



# RF REPORT

**Report Reference No.**..... : **TRE1708000801** R/C.....: 31689

**FCC ID**..... : 2AMHN1001055

**IC** ..... : 21797-1001055

**Applicant's name** ..... : Cellnovo Limited

**Address**..... : Pencoed Technology Park, Pencoed, CF35 5HZ. United Kingdom

**Manufacturer**..... : CK Telecom Limited

**Address**..... : Room 802/901/902 Building 4C, Software Industry Base, Keyuan Road, Nanshan Dist, Shenzhen, Guangdong, China

**Test item description**..... : Cellnovo OTS Handset

**Trade Mark** ..... : Cellnovo

**Model/Type reference** ..... : 1001055

**Standard** ..... : FCC CFR Title 47 Part 15 Subpart C Section 15.247  
RSS-247: Issue 2, February 2017 / RSS-GEN: Issue 4, November 2014

**Date of receipt of test sample**..... : Jun. 16, 2017

**Date of testing**..... : Jun. 21, 2017 - Jul. 05, 2017

**Date of issue**..... : Jul. 06, 2017

**Result**..... : **Pass**

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### APPENDIX A: TEST RESULT OF CONDUCTED TEST

Change History		
Issue	Date	Reason for change
1.0	2017.07.06	First edition



## 1. General Information

### 1.1. EUT Description

EUT Type	Cellnovo OTS Handset
Hardware Version	MIRAGE03A-V1.0
Software Version	MIRAGE03A-S00B_CKT_L142EN_V101_150724
EUT supports Radios application	Bluetooth V4.0 BLE
Frequency Range	2402MHz~2480MHz
Channel Number	40
Bit Rate of Transmitter	1Mbps
Modulation Type	GFSK
Antenna Type	PIFA Antenna
Antenna Gain	1dBi

Note 1: The EUT is a BLUETOOTH SPEAKER, it contain Bluetooth 4.0 BLE chipset operating at 2.4GHz ISM band; the frequencies allocated for the Bluetooth 4.0 BLE is  $F(\text{MHz})=2402+2*n$  ( $0 \leq n \leq 39$ ). The lowest, middle, highest channel numbers of the Bluetooth Module used and tested in this report are separately 0 (2402MHz), 19(2440MHz) and 39 (2480MHz).

Note 2: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.



## 1.2. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C (Bluetooth, 2.4GHz ISM band radiators) for the EUT FCC / IC Certification:

No.	Identity	Document Title
1	47 CFR Part 15 Subpart C 2017	Radio Frequency Devices
2	ANSI C63.10 2013	American National Standard for Testing Unlicensed Wireless Devices
3	RSS-GEN: Issue 4, November 2014	General Requirements and Information for the Certification of Radio Apparatus
4	RSS-247: Issue 2, February 2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Test detailed items/section required by FCC/IC rules and results are as below:

No.	Standard(s) Section		Description	Result
	FCC	IC		
1	15.203	8.3	Antenna Requirement	PASS
2	15.247(b)(3)	RSS-247 Issue2 - 5.4(4)	Peak Output Power	PASS
3	15.247(a)(2)	RSS-247 Issue2 - 5.2(1)	Bandwidth – 6dB bandwidth	PASS
4	/	RSS Gen clause - 4.6.1	99% Occupied Bandwidth	PASS
5	15.247(d)	RSS-247 Issue2 - 5.5	Conducted Spurious Emission	PASS
6	15.247(e)	RSS-247 Issue2 - 5.2(2)	Power spectral density (PSD)	PASS
7	15.205 15.247(d)	RSS-247 Issue2 - 5.5 RSS - Gen	Band Edge	PASS
8	15.209(a)	RSS-GEN	Spurious emissions radiated below 30MHz	PASS
9	15.247(d) 15.109	RSS-247 Issue2 - 5.5 RSS-Gen	Spurious emissions radiated 30 MHz to 1GHz and above 1GHz	PASS
10	15.107(a), 15.20(c)	RSS-GEN	Conducted Emission	PASS

The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10 2013.

These RF tests were performed according to the method of measurements prescribed in KDB558074 D01 V03r05.



### 1.3. Description of test environment test modes

40 channels are provided for Bluetooth LE 4.0

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



To investigate the maximum EMI emission characteristics generated from EUT, the test system was pre-scanning tested based on the consideration of following EUT operation mode or test configuration mode which possibly have effect on EMI emission level. Each of this EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	TX CH 0
Mode 2	TX CH 19
Mode 3	TX CH 39
Mode 4	Normal operating mode

For Conducted Emission	
Final Test Mode	Description
Mode 4	Normal operating mode

For Radiated Emission	
Final Test Mode	Description
Mode 1	TX CH 0
Mode 2	TX CH 19
Mode 3	TX CH 39

Note1: The EUT was programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98%.

Note2: Fully-charged battery was used during test.



## **1.4. Facilities and Accreditations**

### **1.4.1. Facilities**

#### **CNAS-Lab Code: L1225**

Shenzhen Huatongwei International Inspection Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories

(identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: February 28, 2015. Valid time is until February 27, 2018.

#### **FCC-Registration No.: 317478**

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 317478, Renewal date Jul. 18, 2014, valid time is until Jul. 18, 2017.

#### **IC-Registration No.: 5377B**

Two 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 5377B on Dec.03, 2014, valid time is until Dec.03, 2017.

### **1.4.2. Test Environment Conditions**

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15°C - 35°C
Relative Humidity (%):	30% -60%
Atmospheric Pressure (kPa):	86KPa-106KPa



## 2. 47 CFR Part 15C Requirements

### 2.1. Antenna requirement

#### 2.1.1. Applicable Standard

According to FCC 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

And according to FCC 47 CFR Section 15.247(c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

#### 2.1.2. Antenna Information

**Antenna Category:** PIFA antenna, can't be removed.

**Antenna General Information:**

No.	EUT	Ant. Type	Gain(dBi)
1	Cellnovo OTS Handset	PIFA	1

#### 2.1.3. Result: comply

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

## 2.2. Peak Output Power

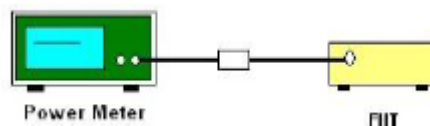
### 2.2.1. Limit of Peak Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

### 2.2.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.2.3. Test Setup



### 2.2.4. Test Procedures

1. The testing follows the Measurement Procedure of FCC KDB 558074D01 v03r05.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.

### 2.2.5. Test Result

Channel	Frequency (MHz)	RF Power(dBm)	Limit (dBm)	Verdict
		GFSK/1Mbps		
0	2402	0.33	30	PASS
19	2440	-0.13		PASS
39	2480	0.98		PASS

## **2.3. 6dB & 99% Bandwidth**

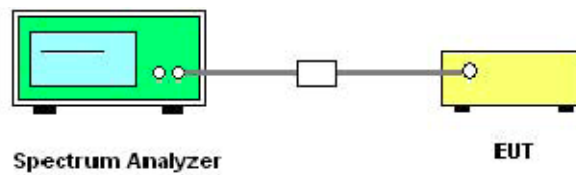
### **2.3.1. Limit of 6dB & 99% Bandwidth**

The minimum 6 dB bandwidth shall be at least 500 kHz.

### **2.3.2. Measuring Instruments**

The measuring equipment is listed in the section 3 of this test report.

### **2.3.3. Test Setup**



### **2.3.4. Test Procedures**

1. The testing follows FCC KDB 558074D01 v03r05.

2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

3. Set to the maximum power setting and enable the EUT transmit continuously.

4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz.

Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500 kHz.

5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 30 kHz and set the Video bandwidth (VBW) = 100 kHz.

6. Measure and record the results in the test report.

### **2.3.5. Test Results of 6dB and 99% Bandwidth**

Please refer to Appendix A for detail

## **2.4. Conducted Band Edges and Spurious Emissions**

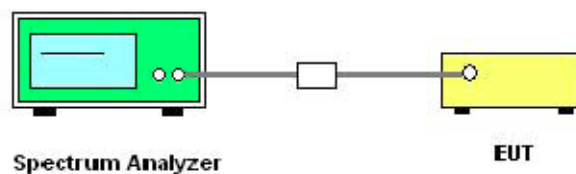
### **2.4.1. Limit of Conducted Band Edges and Spurious Emissions**

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

### **2.4.2. Measuring Instruments**

The measuring equipment is listed in the section 3 of this test report.

### **2.4.3. Test Setup**



### **2.4.4. Test Procedure**

1. The testing follows FCC KDB 558074D01 v03r05.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.  
The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.



#### **2.4.5. Test Results of Conducted Band Edges and Spurious Emissions**

Please refer to Appendix A for detail

## 2.5. Power spectral density (PSD)

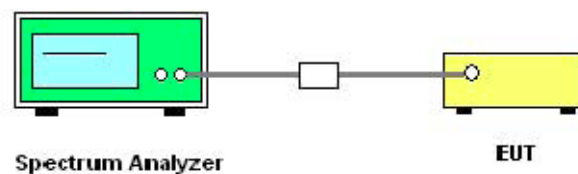
### 2.5.1. Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

### 2.5.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.5.3. Test Setup



### 2.5.4. Test Procedures

1. The testing follows Measurement Procedure 10.2 Method PKPSD of FCC KDB 558074D01 v03r05.

2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.

