



## Test Report

**Date** : 2018-06-15  
**No.** : HMD18060036

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**Applicant** : Whalen LLC dba Whalen Furniture Manufacturing  
1578 Air Wing Road, San Diego, CA 92154

**Supplier / Manufacturer** : Whalen LLC dba Whalen Furniture Manufacturing  
1578 Air Wing Road, San Diego, CA 92154

**Description of Sample(s)** : Submitted sample(s) said to be  
Product: 33" Combination Electric Fireplace Heater  
Brand Name: N/A  
Model No.: EF22-33B  
FCC ID: 2AAHD-EF22-33B

**Date Samples Received** : 2018-06-05

**Date Tested** : 2018-06-06 to 2018-06-15

**Investigation Requested** : Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 and ANSI C63.10:2013 for FCC Certification.

**Conclusions** : The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.

**Remarks** : Bluetooth DTS (GFSK)

  
  
CHEUNG Chi, Kenneth  
Authorized Signatory  
ElectroMagnetic Compatibility Department  
For and on behalf of  
The Hong Kong Standards and Testing Centre Ltd.



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### **1.0 General Details**

#### **1.1 Test Laboratory**

The Hong Kong Standards and Testing Centre Ltd.  
EMC Laboratory  
10 Dai Wang Street, Taipo Industrial Estate, New Territories, Hong Kong  
Telephone: 852 2666 1888  
Fax: 852 2664 4353

#### **1.2 Equipment Under Test [EUT]**

##### **Description of Sample(s)**

Product: 33" Combination Electric Fireplace Heater  
Manufacturer: Whalen LLC dba Whalen Furniture Manufacturing  
1578 Air Wing Road, San Diego, CA 92154  
Brand Name: N/A  
Model Number: EF22-33B  
Rating: 100-240Va.c. 50/60Hz

#### **1.2.1 Description of EUT Operation**

The Equipment Under Test (EUT) is a 33" Combination Electric Fireplace Heater. The transmission signal is digital modulated with channel frequency range 2402-2480MHz. The R.F. signal was modulated by IC; the type of modulation used was frequency hopping spread spectrum Modulation.

#### **1.3 Date of Order**

2018-06-05

#### **1.4 Submitted Sample(s):**

1 Sample

#### **1.5 Test Duration**

2018-06-06 to 2018-06-15

#### **1.6 Country of Origin**

China

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### 1.7 RF Module Details

Module Model Number: BLE003U  
Module FCC ID: N/A  
Module Transmission Type: Bluetooth BLE4.0  
Modulation: GFSK  
Data Rates: 1Mbps  
Frequency Range: 2400-2483.5MHz  
Carrier Frequencies: 2402MHz – 2480MHz

Module Specification (specification provided by manufacturer)

### 1.8 Antenna Details

Antenna Type: Meander Line antenna  
Antenna Gain: -2dBi

### 1.9 Channel List

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

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### 2.0 Technical Details

#### **2.1 Investigations Requested**

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 Regulations and ANSI C63.10:2013 for FCC Certification. According FCC KDB 558074 DTS Measurement Guidance, Duty cycle  $\cong$  98%.  
The device was realized by test software.

#### **2.2 Test Standards and Results Summary Tables**

EMISSION Results Summary						
Test Condition	Test Requirement	Test Method	Class / Severity	Test Result		
				Pass	Failed	N/A
Maximum Peak Output Power	FCC 47CFR 15.247(b)(3)	ANSI C63.10: 2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Radiated Spurious Emissions	FCC 47CFR 15.209	ANSI C63.10: 2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
AC Mains Conducted Emissions	FCC 47CFR 15.207	ANSI C63.10: 2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Power Spectral Density	FCC 47CFR 15.247(e)	ANSI C63.10: 2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6dB Bandwidth	FCC 47CFR 15.247(a)(2)	ANSI C63.10: 2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Band Edge Emissions (Radiated)	FCC 47CFR 15.247(d)	ANSI C63.10: 2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Antenna requirement	FCC 47CFR 15.203	N/A	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note: N/A - Not Applicable

