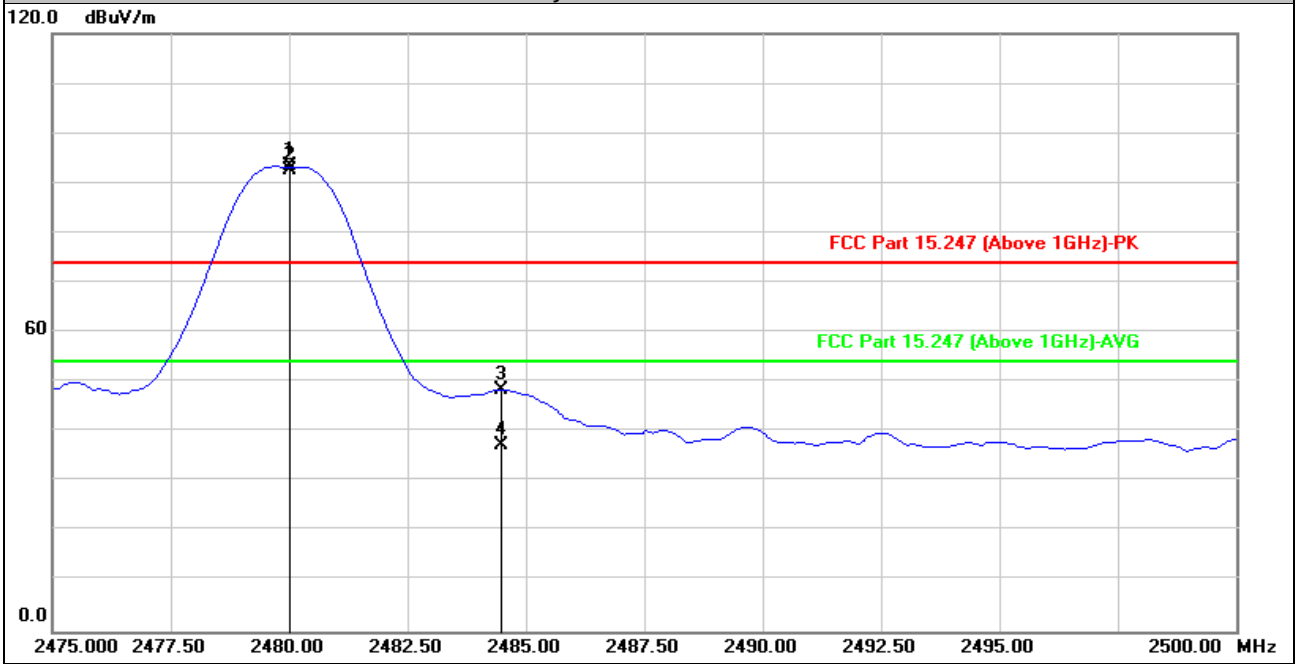


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1*	2480.000	100.78	-0.96	99.82			peak	117	99	
2 *	2480.000	100.16	-0.96	99.20			AVG	117	99	
3	2483.500	56.19	-0.94	55.25	74.00	-18.75	peak	117	99	
4	2483.500	44.71	-0.94	43.77	54.00	-10.23	AVG	117	99	
5	4960.000	44.42	5.39	49.81	74.00	-24.19	peak	294	58	
6	4960.000	39.78	5.39	45.17	54.00	-8.83	AVG	294	58	
7	7440.000	40.37	11.56	51.93	74.00	-22.07	peak	216	136	
8	7440.000	32.77	11.56	44.33	54.00	-9.67	AVG	216	136	

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. 2480MHz: Fundamental frequency.

Antennal Polarity&Test Distance: Vertical at 3 m



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1 *	2480.000	94.28	-0.96	93.32			peak	107	221	
2 *	2480.000	93.63	-0.96	92.67			AVG	107	221	
3	2484.469	49.49	-0.94	48.55	74.00	-25.45	peak	107	221	
4	2484.469	38.32	-0.94	37.38	54.00	-16.62	AVG	107	221	
5	4960.000	44.53	5.39	49.92	74.00	-24.08	peak	100	79	
6	4960.000	39.67	5.39	45.06	54.00	-8.94	AVG	100	79	
7	7440.000	42.75	11.56	54.31	74.00	-19.69	peak	173	195	
8	7440.000	35.65	11.56	47.21	54.00	-6.79	AVG	173	195	

Remarks:

4. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
5. Margin value = Emission level – Limit value
6. 2480MHz: Fundamental frequency.

3.2 Conducted Emission Measurement

3.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to0.50MHz.

3.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
EMI Test Receiver Rohde&Schwarz	ESCI3	101418	2019-10-19	2020-9-18
Artificial Mains Network Rohde&Schwarz	ENV216	3560.6550.15	2019-10-19	2020-9-18
Test software FARAD	EZ_EMC V1.1.4.2	N/A	N/A	N/A
Hygrothermograph Yuhuaze	HTC-1	NA	2019-10-19	2020-9-18
Digital Multimeter FLUKE	15B+	43512617WS	2019-10-19	2020-9-18

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA.
2. The test was performed in Shielded Room 1.