The path loss was compensated to the results for each measurement.

3. Set to the maximum power setting and enable the EUT transmit continuously.

4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz.

Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)

5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.

6. Measure and record the results in the test report.

7. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.



### **2.5.5. Test Results of Power spectral density**

Please refer to Appendix A for detail

## 2.6. Radiated Band Edge and Spurious Emission

### 2.6.1. Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

Note: Wireless charger configuration was evaluated.

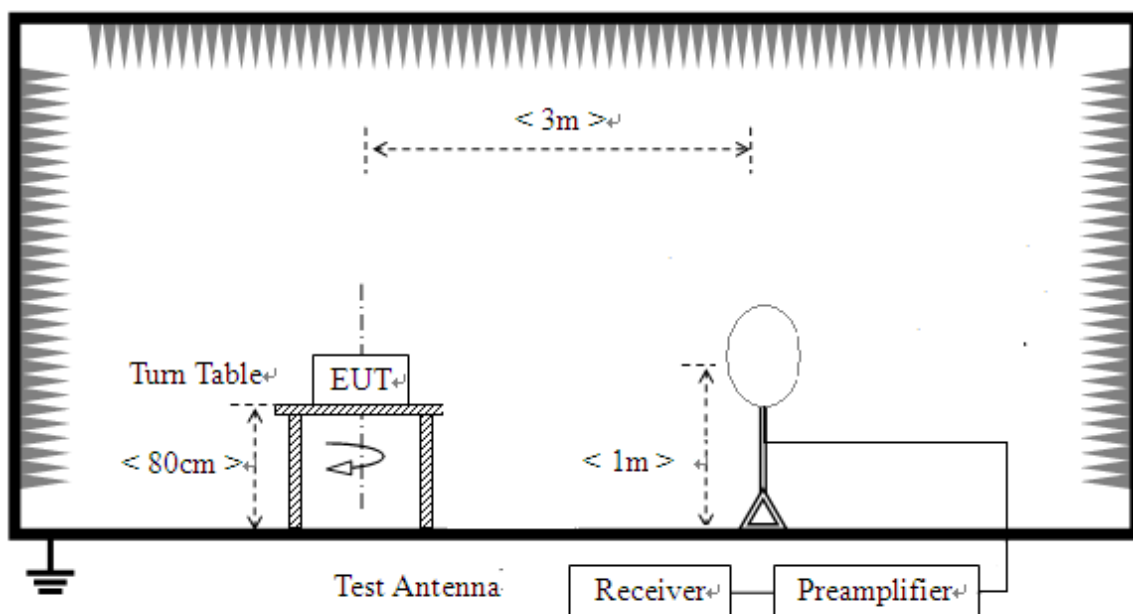
Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ )	Measurement Distance (m)
0.009 - 0.490	$2400/F(\text{kHz})$	300
0.490 - 1.705	$24000/F(\text{kHz})$	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

### 2.6.2. Measuring Instruments

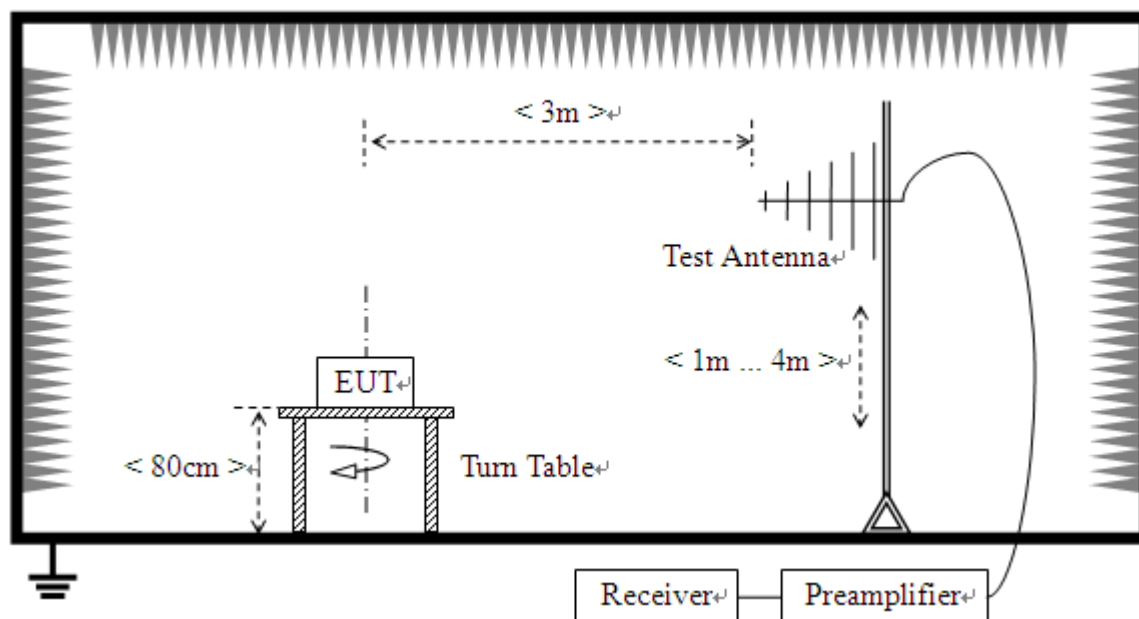
The measuring equipment is listed in the section 3 of this test report.

### 2.6.3. Test Setup

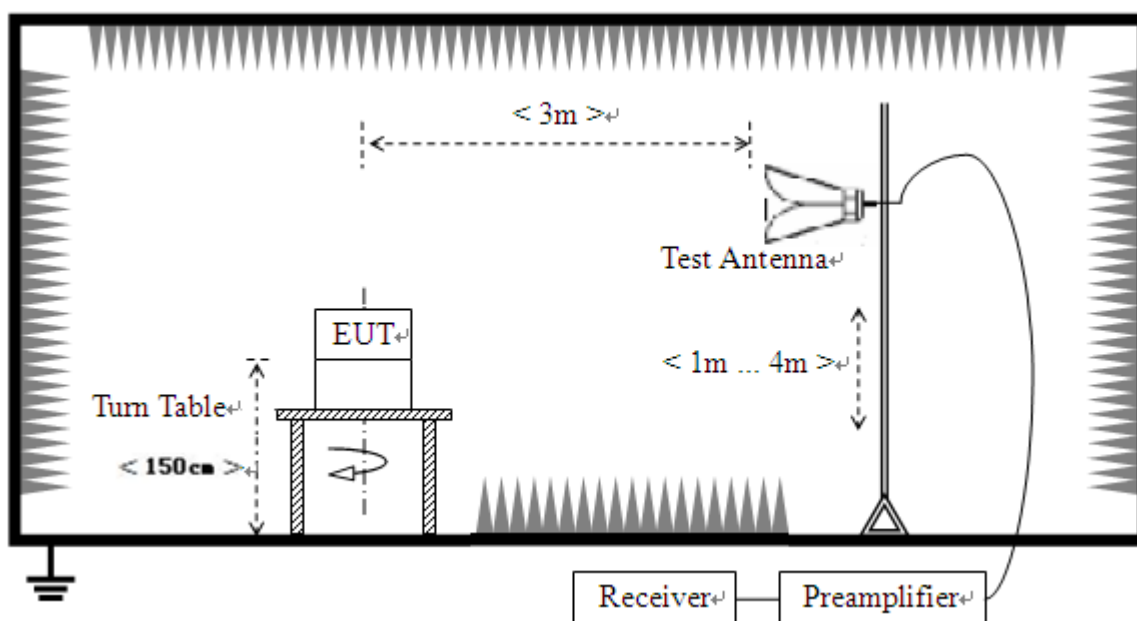
For radiated emissions from 9kHz to 30MHz



# For radiated emissions from 30MHz to 1GHz



# For radiated emissions above 1GHz



#### **2.6.4. Test Procedures**

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. Height of receiving 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.
4. 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.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported.  
  
Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
7. For the radiated emission test above 1GHz:  
  
Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.



NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle  $< 98\%$ ) or 10Hz (Duty cycle  $> 98\%$ ) for Average detection (AV) at frequency above 1GHz.
4. All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

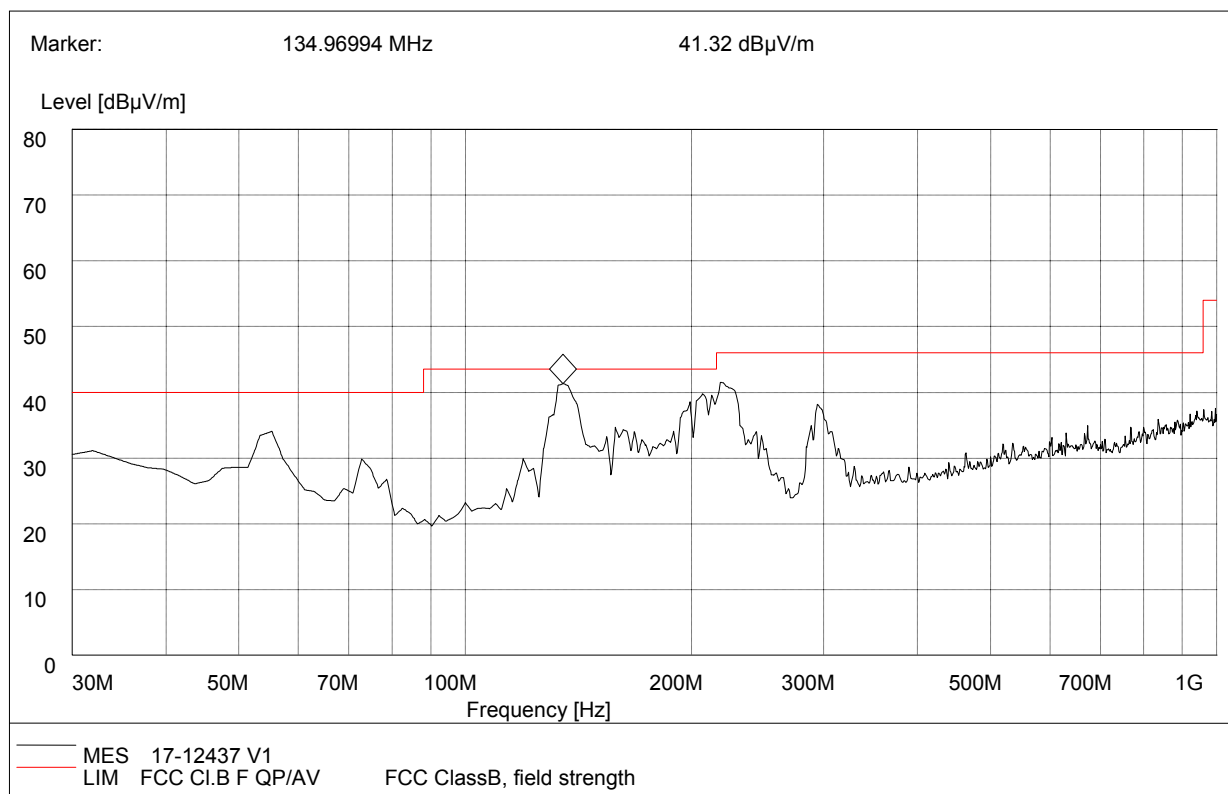


## 2.6.5. Test Results of Radiated Band Edge and Spurious Emission

### For 9KHz to 30MHz

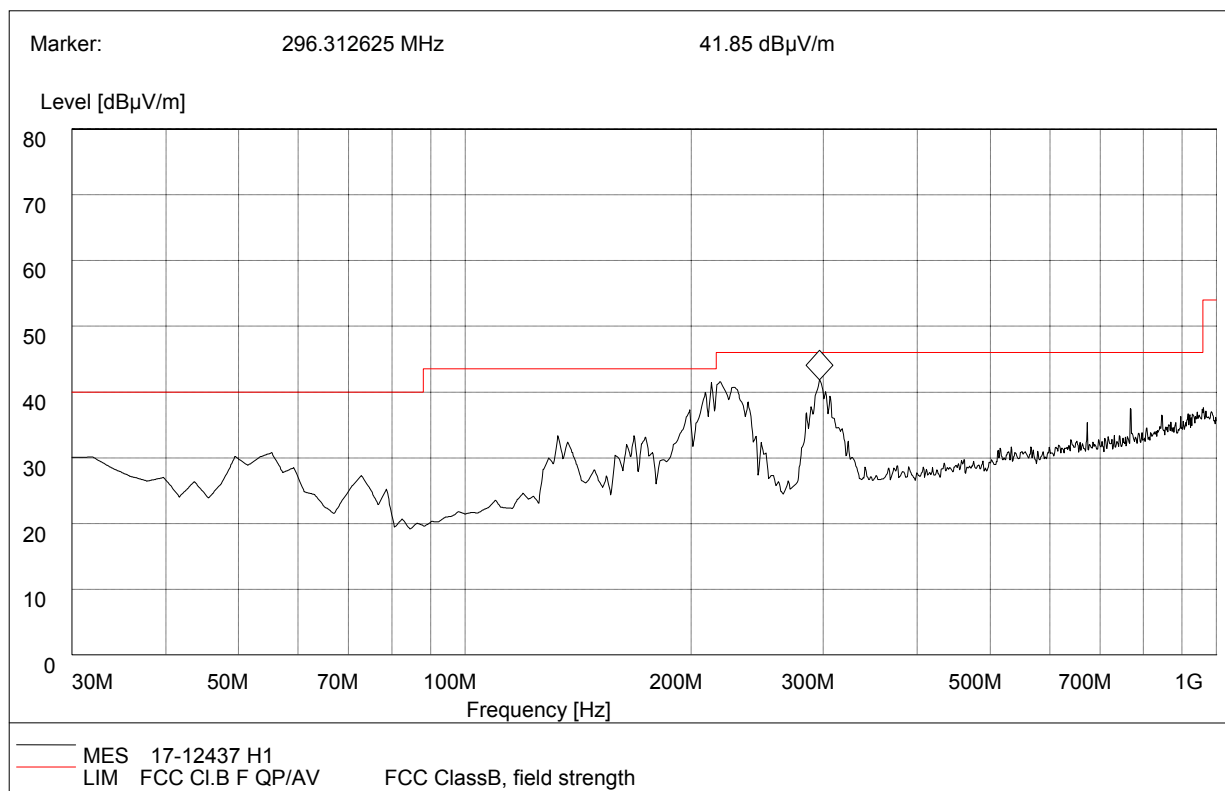
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

### For 30MHz to 1000 MHz



Plot A: 30MHz to 1GHz, Antenna Vertical

Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dB $\mu$ V/m)	Antenna	Verdict
33.190000	29.18	120.000	100.0	40.0	Vertical	Pass
56.180000	32.05	120.000	100.0	40.0	Vertical	Pass
73.370000	27.40	120.000	100.0	40.0	Vertical	Pass
135.810000	39.39	120.000	100.0	43.5	Vertical	Pass
219.050000	40.58	120.000	100.0	46.0	Vertical	Pass
295.180000	37.18	120.000	100.0	46.0	Vertical	Pass



Plot B: 30MHz to 1GHz, Antenna Horizontal

Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dB $\mu$ V/m)	Antenna	Verdict
30.850000	27.55	120.000	100.0	40.0	Horizontal	Pass
56.180000	28.48	120.000	100.0	40.0	Horizontal	Pass
133.870000	31.92	120.000	100.0	43.5	Horizontal	Pass
168.690000	31.27	120.000	100.0	43.5	Horizontal	Pass
213.230000	39.38	120.000	100.0	43.5	Horizontal	Pass
298.510000	39.48	120.000	100.0	46.0	Horizontal	Pass



**For 1GHz to 25GHz**

**ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (0CH\_2402MHz)**

No.	Fre. (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Cab. Loss (dB)	Ant. Factor (dB)	Pre. Amp. (dB)	Cor. Factor (dB/m)
1	1001.94	44.86	PK	74.00	-29.14	1.50 H	36	45.66	1.5	29.6	31.9	-0.8
2	1001.94	34.14	AV	54.00	-19.86	1.50 H	36	34.94	1.5	29.6	31.9	-0.8
3	2390.18	48.21	PK	74.00	-25.79	1.50 H	52	46.91	5.2	28.6	32.5	1.3
4	2390.18	36.56	AV	54.00	-17.44	1.50 H	52	35.26	5.2	28.6	32.5	1.3
5	4799.60	47.75	PK	74.00	-26.25	1.50 H	60	41.35	7.4	30.4	31.4	6.4
6	4799.60	36.35	AV	54.00	-17.65	1.50 H	60	29.95	7.4	30.4	31.4	6.4

**ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (0CH\_2402MHz)**

No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Cab. Loss (dB)	Ant. Factor (dB)	Pre. Amp. (dB)	Cor. Factor (dB/m)
1	1001.94	45.12	PK	74.00	-28.88	1.50 V	45	45.92	1.5	29.6	31.9	-0.8
2	1001.94	34.37	AV	54.00	-19.63	1.50 V	45	35.17	1.5	29.6	31.9	-0.8
3	2390.18	48.85	PK	74.00	-25.15	1.50 V	33	47.55	5.2	28.6	32.5	1.3
4	2390.18	38.56	AV	54.00	-15.44	1.50 V	33	37.26	5.2	28.6	32.5	1.3
5	4799.60	48.29	PK	74.00	-25.71	1.50 V	50	41.89	7.4	30.4	31.4	6.4
6	4799.60	36.35	AV	54.00	-17.65	1.50 V	50	29.95	7.4	30.4	31.4	6.4



### ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (19CH\_2440MHz)

No.	Fre. (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Cab. Loss (dB)	Ant. Factor (dB)	Pre. Amp. (dB)	Cor. Factor (dB/m)
1	1197.45	45.18	PK	74.00	-28.82	1.50 H	25	45.78	1.8	29.5	31.9	-0.6
2	1197.45	34.31	AV	54.00	-19.69	1.50 H	25	34.91	1.8	29.5	31.9	-0.6
3	2997.63	46.84	PK	74.00	-27.16	1.50 H	34	42.09	6.2	30.05	31.5	4.75
4	2997.63	35.72	AV	54.00	-18.28	1.50 H	34	30.97	6.2	30.05	31.5	4.75
5	4883.77	48.65	PK	74.00	-25.35	1.50 H	30	42.25	6.7	31.2	31.5	6.4
6	4883.77	36.61	AV	54.00	-17.39	1.50 H	30	30.21	6.7	31.2	31.5	6.4

### ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (19CH\_2440MHz)

No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Cab. Loss (dB)	Ant. Factor (dB)	Pre. Amp. (dB)	Cor. Factor (dB/m)
1	1197.45	45.31	PK	74.00	-28.69	1.50 V	32	45.91	1.8	29.5	31.9	-0.6
2	1197.45	34.52	AV	54.00	-19.48	1.50 V	32	35.12	1.8	29.5	31.9	-0.6
3	2997.63	47.03	PK	74.00	-26.97	1.50 V	40	42.28	6.2	30.05	31.5	4.75
4	2997.63	35.96	AV	54.00	-18.04	1.50 V	40	31.21	6.2	30.05	31.5	4.75
5	4883.77	48.85	PK	74.00	-25.15	1.50 V	40	42.45	6.7	31.2	31.5	6.4
6	4883.77	37.01	AV	54.00	-16.99	1.50 V	40	30.61	6.7	31.2	31.5	6.4



### ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (39CH\_2480MHz)

No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Cab. Loss (dB)	Ant. Factor (dB)	Pre. Amp. (dB)	Cor. Factor (dB/m)
1	2483.37	50.46	PK	74.00	-23.54	1.50 H	30	47.86	5.7	28.7	31.8	2.6
2	2483.37	37.87	AV	54.00	-16.13	1.50 H	30	35.27	5.7	28.7	31.8	2.6
3	4955.91	47.60	PK	74.00	-26.40	1.50 H	45	40.90	7	31.2	31.5	6.7
4	4955.91	37.06	AV	54.00	-16.94	1.50 H	45	30.36	7	31.2	31.5	6.7
5	11152.50	53.16	PK	74.00	-20.84	1.50 H	50	38.26	16	30.9	32	14.9
6	11152.50	41.27	AV	54.00	-12.73	1.50 H	50	26.37	16	30.9	32	14.9

### ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M (39CH\_2480MHz)

No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Cab. Loss (dB)	Ant. Factor (dB)	Pre. Amp. (dB)	Cor. Factor (dB/m)
1	2483.37	48.81	PK	74.00	-25.19	1.50 V	38	46.21	5.7	28.7	31.8	2.6
2	2483.37	37.39	AV	54.00	-16.61	1.50 V	38	34.79	5.7	28.7	31.8	2.6
3	4955.91	49.11	PK	74.00	-24.89	1.50 V	52	42.41	7	31.2	31.5	6.7
4	4955.91	37.07	AV	54.00	-16.93	1.50 V	52	30.37	7	31.2	31.5	6.7
5	11152.50	53.84	PK	74.00	-20.16	1.50 V	40	38.94	16	30.9	32	14.9
6	11152.50	41.06	AV	54.00	-12.94	1.50 V	40	26.16	16	30.9	32	14.9

#### REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)  
- Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level - Limit value

## 2.7. Conducted Emission

### 2.7.1. Limit of Conducted Emission

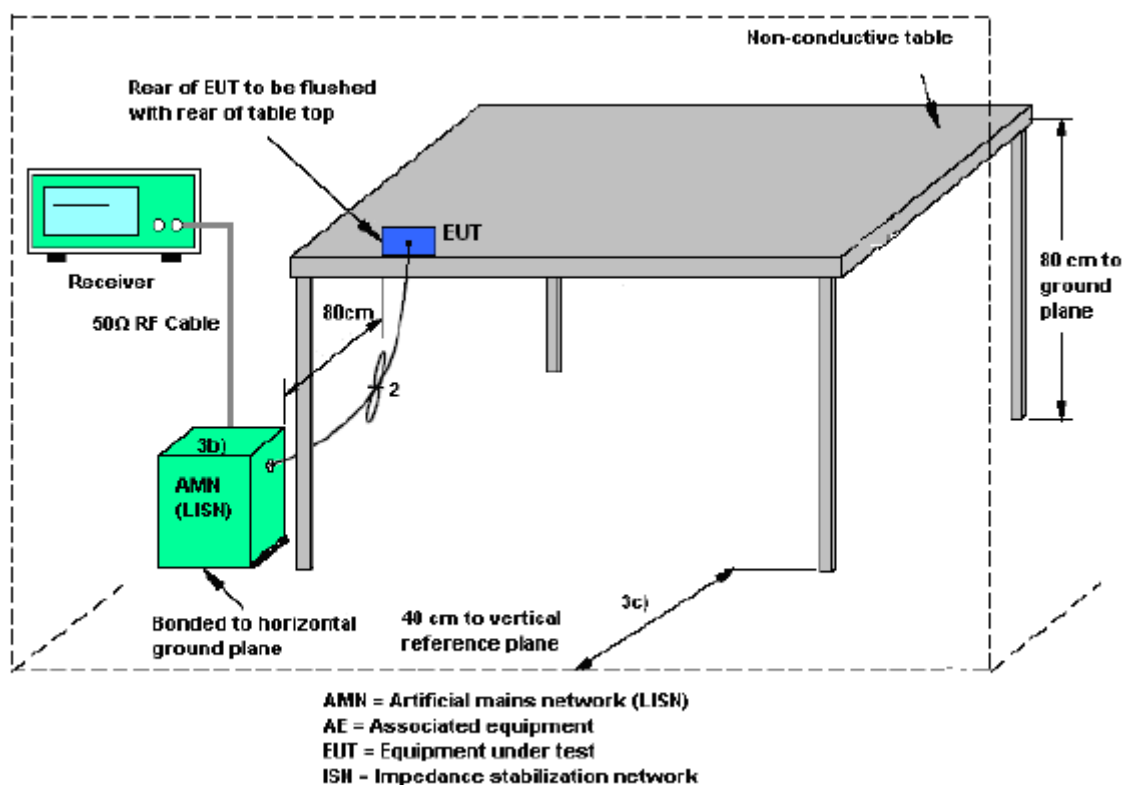
For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency range (MHz)	Conducted Limit (dB $\mu$ V)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