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### 3.0 Test Results

#### **3.1 Emission**

##### **3.1.1 Maximum Peak Output Power**

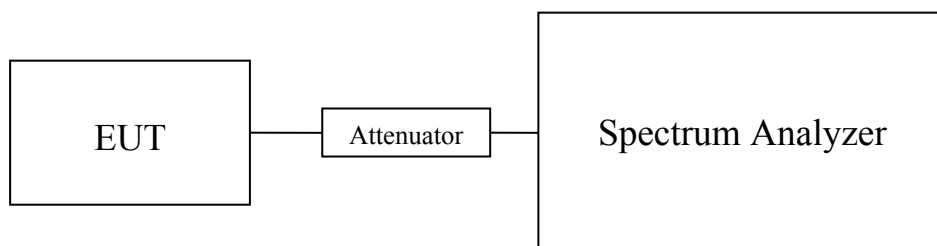
Test Requirement:	FCC 47CFR 15.247(b)(3)
Test Method:	ANSI C63.10: 2013
Test Date:	2018-06-14
Mode of Operation:	Bluetooth DTS Tx mode

Ambient Temperature: 25°C      Relative Humidity: 51%      Atmospheric Pressure: 101 kPa

#### **Test Method:**

The RF output of the EUT was connected to the spectrum analyzer. All the attenuation or cable loss will be added to the measured maximum output power. The results are recorded in Watt.

#### **Test Setup:**



Note: a temporary antenna connector was soldered to the RF output.



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### Limits for Peak Output Power of Fundamental & Harmonics Emissions [FCC 47CFR 15.247]:

For Digital Transmission systems in 2400-2483.5 MHz Band: 1 Watt (30dBm)

<b>Results of BT DTS Tx Mode (2402MHz to 2480MHz) : Pass (TX Unit) (GFSK)</b> <b>Maximum conducted output power</b>		
Channel	Frequency(MHz)	Output Power(Watt)
0	2402	0.000617
19	2440	0.000713
39	2480	0.000778

Channel	Frequency(MHz)	Output Power(Watt)
0	2402	0.000617
19	2440	0.000713
39	2480	0.000778

Calculated measurement uncertainty : 30MHz to 1GHz 1.7dB  
1GHz to 26GHz 1.7dB

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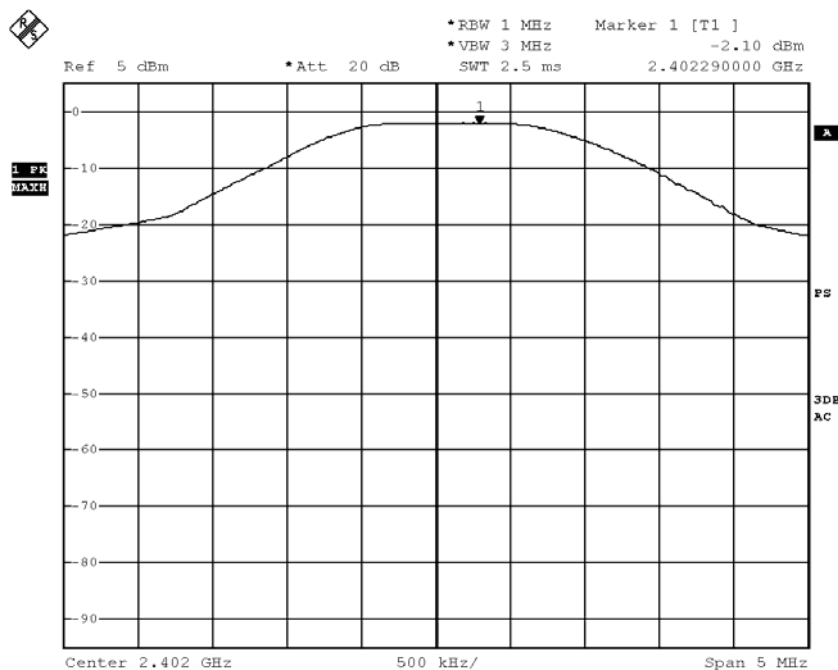
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Test plot of Maximum Peak Conducted Output Power :

Bluetooth Communication mode (BT DTS-GFSK, 2402MHz)