3.2.3 Test Procedures

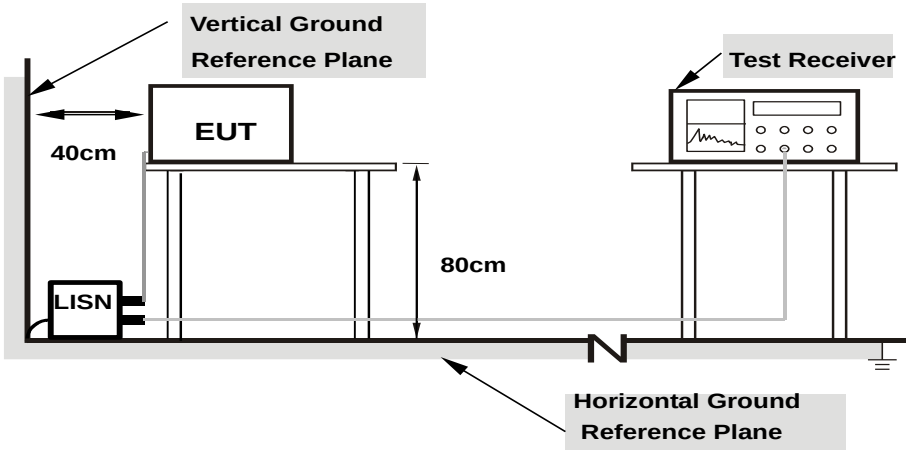
a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50uH of coupling impedance for the measuring instrument.
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit – 20dB)was not recorded.

Note: All modes of operation were investigated and the worst-case emissions are reported.

3.2.4 Deviationfrom Test Standard

No deviation.

3.2.5 Test setup



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

3.2.6 EUT Operating Conditions

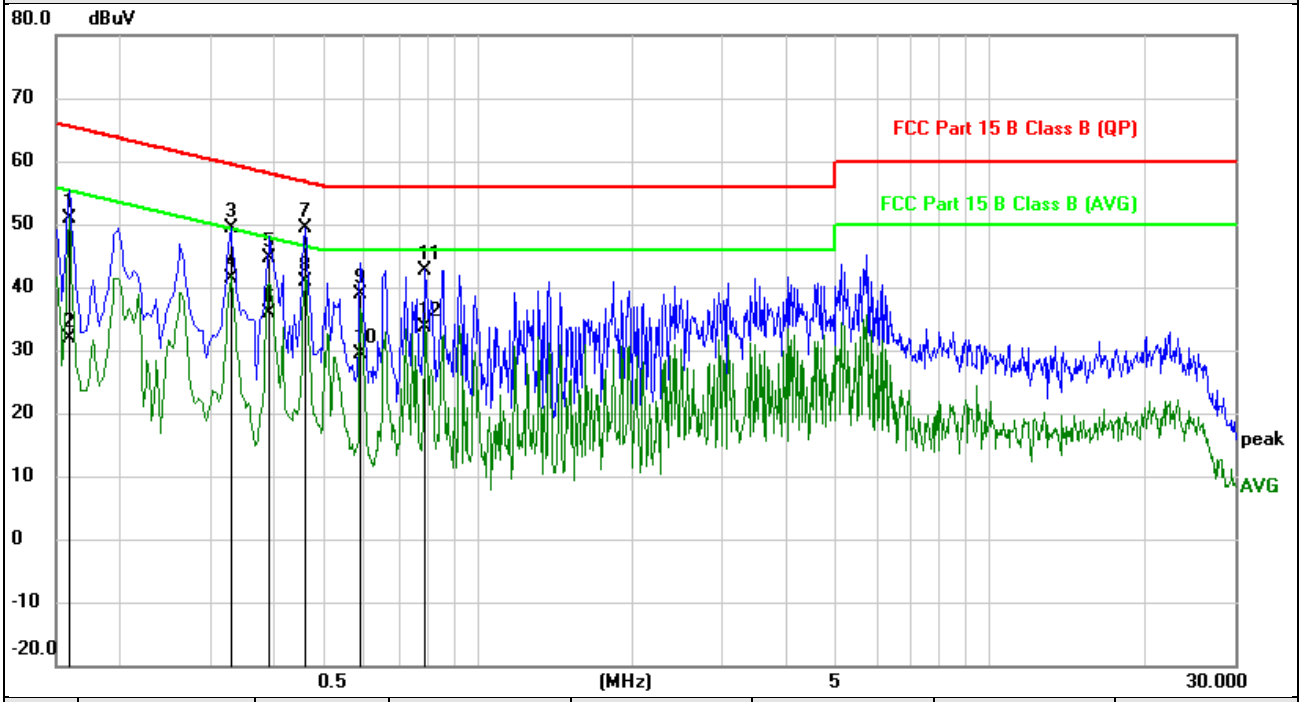
a. Placed the EUT on the testing table.
b. Set the EUT under transmission condition continuously at specific channel frequency.

3.2.7 Test Results

Conducted worst-case data

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution andwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Power Supply	AC120V 60Hz	Environmental Conditions	25℃, 60%RH
Tested by	24deg. C, 57%RH	Test Date	2020/5/21

Phase Of Power: Line (L)