### 2.7.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.7.3. Test Setup

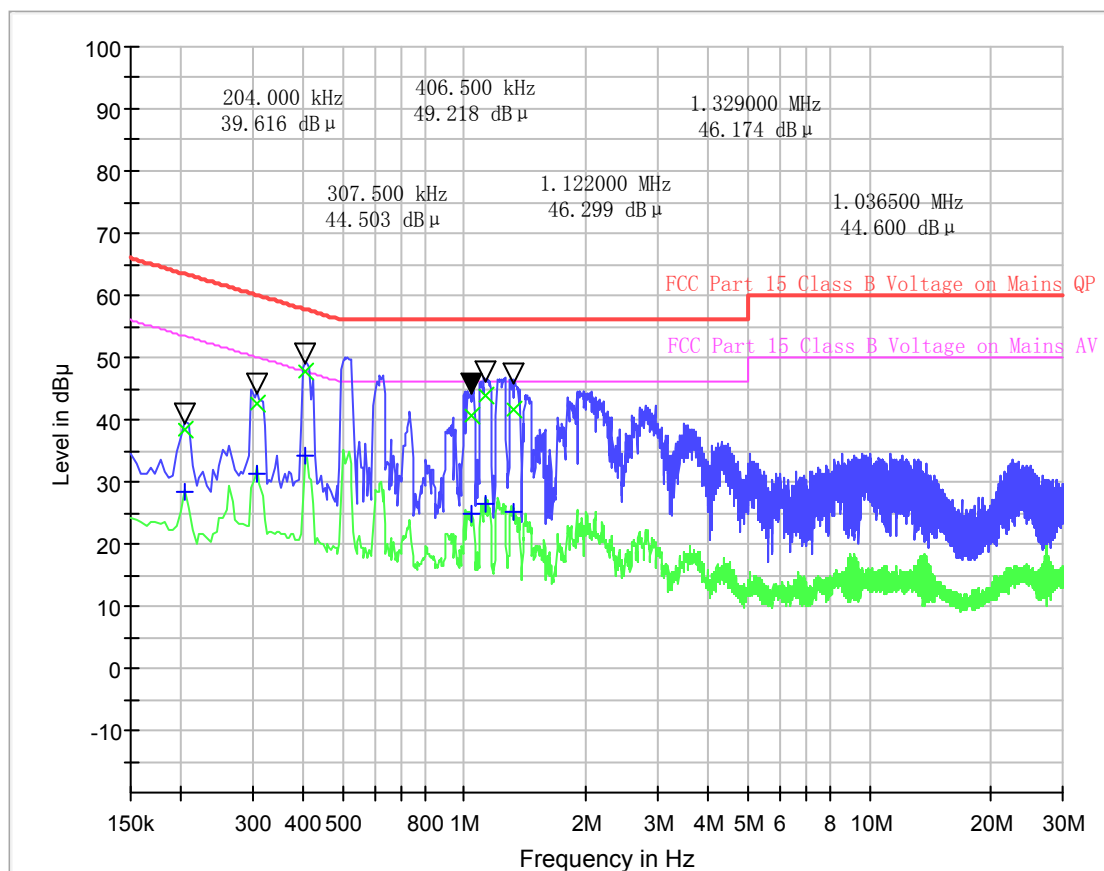


#### **2.7.4. Test Procedures**

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

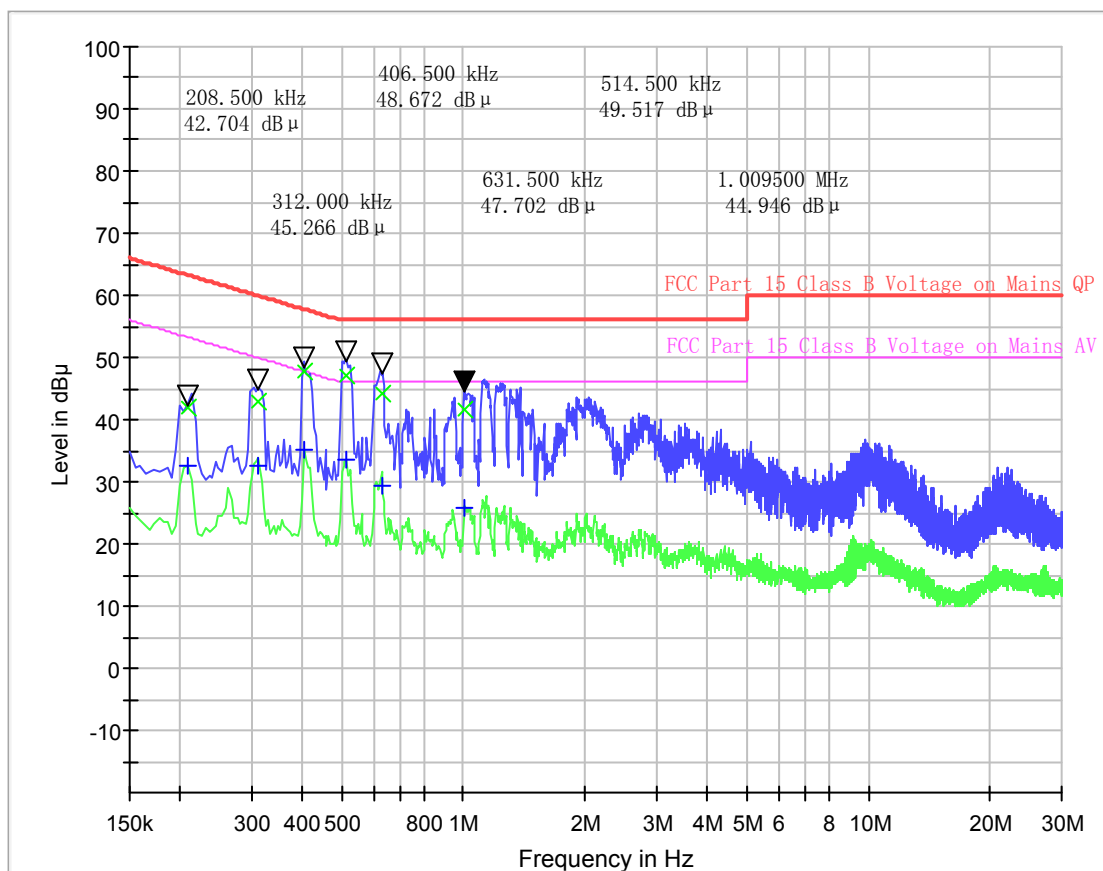
#### **2.7.5. Test Result**

1. The EUT configuration of the emission tests is Bluetooth Link.
2. The power adapter support (100~240V AC, 50/60Hz), the EUT was tested at the (120V/60Hz)



(Plot A: L Phase)

Conducted Disturbance at Mains Terminals					
QP			AV		
Frequency (MHz)	Limits (dBμV)	Measurement Value (dBμV)	Frequency (MHz)	Limits (dBμV)	Measurement Value (dBμV)
0.204000	63.4	38.51	0.204000	53.4	28.43
0.307500	60.0	42.67	0.307500	50.0	31.23
0.406500	57.7	47.59	0.406500	47.7	34.16
1.036500	56.0	40.74	1.036500	46.0	24.74
1.122000	56.0	43.94	1.122000	46.0	26.48
1.329000	56.0	41.68	1.329000	46.0	25.05



(Plot B: N Phase)

Conducted Disturbance at Mains Terminals					
QP			AV		
Frequency (MHz)	Limits (dBμV)	Measurement Value (dBμV)	Frequency (MHz)	Limits (dBμV)	Measurement Value (dBμV)
0.208500	63.3	41.87	0.208500	53.3	32.52
0.312000	59.9	42.86	0.312000	49.9	32.73
0.406500	57.7	47.89	0.406500	47.7	35.12
0.514500	56.0	47.00	0.514500	46.0	33.48
0.631500	56.0	44.31	0.631500	46.0	29.51
1.009500	56.0	41.50	1.009500	46.0	25.81



### 3. List of measuring equipment

Radiated Emission					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal
1	Ultra-Broadband Antenna	ShwarzBeck	VULB9163	538	11/13/2016
2	EMI TEST RECEIVER	Rohde&Schwarz	ESI 26	100009	11/13/2016
3	EMI TEST Software	Audix	E3	N/A	N/A
4	TURNTABLE	ETS	2088	2149	N/A
5	ANTENNA MAST	ETS	2075	2346	N/A
6	EMI TEST Software	Rohde&Schwarz	ESK1	N/A	N/A
7	HORNANTENNA	ShwarzBeck	9120D	1011	11/13/2016
8	Amplifer	Sonoma	310N	E009-13	11/13/2016
9	JS amplifer	Rohde&Schwarz	JS4-00101800-2 8-5A	F201504	11/13/2016
10	High pass filter	Compliance Direction systems	BSU-6	34202	11/13/2016
11	HORNANTENNA	ShwarzBeck	9120D	1012	11/13/2016
12	Amplifer	Compliance Direction systems	PAP1-4060	120	11/13/2016
13	Loop Antenna	Rohde&Schwarz	HFH2-Z2	100020	11/13/2016
14	TURNTABLE	MATURO	TT2.0	----	N/A
15	ANTENNA MAST	MATURO	TAM-4.0-P	----	N/A
16	Horn Antenna	SCHWARZBECK	BBHA9170	25841	11/13/2016
17	ULTRA-BROADBAN D ANTENNA	Rohde&Schwarz	HL562	100015	11/13/2016

#### Maximum Peak Output Power / Power Spectral Density / 6dB Bandwidth / Band Edge Compliance of RF Emission / Spurious RF Conducted Emission

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal
1	Spectrum Analyzer	Rohde&Schwarz	FSV-40	101008	05/04/2017
2	Switch Unit with OSP-B157	Rohde&Schwarz	OSP120	101130	05/04/2017
2	Power Meter	Anritsu	ML2480B	100798	11/13/2016
3	Power Sensor	Anritsu	MA2411B	100258	11/13/2016

#### Conducted Emission

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal.
1	EMI TEST RECEIVER	Rohde & Schwarz	ESCI	100106	11/13/2016
2	ARTIFICIAL MAINS	Rohde & Schwarz	ESH2-Z5	100028	11/13/2016
3	PULSE LIMITER	Rohde & Schwarz	ESHSZ2	100044	11/13/2016
4	EMI TEST SOFTWARE	Rohde & Schwarz	ES-K1	N/A	N/A

## Appendix A: Test result of Conducted test

### 6dB Bandwidth

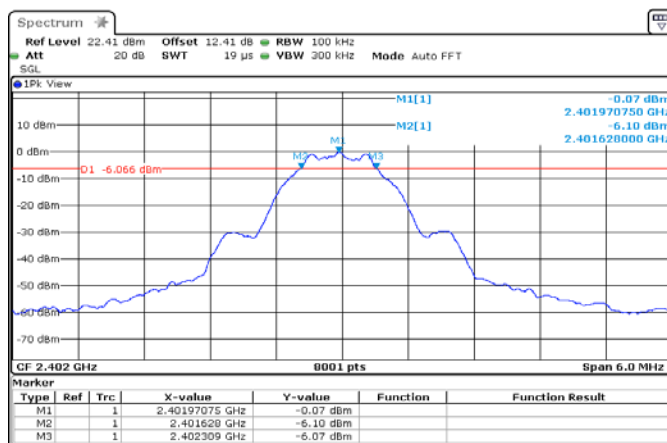
#### Test Result

Mode	Channel	6dB Bandwidth [MHz]	Verdict
BLE	LCH	0.681	PASS
BLE	MCH	0.685	PASS
BLE	HCH	0.676	PASS