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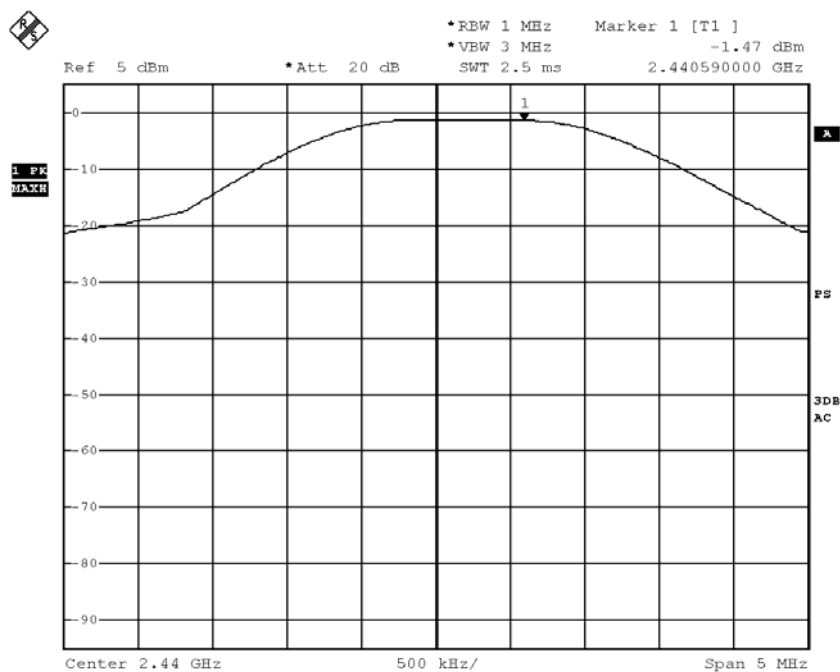


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### Bluetooth Communication mode (BT DTS-GFSK, 2440MHz)



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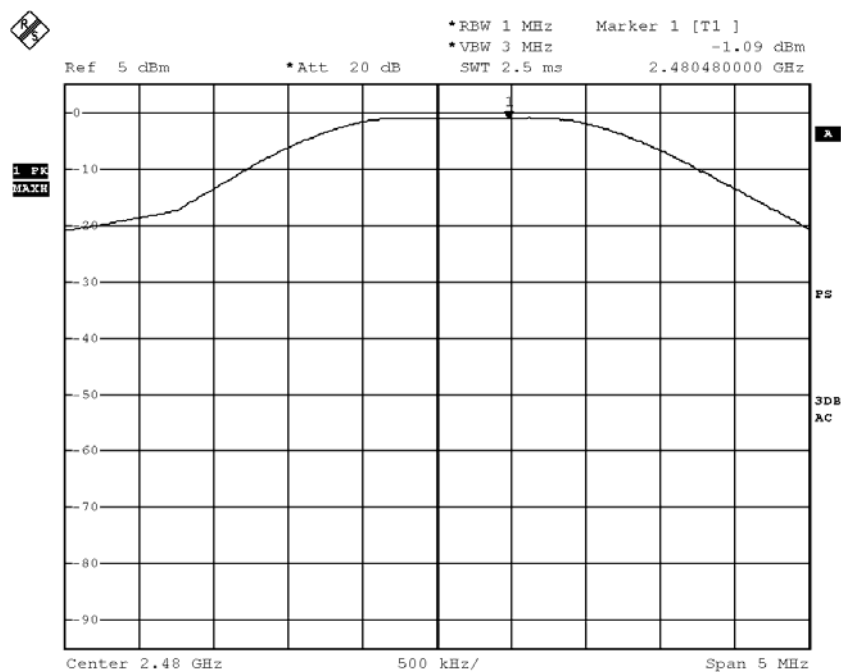


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### Bluetooth Communication mode (BT DTS-GFSK, 2480MHz)



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### 3.1.2 Radiated Emissions

Test Requirement: FCC 47CFR 15.209  
Test Method: ANSI C63.10:2013  
Test Date: 2018-06-14  
Mode of Operation: Tx mode / Bluetooth Communication mode (GFSK)

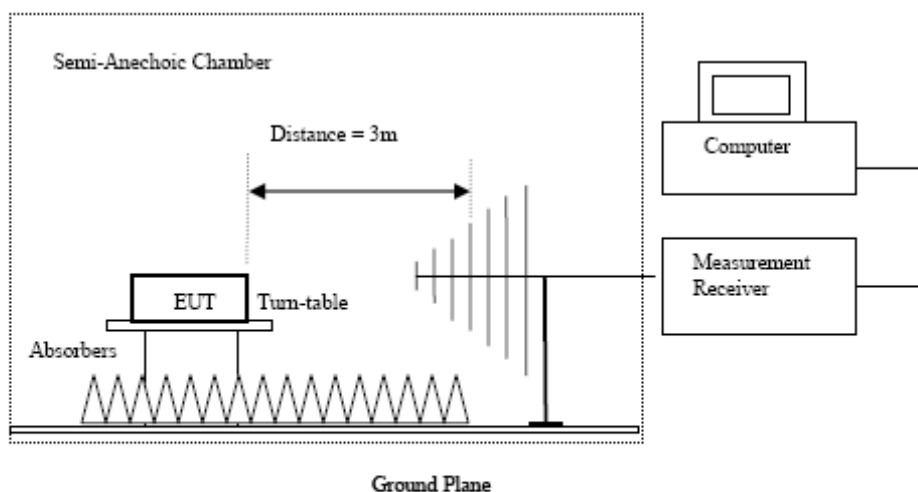
Ambient Temperature: 24°C      Relative Humidity: 52%      Atmospheric Pressure: 101 kPa