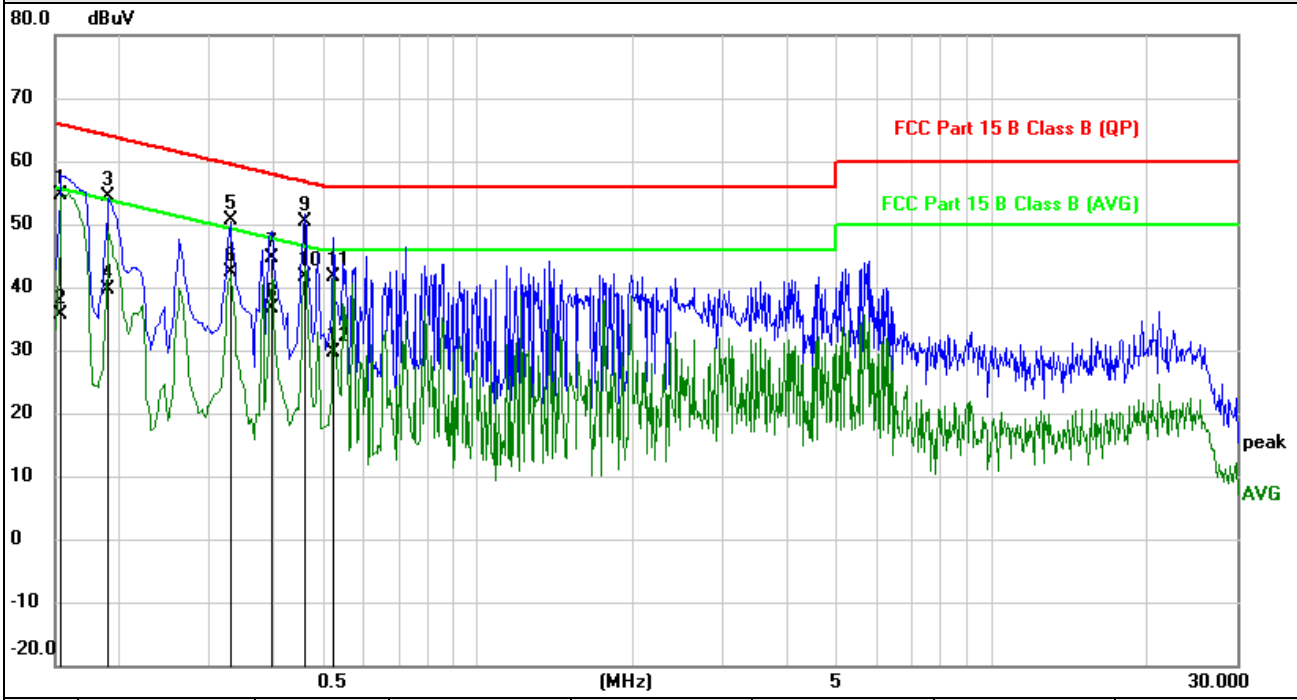
No	Frequency (MHz)	Reading (dBuV)	Correct dB	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark Detecter
1	0.1590	41.23	9.64	50.87	65.52	-14.65	QP
2	0.1590	22.27	9.64	31.91	55.52	-23.61	AVG
3	0.3300	39.89	9.60	49.49	59.45	-9.96	QP
4	0.3300	31.79	9.60	41.39	49.45	-8.06	AVG
5	0.3930	34.94	9.59	44.53	58.00	-13.47	QP
6	0.3930	26.37	9.59	35.96	48.00	-12.04	AVG
7	0.4605	39.91	9.59	49.50	56.68	-7.18	QP
8	0.4605	31.17	9.59	40.76	46.68	-5.92	AVG
9	0.5910	29.33	9.59	38.92	56.00	-17.08	QP
10	0.5910	19.81	9.59	29.40	46.00	-16.60	AVG
11	0.7890	33.05	9.58	42.63	56.00	-13.37	QP
12	0.7890	24.11	9.58	33.69	46.00	-12.31	AVG

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution andwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Power Supply	AC120V 60Hz	Environmental Conditions	25℃, 60%RH
Tested by	24deg. C, 57%RH	Test Date	2020/5/21

Phase Of Power: Neutral (N)



No	Frequency (MHz)	Reading (dBuV)	Correct dB	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark Detecter
1	0.1545	44.86	9.65	54.51	65.75	-11.24	QP
2	0.1545	25.96	9.65	35.61	55.75	-20.14	AVG
3	0.1905	44.87	9.63	54.50	64.01	-9.51	QP
4	0.1905	29.97	9.63	39.60	54.01	-14.41	AVG
5	0.3300	40.95	9.60	50.55	59.45	-8.90	QP
6	0.3300	32.69	9.60	42.29	49.45	-7.16	AVG
7	0.3975	35.04	9.59	44.63	57.91	-13.28	QP
8	0.3975	27.12	9.59	36.71	47.91	-11.20	AVG
9	0.4605	40.80	9.59	50.39	56.68	-6.29	QP
10	0.4605	32.16	9.59	41.75	46.68	-4.93	AVG
11	0.5235	31.99	9.59	41.58	56.00	-14.42	QP
12	0.5235	20.03	9.59	29.62	46.00	-16.38	AVG

Remarks:

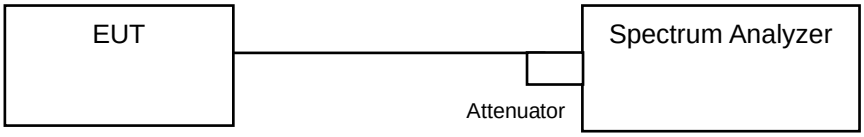
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

3.3 6dB Bandwidth Measurement

3.3.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

3.3.2 Test Setup



3.3.3 Test Instruments

Refer to section 10.1 to get information of above instrument.

3.3.4 Test Procedure

a. Set resolution bandwidth (RBW) = 100kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. Measure the maximum width of the emission that is constrained by the frequencies associatedwith the two amplitude points (upper and lower) that are attenuated by 6 dB relative to themaximum level measured in the fundamental emission

3.3.5 Deviation fromTest Standard

No deviation.