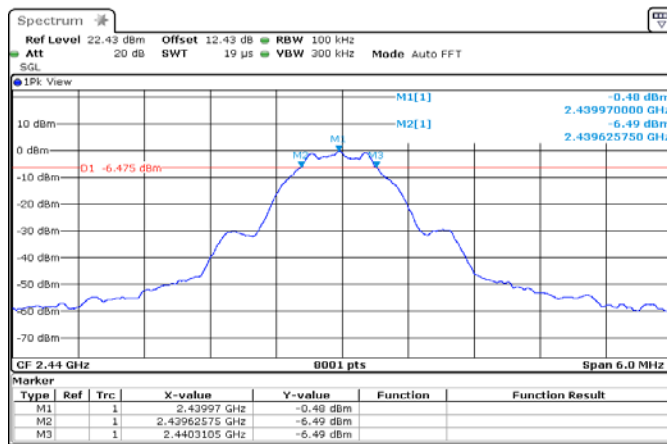
#### Test Graphs

##### Graphs

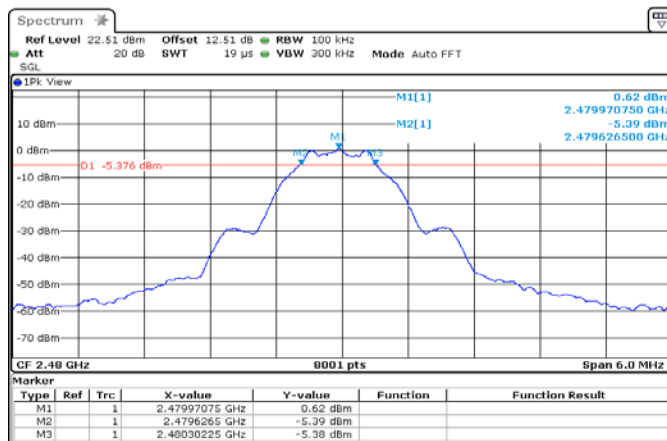
LCH



MCH



HCH





## 99% Occupied Bandwidth

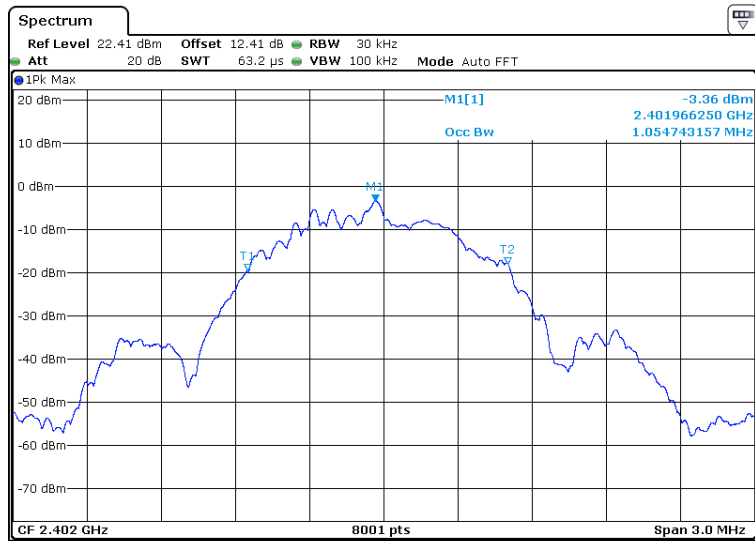
### Test Result

Mode	Channel	99% OBW[MHz]	Verdict
BLE	LCH	1.055	PASS
BLE	MCH	1.054	PASS
BLE	HCH	1.055	PASS

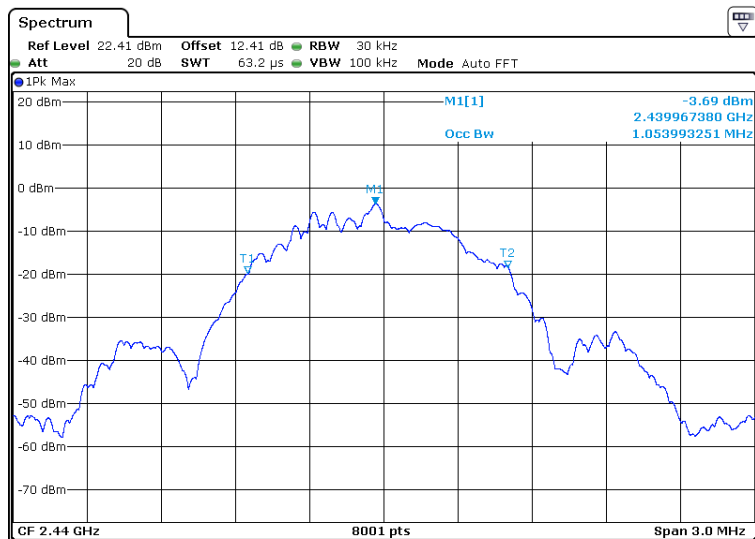
### Test Graphs

#### Graphs

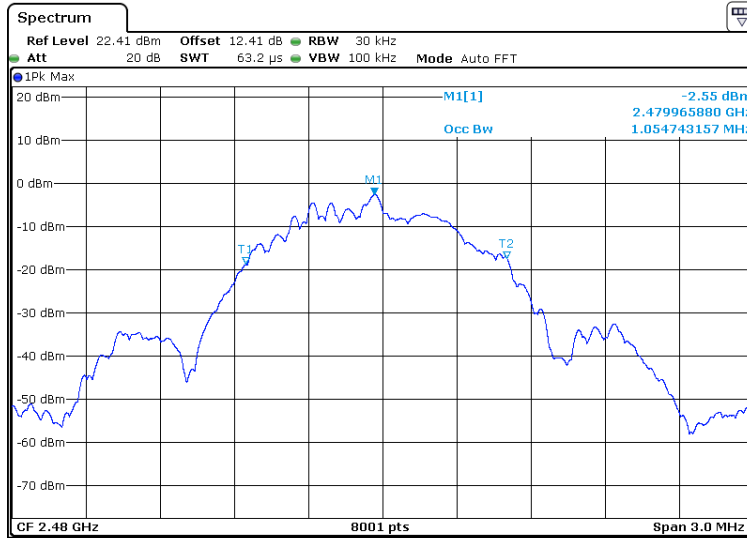
LCH



MCH



HCH



## Band-edge for RF Conducted Emissions

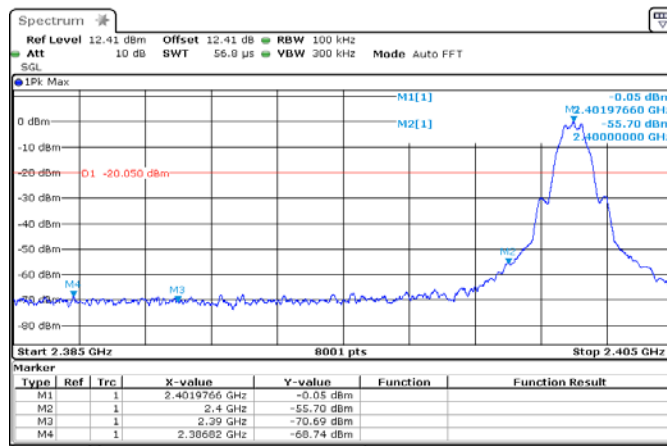
### Result Table

Mode	Channel	Carrier Power[dBm]	Max.Spurious Level [dBm]	Limit [dBm]	Verdict
BLE	LCH	-0.050	-68.741	-20.05	PASS
BLE	HCH	0.670	-65.578	-19.33	PASS

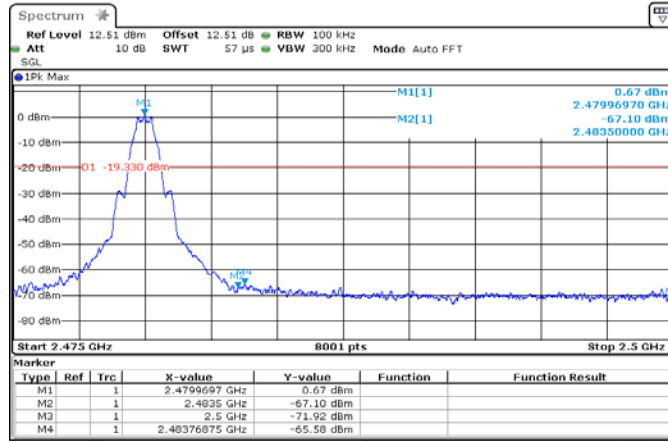
### Test Graphs

#### Graphs

LCH



HCH



## RF Conducted Spurious Emissions

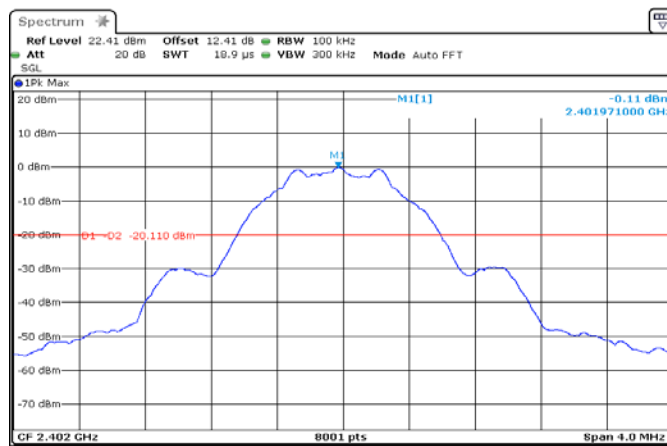
### Result Table

Mode	Channel	Pref [dBm]	Puw[dBm]	Verdict
BLE	LCH	-0.11	<Limit	PASS
BLE	MCH	-0.46	<Limit	PASS
BLE	HCH	0.59	<Limit	PASS