#### Test Method:

For emission measurements at or below 1 GHz, the sample was placed 0.01m above the ground plane of semi-anechoic Chamber\*. For emission measurements above 1 GHz, the sample was placed 0.01m above the ground plane of semi-anechoic Chamber\*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

\* Semi-Anechoic chamber located on the G/F of The Hong Kong Standards and Testing Centre Ltd. with a metal ground plane filed with the FCC pursuant to section 2.948 of the FCC rules, with Registration Number: 607756.

#### Test Setup:



- Absorbers placed on top of the ground plane are for measurements above 1000MHz only.  
- Measurements between 30MHz to 1000MHz made with Bi-log antennas, above 1000MHz horn antennas are used, 9kHz to 30MHz loop antennas are used.

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**Limits for Radiated Emissions FCC 47 CFR 15.247 Class B]:**

Frequency Range [MHz]	Quasi-Peak Limits [μV/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

**Result of Tx mode (2402.0 MHz) (GFSK) (9kHz – 30MHz): Pass**

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
<b>Emissions detected are more than 20 dB below the FCC Limits</b>						

**Result of Tx mode (2402.0 MHz) (GFSK) (Above 1GHz): Pass**

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
4804.0	14.9	41.5	56.4	74.0	17.6	Vertical
4804.0	13.0	42.4	55.4	74.0	18.6	Horizontal
7206.0	10.4	45.1	55.5	74.0	18.5	Vertical
7206.0	6.6	46.2	52.8	74.0	21.2	Horizontal
9608.0	8.5	48.0	56.5	74.0	17.5	Vertical
9608.0	7.0	48.8	55.8	74.0	18.2	Horizontal
12010.0	3.4	51.8	55.2	74.0	18.8	Vertical
12010.0	2.7	52.4	55.1	74.0	18.9	Horizontal

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<b>Field Strength of Spurious Emissions</b>						
<b>Average Value</b>						
Frequency MHz	Measured Level @3m dB $\mu$ V	Correction Factor dB/m	Field Strength dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB	E-Field Polarity
4804.0	3.7	41.5	45.2	54.0	8.8	Vertical
4804.0	1.3	42.4	43.7	54.0	10.3	Horizontal
7206.0	-3.9	45.1	41.2	54.0	12.8	Vertical
7206.0	-6.3	46.2	39.9	54.0	14.1	Horizontal
9608.0	-6.7	48.0	41.3	54.0	12.7	Vertical
9608.0	-8.1	48.8	40.7	54.0	13.3	Horizontal
12010.0	-13.0	51.8	38.8	54.0	15.2	Vertical
12010.0	-11.9	52.4	40.5	54.0	13.5	Horizontal

**Result of Tx mode (2440.0 MHz) (GFSK) (9kHz – 30MHz): Pass**

<b>Field Strength of Spurious Emissions</b>						
<b>Peak Value</b>						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
<b>Emissions detected are more than 20 dB below the FCC Limits</b>						

**Result of Tx mode (2440.0 MHz) (GFSK) (Above 1GHz): Pass**

<b>Field Strength of Spurious Emissions</b>						
<b>Peak Value</b>						
Frequency MHz	Measured Level @3m dB $\mu$ V	Correction Factor dB/m	Field Strength dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB	E-Field Polarity
4880.0	15.1	41.6	56.7	74.0	17.3	Vertical
4880.0	13.8	42.5	56.3	74.0	17.7	Horizontal
7320.0	2.4	53.2	55.6	74.0	18.4	Vertical
7320.0	9.5	46.3	55.8	74.0	18.2	Horizontal
9760.0	7.4	48.1	55.5	74.0	18.5	Vertical
9760.0	7.4	48.9	56.3	74.0	17.7	Horizontal
12200.0	4.2	51.6	55.8	74.0	18.2	Vertical
12200.0	1.1	52.5	53.6	74.0	20.4	Horizontal