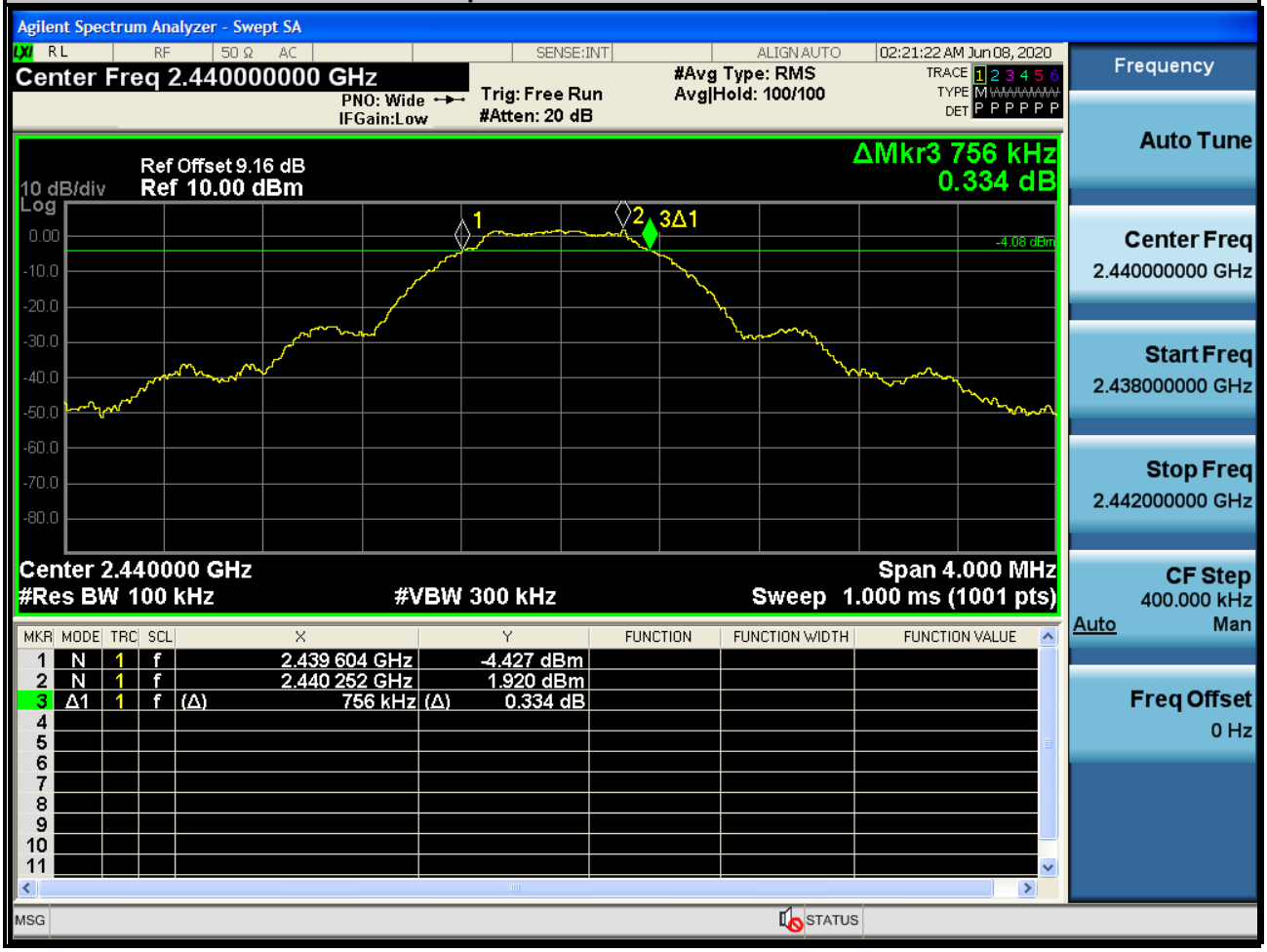
3.3.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.3.7 Test Result

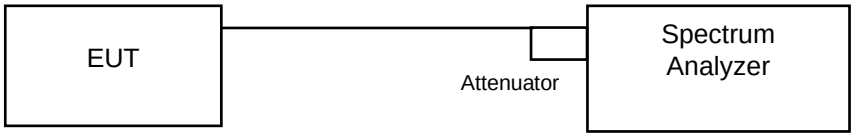
Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	0.728	0.5	Pass
19	2440	0.756	0.5	Pass
39	2480	0.716	0.5	Pass

Spectrum Plot of Worst Value



3.4 Occupied Bandwidth Measurement

3.4.1 Test Setup



3.4.2 Test Instruments

Refer to section 10.1 to get information of above instrument.

3.4.3 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidthand set the detector to peak. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 %of the total mean power of a given emission.

3.4.4 Deviation from Test Standard

No deviation.