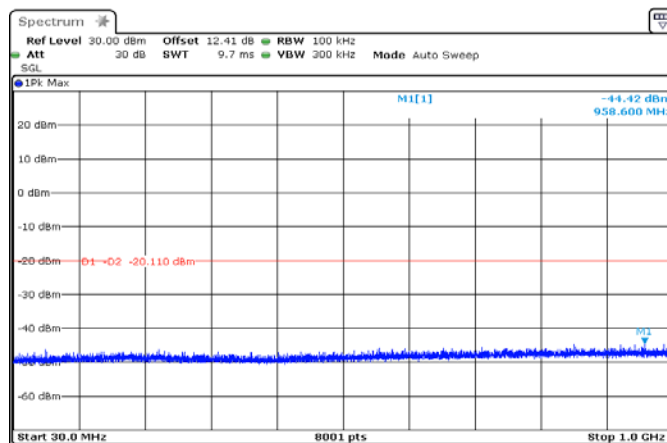
### Test Graphs

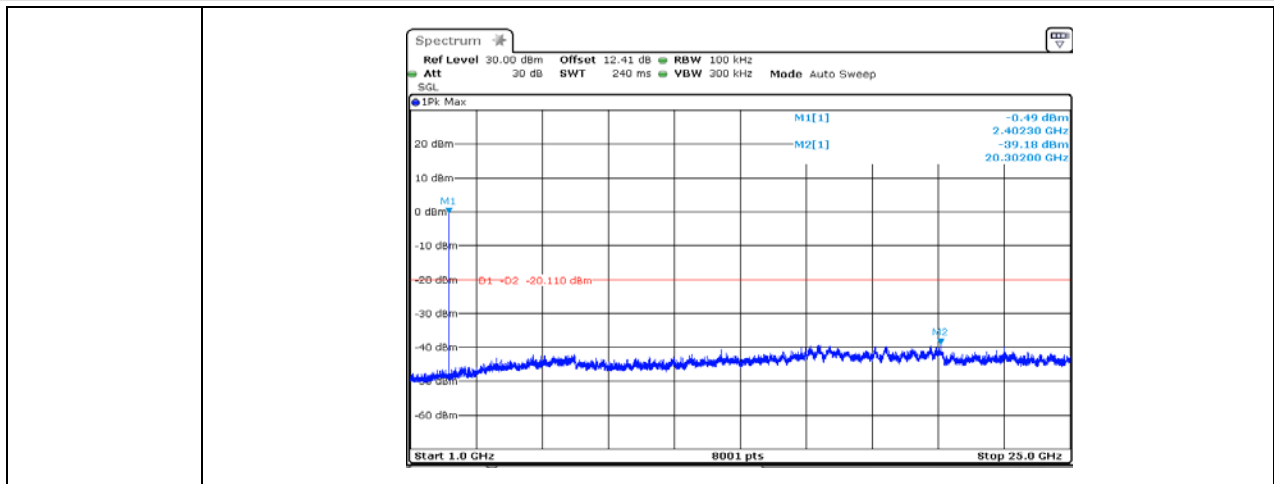
#### BLE\_LCH\_Graphs

Pref/BLE/LCH

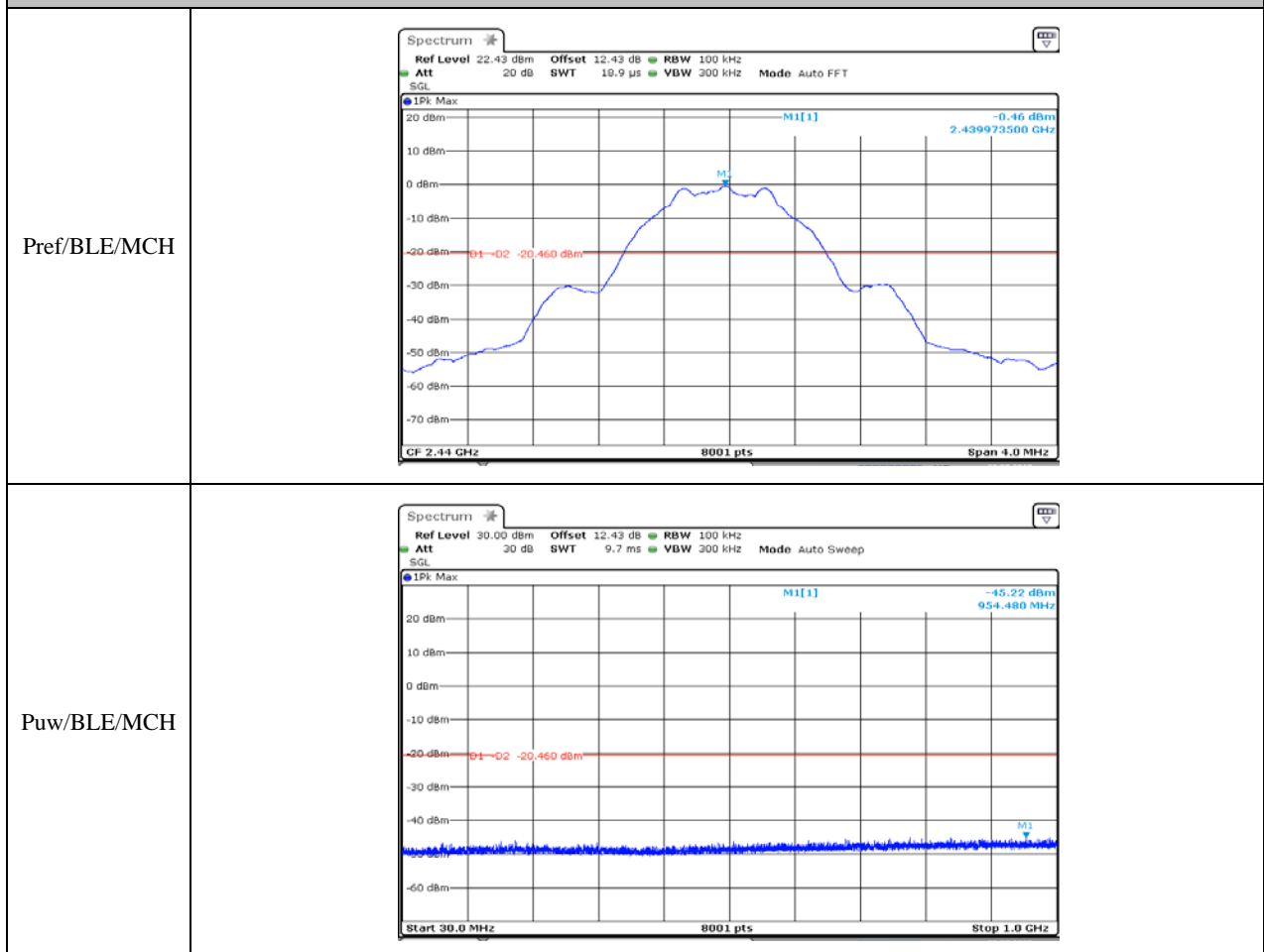


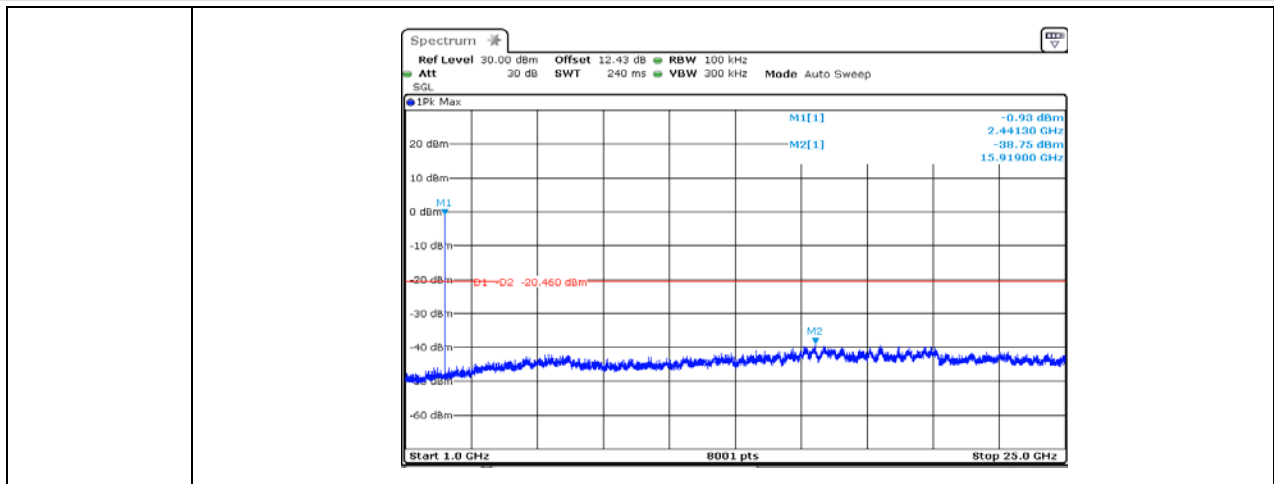
Puw/BLE/LCH



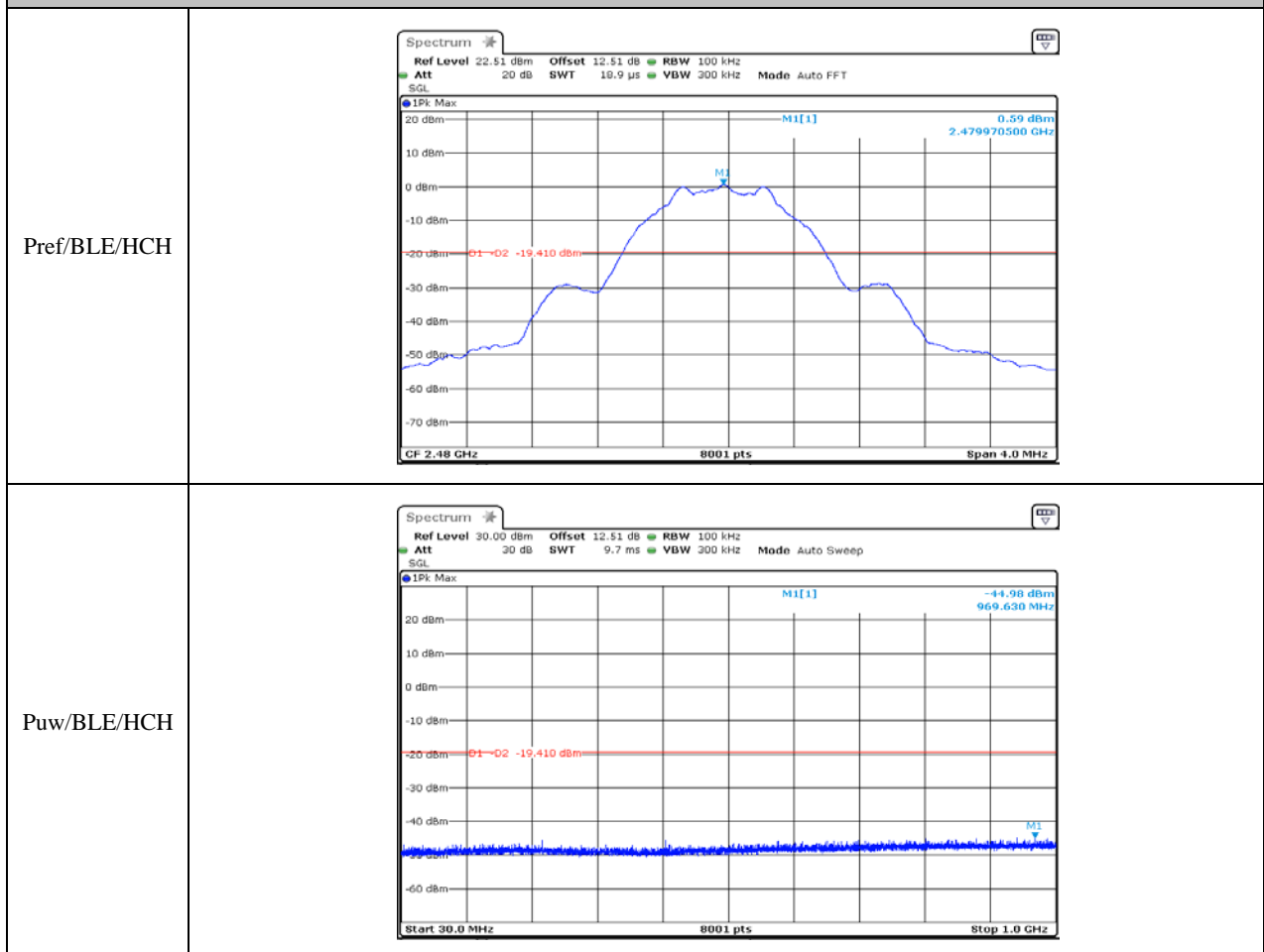


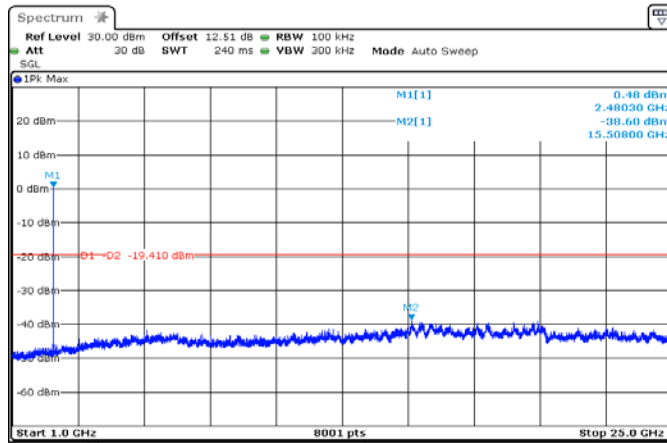