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<b>Field Strength of Spurious Emissions</b>						
<b>Average Value</b>						
Frequency MHz	Measured Level @3m dB $\mu$ V	Correction Factor dB/m	Field Strength dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB	E-Field Polarity
4880.0	-1.4	41.6	40.2	54.0	13.8	Vertical
4880.0	-2.7	42.5	39.8	54.0	14.2	Horizontal
7320.0	-5.8	45.2	39.4	54.0	14.6	Vertical
7320.0	-6.7	46.3	39.6	54.0	14.4	Horizontal
9760.0	-9.1	48.1	39.0	54.0	15.0	Vertical
9760.0	-9.9	48.9	39.0	54.0	15.0	Horizontal
12200.0	-12.0	51.6	39.6	54.0	14.4	Vertical
12200.0	-13.6	52.5	38.9	54.0	15.1	Horizontal

**Result of Tx mode (2480.0 MHz) (GFSK) (9kHz – 30MHz): Pass**

<b>Field Strength of Spurious Emissions</b>						
<b>Peak Value</b>						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
<b>Emissions detected are more than 20 dB below the FCC Limits</b>						

**Result of Tx mode (2480.0 MHz) (GFSK) (Above 1GHz): Pass**

<b>Field Strength of Spurious Emissions</b>						
<b>Peak Value</b>						
Frequency MHz	Measured Level @3m dB $\mu$ V	Correction Factor dB/m	Field Strength dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB	E-Field Polarity
4960.0	15.4	41.4	56.8	74.0	17.2	Vertical
4960.0	11.6	42.7	54.3	74.0	19.7	Horizontal
7440.0	8.4	45.6	54.0	74.0	20.0	Vertical
7440.0	7.7	46.5	54.2	74.0	19.8	Horizontal
9920.0	7.3	48.6	55.9	74.0	18.1	Vertical
9920.0	4.5	49.7	54.2	74.0	19.8	Horizontal
12400.0	3.3	51.7	55.0	74.0	19.0	Vertical
12400.0	1.0	52.7	53.7	74.0	20.3	Horizontal

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Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dB $\mu$ V	Correction Factor dB/m	Field Strength dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB	E-Field Polarity
4960.0	-2.5	41.4	38.9	54.0	15.1	Vertical
4960.0	-1.7	42.7	41.0	54.0	13.0	Horizontal
7440.0	-6.7	45.6	38.9	54.0	15.1	Vertical
7440.0	-8.6	46.5	37.9	54.0	16.1	Horizontal
9920.0	-10.0	48.6	38.6	54.0	15.4	Vertical
9920.0	-12.1	49.7	37.6	54.0	16.4	Horizontal
12400.0	-13.4	51.7	38.3	54.0	15.7	Vertical
12400.0	-15.2	52.7	37.5	54.0	16.5	Horizontal

**Remarks:**

No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz

\* Denotes restricted band of operation.

Measurements were made using a peak detector. Any emission less than 1000MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 and the limits of FCC Rules Part 15 Section 15.209 were applied.

Correction Factor included Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty  
(9kHz-30MHz): 2.0dB  
(30MHz -1GHz): 4.9dB  
(1GHz -6GHz): 4.02dB  
(6GHz -26.5GHz): 4.03dB

Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

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**Radiated Emissions Measurement:**

**Limit :**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).

**Result: RF Radiated Emissions (Lowest)-GFSK**

<b>Field Strength of Band-edge Compliance</b>						
<b>Peak Value</b>						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
2390.0	19.1	36.8	55.9	74.0	18.1	Vertical
2390.0	18.2	36.4	54.6	74.0	19.4	Horizontal

<b>Field Strength of Band-edge Compliance</b>						
<b>Average Value</b>						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
2390.0	1.1	36.8	37.9	54.0	16.1	Vertical
2390.0	0.5	36.4	36.9	54.0	17.1	Horizontal

**Result: RF Radiated Emissions (Highest) -GFSK**

<b>Field Strength of Band-edge Compliance</b>						
<b>Peak Value</b>						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
2483.5	16.7	36.8	53.5	74.0	20.5	Vertical
2483.5	16.7	36.4	53.1	74.0	20.9	Horizontal

<b>Field Strength of Band-edge Compliance</b>						
<b>Average Value</b>						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
2483.5	-1.0	36.8	35.8	54.0	18.2	Vertical
2483.5	-0.2	36.4	36.2	54.0	17.8	Horizontal

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**Limits for Radiated Emissions FCC 47 CFR 15.247 Class B]:**