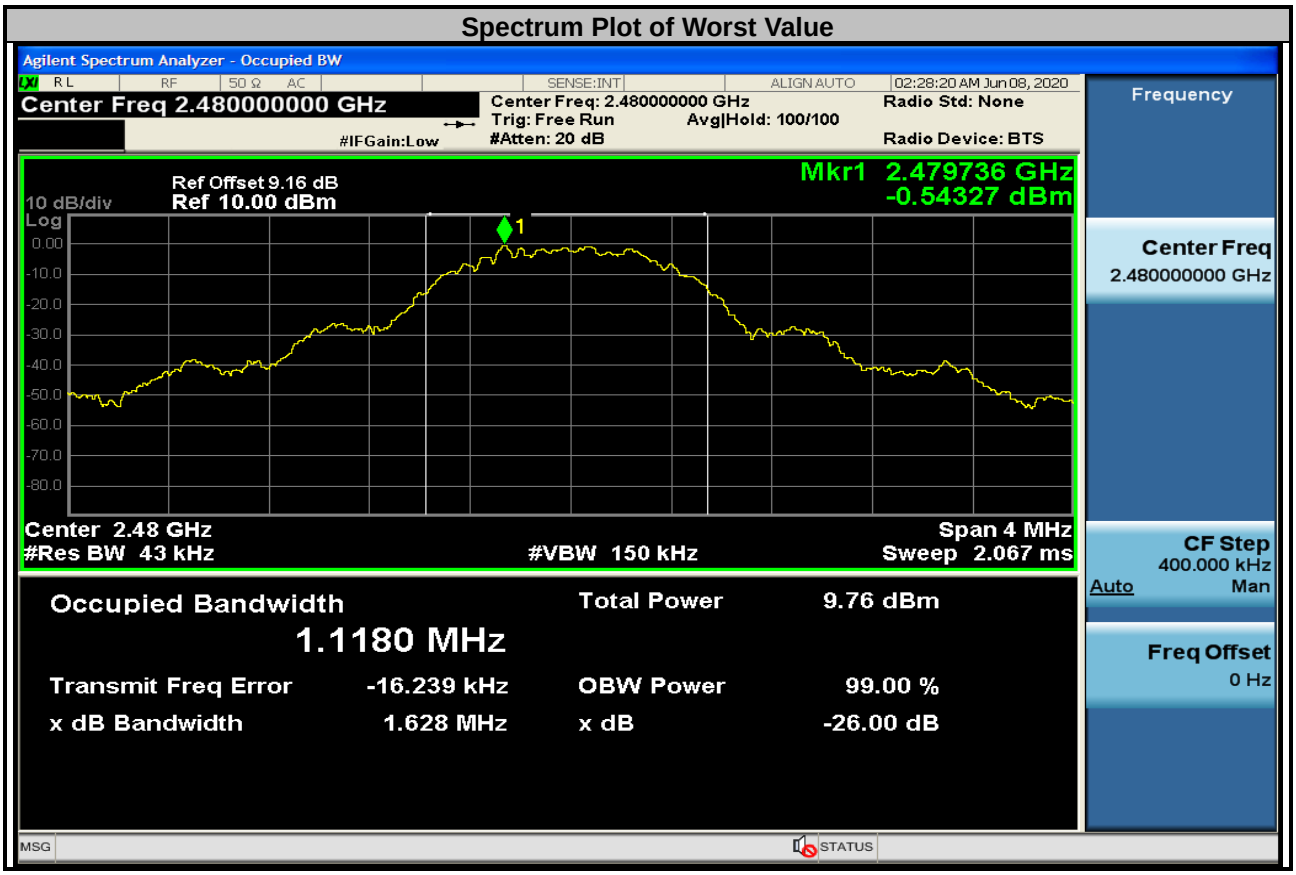
3.4.5 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.4.6 Test Results

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	Pass / Fail
0	2402	1.0561	Pass
19	2440	1.0905	Pass
39	2480	1.1180	Pass

Spectrum Plot of Worst Value

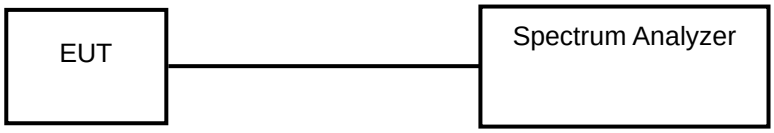


3.5 Conducted Output Power Measurement

3.5.1 Limits ofConducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHzbands: 1 Watt (30dBm)

3.5.2 Test Setup



3.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

3.5.4 Test Procedures

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect it to measurement instrument. 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.
c. The center frequency of the spectrum analyzer is set to the fundamental frequency and using 3 MHz RBW and 10 MHz VBW.
d. Measure the captured power within the band and recording the plot.
e. Repeat above procedures until all frequencies required were complete.

3.5.5 Deviation from Test Standard

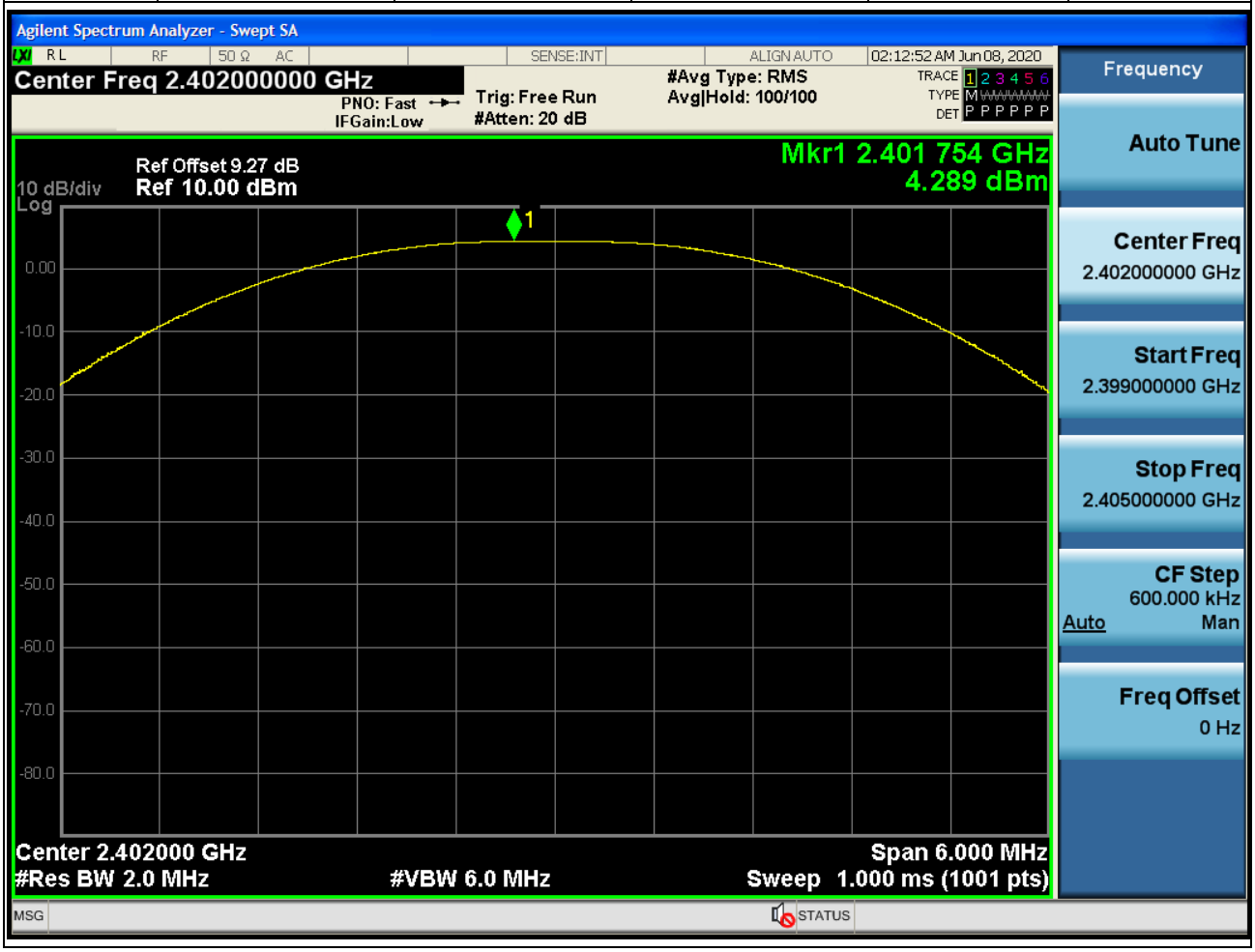
No deviation.