### BLE\_MCH\_Graphs





### LE\_HCH\_Graphs





## Power Spectral Density

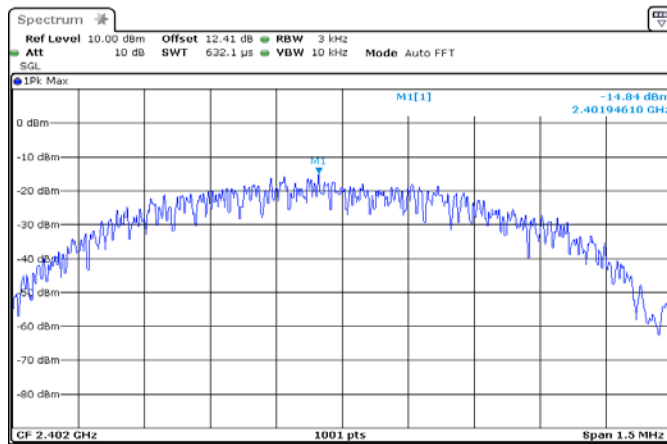
### Result Table

Mode	Channel	PSD [dBm]	Verdict
BLE	LCH	-14.840	PASS
BLE	MCH	-15.410	PASS
BLE	HCH	-14.280	PASS

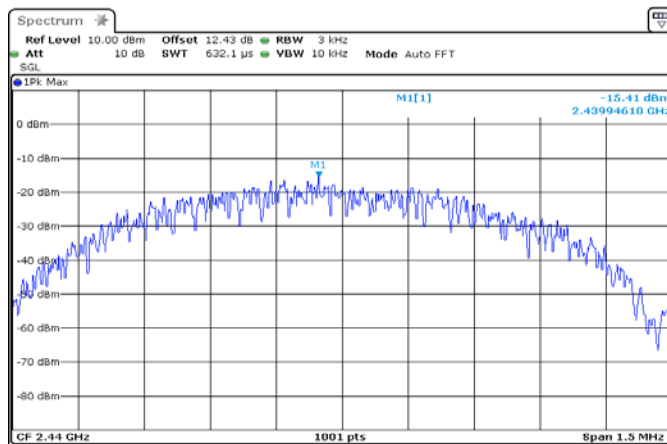
### Test Graphs

#### Graphs

LCH

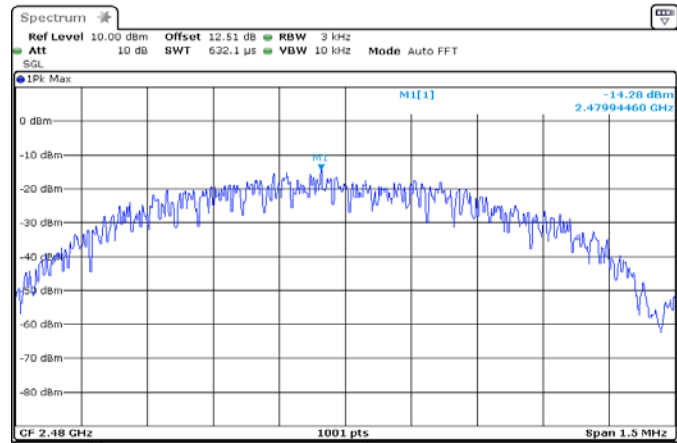


MCH





HCH



\*\* END OF REPORT \*\*