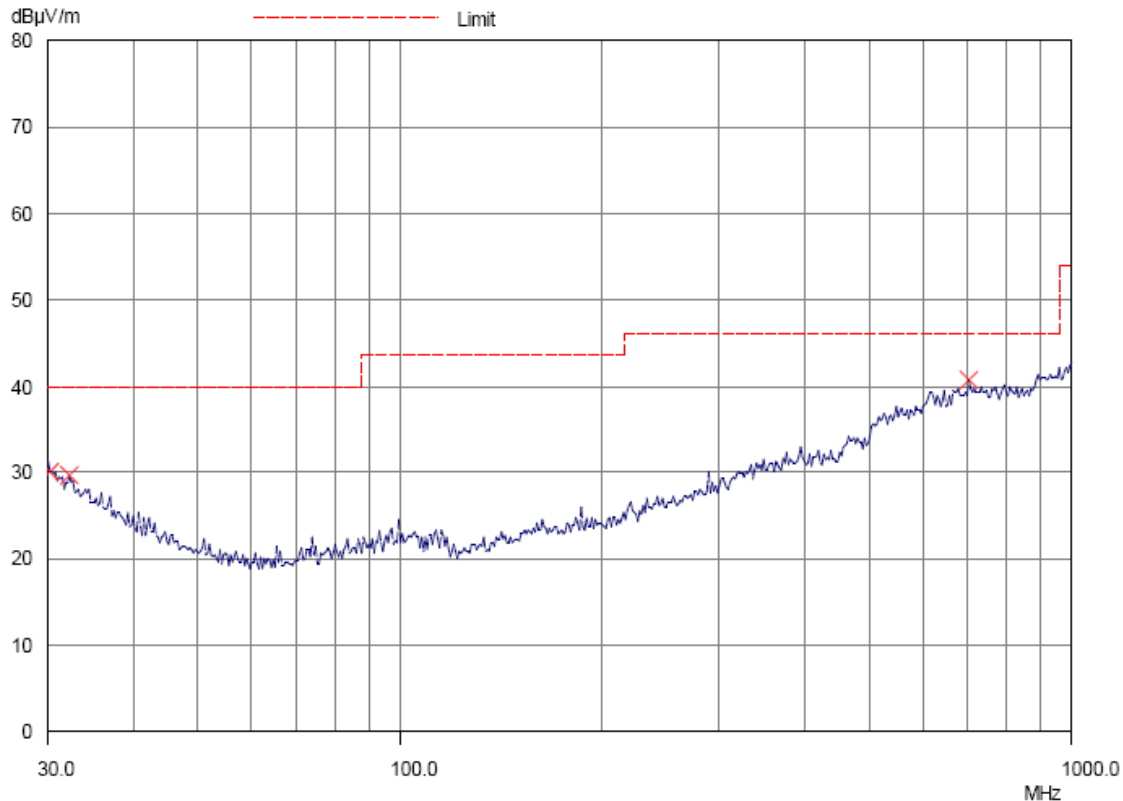
Frequency Range [MHz]	Quasi-Peak Limits [ $\mu$ V/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

**Results of Bluetooth Communication mode (2480.0 MHz) (30MHz – 1GHz): Pass**

Please refer to the following table for result details(The data is the worst cases)

Horizontal



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### Result of Bluetooth Communication mode (2480.0 MHz) (30MHz – 1GHz): Pass

Radiated Emissions					
Quasi-Peak					
Emission Frequency MHz	E-Field Polarity	Level @3m dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Level @3m $\mu$ V/m	Limit @3m $\mu$ V/m
30.1	Horizontal	27.1	40.0	22.6	100
32.1	Horizontal	26.6	40.0	21.4	100
702.5	Horizontal	36.0	46.0	63.1	200

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**Limits for Radiated Emissions FCC 47 CFR 15.247 Class B]:**