3.5.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.5.7 Test Results

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
0	2402	2.685	**4.29**	30	Pass
19	2440	2.061	3.14	30	Pass
39	2480	2.009	3.03	30	Pass

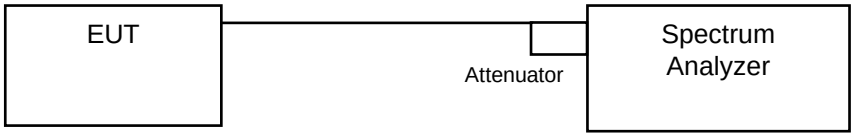


3.6 Power Spectral Density Measurement

3.6.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm/3kHz.

3.6.2 Test Setup



3.6.3 Test Instruments

Refer to section 10.1 to get information of above instrument.

3.6.4 Test Procedure

a. Set the RBW = 3 kHz, VBW =10 kHz, Detector = peak.
b. Sweep time = auto couple, Trace mode = max hold,allow trace to fully stabilize.
c. Use the peak marker function to determine the maximum power level in any 100 kHz bandsegment within the fundamental EBW.

3.6.5 Deviationfrom Test Standard

No deviation.

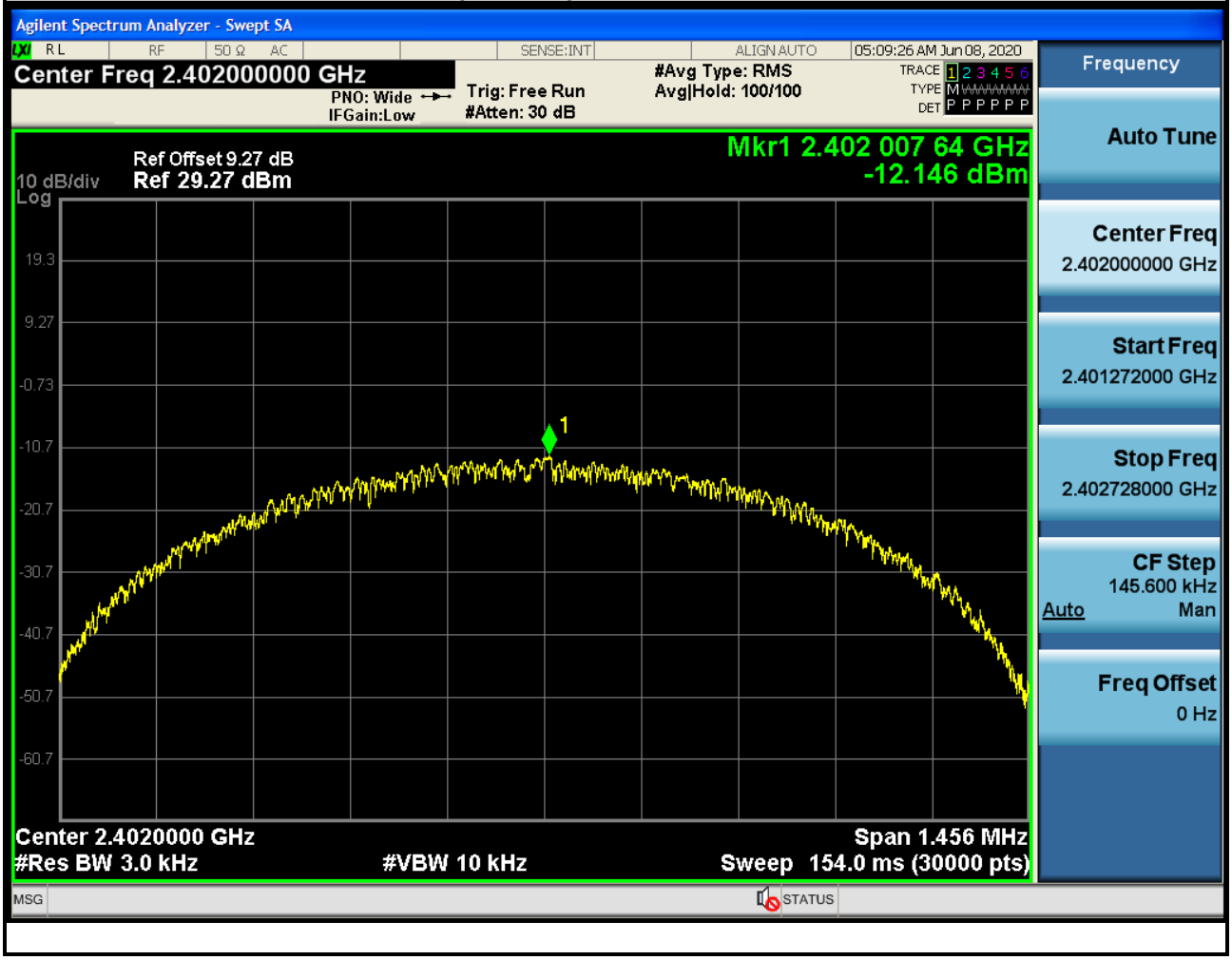
3.6.6 EUT Operating Condition

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.6.7 Test Results

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
0	2402	-12.15	8	Pass
19	2440	-13.51	8	Pass
39	2480	-13.90	8	Pass

Spectrum plot of worst value

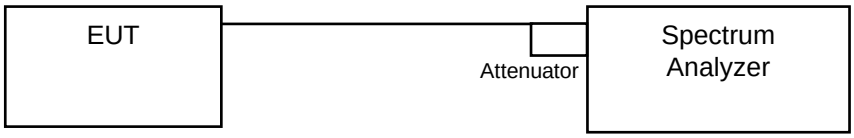


3.7 Conducted Out of Band Emission Measurement

3.7.1 Limits of Conducted Out of Band Emission Measurement

For average power：
Below –30dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).
For peak power:
Below –20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth)

3.7.2 Test Setup



3.7.3 Test Instruments

Refer to section 10.1 to get information of above instrument.

3.7.4 Test Procedure

Measurement procedure REF
1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHzband segment within the fundamental EBW.

3.7.5 Measurement procedure OOBE

1. Set RBW = 100 kHz.
2. Set VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

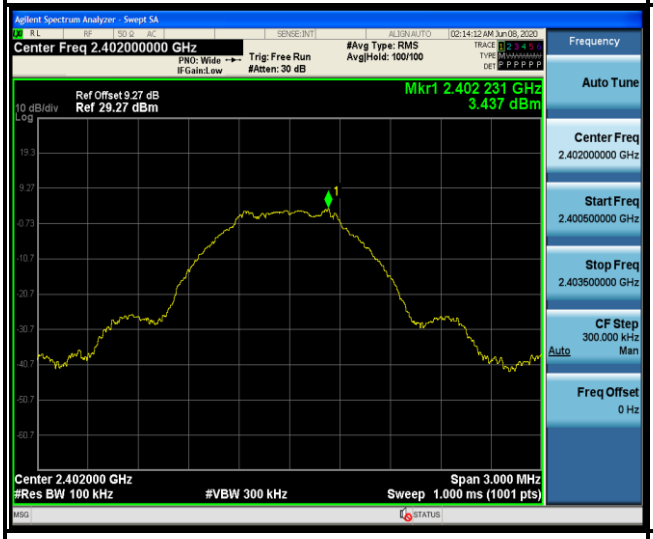
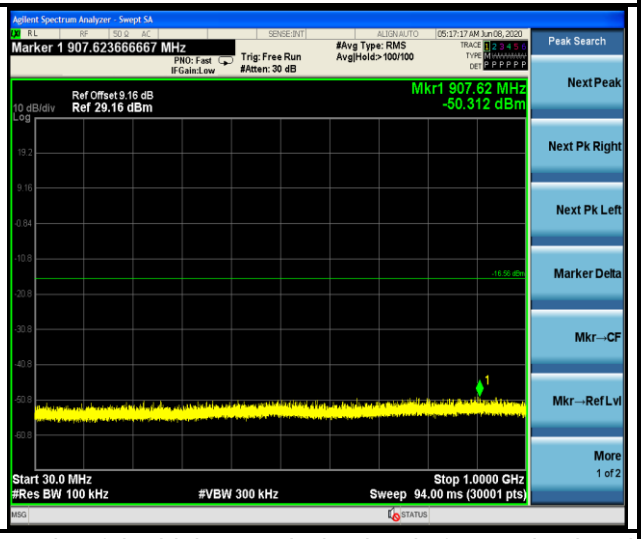
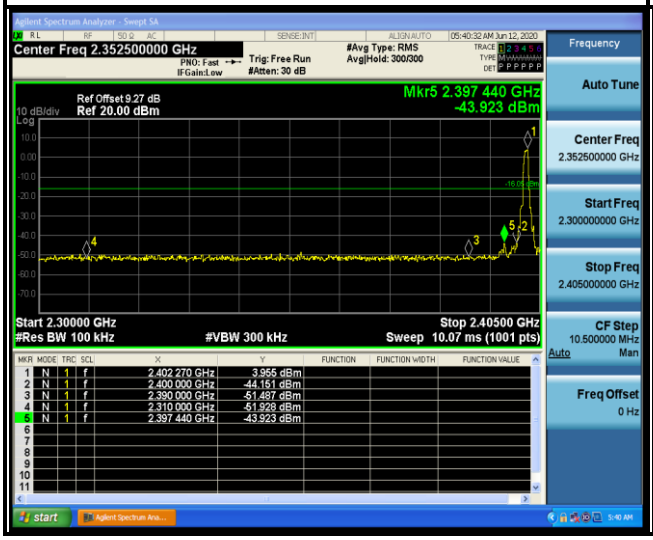
3.7.6 Deviation from Test Standard