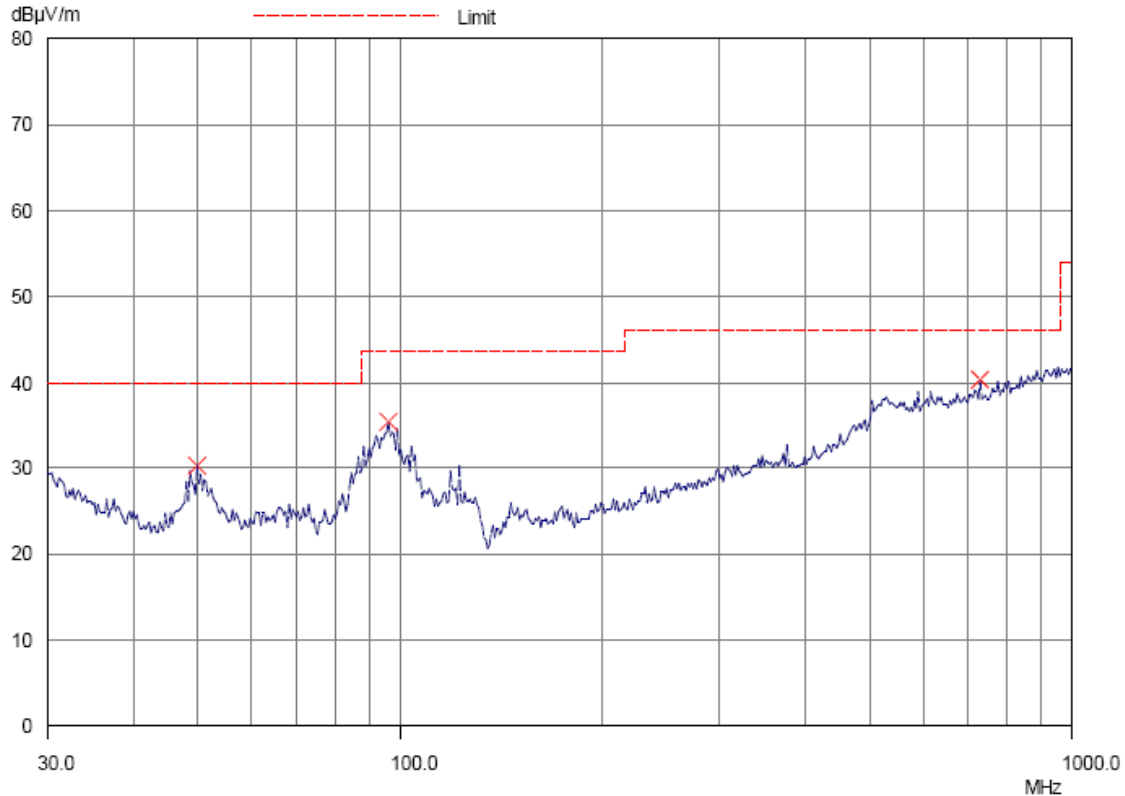
Frequency Range [MHz]	Quasi-Peak Limits [μV/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

**Results of Bluetooth Communication mode (2480.0 MHz) (30MHz – 1GHz): Pass**

Please refer to the following table for result details(The data is the worst cases)

Vertical



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### **Result of Bluetooth Communication mode (2480.0 MHz) (30MHz – 1GHz): Pass**

<b>Radiated Emissions</b>					
<b>Quasi-Peak</b>					
Emission Frequency MHz	E-Field Polarity	Level @3m dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Level @3m $\mu$ V/m	Limit @3m $\mu$ V/m
49.8	Vertical	28.1	40.0	25.4	100
96.1	Vertical	33.4	43.5	46.8	150
725.4	Vertical	36.2	46.0	64.6	200

Remarks:

Calculated measurement uncertainty (30MHz – 1GHz): 4.9dB

Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

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### 3.1.3 AC Mains Conducted Emissions (0.15MHz to 30MHz)

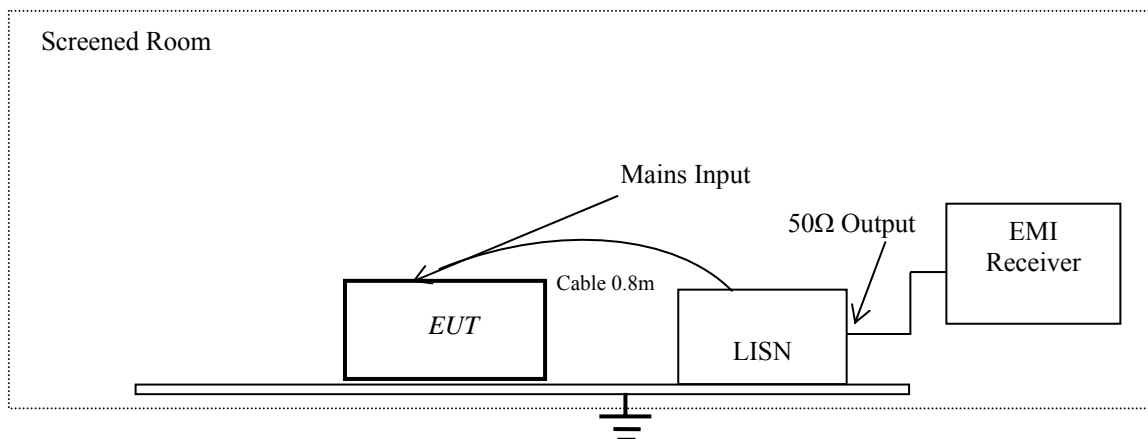
Test Requirement:	FCC 47CFR 15.207
Test Method:	ANSI C63.10:2013
Test Date:	2018-06-06
Mode of Operation:	Bluetooth mode
Test Voltage:	120V a.c. 60Hz