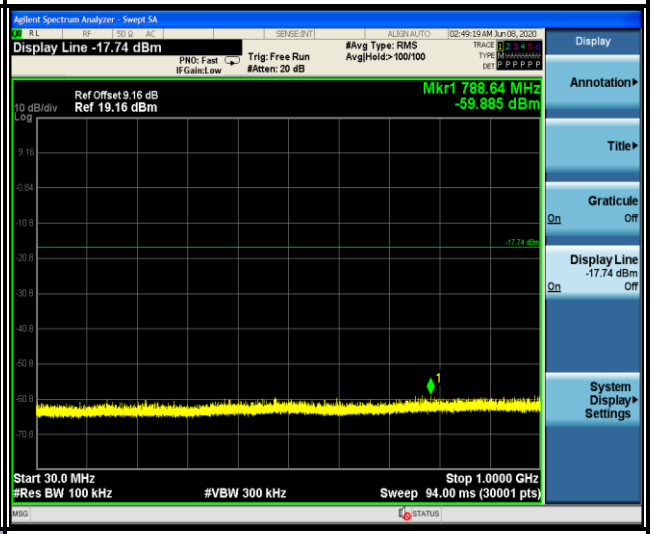
No deviation.

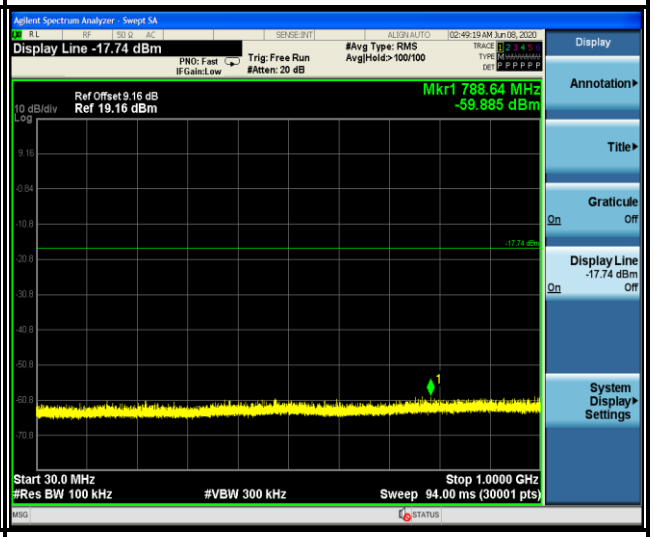
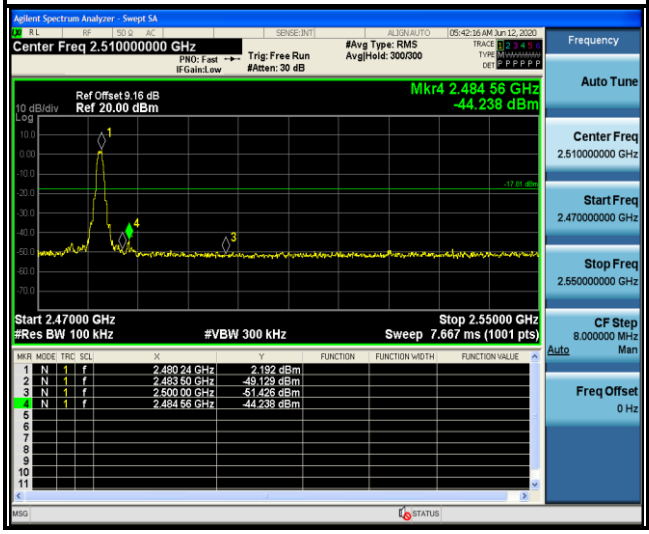
3.7.7 EUT OperatingCondition

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.7.8 Test results

Ch0	
Reference level(the highest emission level)	–30dB of the highest emission level of operating band 30MHz~1GHz
	
Band Edge	–30dB of the highest emission level of operating band Above 1GHz
	

Ch 19	
Reference level(the highest emission level)	–30dB of the highest emission level of operating band 30MHz~1GHz
	
	–30dB of the highest emission level of operating band Above 1GHz
	

Ch 39	
Reference level(the highest emission level)	–30dB of the highest emission level of operating band 30MHz~1GHz
	
Band Edge	–30dB of the highest emission level of operating band Above 1GHz
	

4. Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

5. Test instruments

Description & Manufacturer	Model No.	Serial No.	Due Date of Calibration
Spectrum Keysight	N9020A	MY51240612	2020-10-17
Spectrum Analyzer Rohde&Schwarz	FSV-40N	101783	2020-10-17
Power Meter10Hz~18GHz Tonscend	JS0806-2	188060126	2020-10-17
Signal generator Keysight	N5182A	GB40051020	2020-10-17
Signal generator Keysight	N5182A	MY47420944	2020-10-17
Test Software Tonscend	JS0806-2	NA	NA
Hygrothermograph Yuhuaze	HTC-1	NA	2020-10-17

Note: 3. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA.

4. The test was performed in Chamber 1.

Appendix – Information on the Testing Laboratories

We, Hwa-Hsing (Dongguan) Co., Ltd.,A global provider of TESTING and CERTIFICATION services for consumer products, electronic products and wireless information technology products. Adhering to the core values “HONEST and TRUSTWORTHY, OBJECTIVE and IMPARTIALITY, RIGOROUS and AFFICIENT”, commitment to provide professional, perfect and efficient comprehensive ONE-STOP solution of TESTING and CERTIFICATION services for Manufacturers, Buyers, Traders, Brands, Retailers. Assist client to better manage risk, protect their brands, reduce costs and cut time to over 150 markets in global. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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Contact Tel: 0769-83078199
Email:customerservice.dg@hwa-hsing.com
Web Site:www.hwa-hsing.com

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