Ambient Temperature: 25°C      Relative Humidity: 51%      Atmospheric Pressure: 101 kPa

#### Test Method:

The test was performed in accordance with ANSI C63.10:2013, with the following: an initial measurement was performed in peak and average detection mode on the live line, any emissions recorded within 30dB of the relevant limit line were re-measured using quasi-peak and average detection on the live and neutral lines with the worst case recorded in the table of results.

#### Test Setup:



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**Limits for Conducted Emissions (FCC 47 CFR 15.207):**

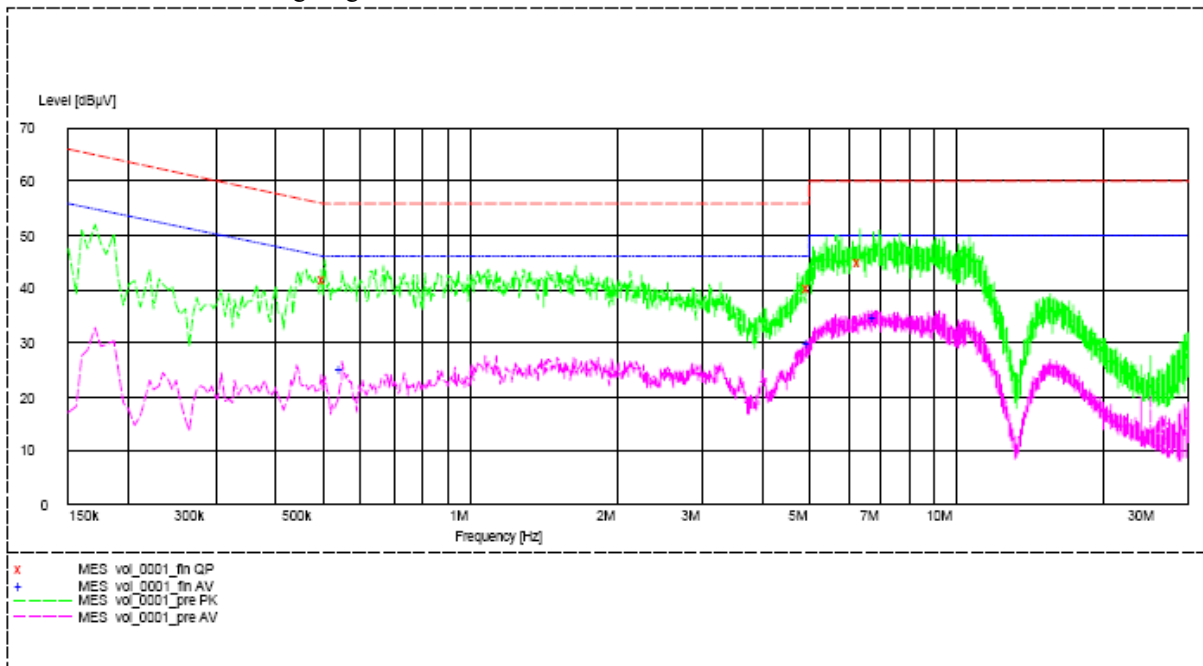
Frequency Range [MHz]	Quasi-Peak Limits [dB $\mu$ V]	Average [dB $\mu$ V]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

\* Decreases with the logarithm of the frequency.

Limits for Conducted Emissions Test, please refer to limit lines (Quasi-Peak and Average) in the following diagram.

**Results of Bluetooth mode (L): PASS**

Please refer to the following diagram for individual results.



Conductor Live or Neutral	Frequency MHz	Quasi-peak		Average	
		Level dB $\mu$ V	Limit dB $\mu$ V	Level dB $\mu$ V	Limit dB $\mu$ V
Live	0.505	41.9	56.0	_*-	_*-
Live	4.970	40.1	56.0	_*-	_*-
Live	6.365	45.2	60.0	_*-	_*-
Live	0.550	_*-	_*-	25.0	46.0
Live	4.970	_*-	_*-	30.0	46.0
Live	6.800	_*-	_*-	35.0	50.0

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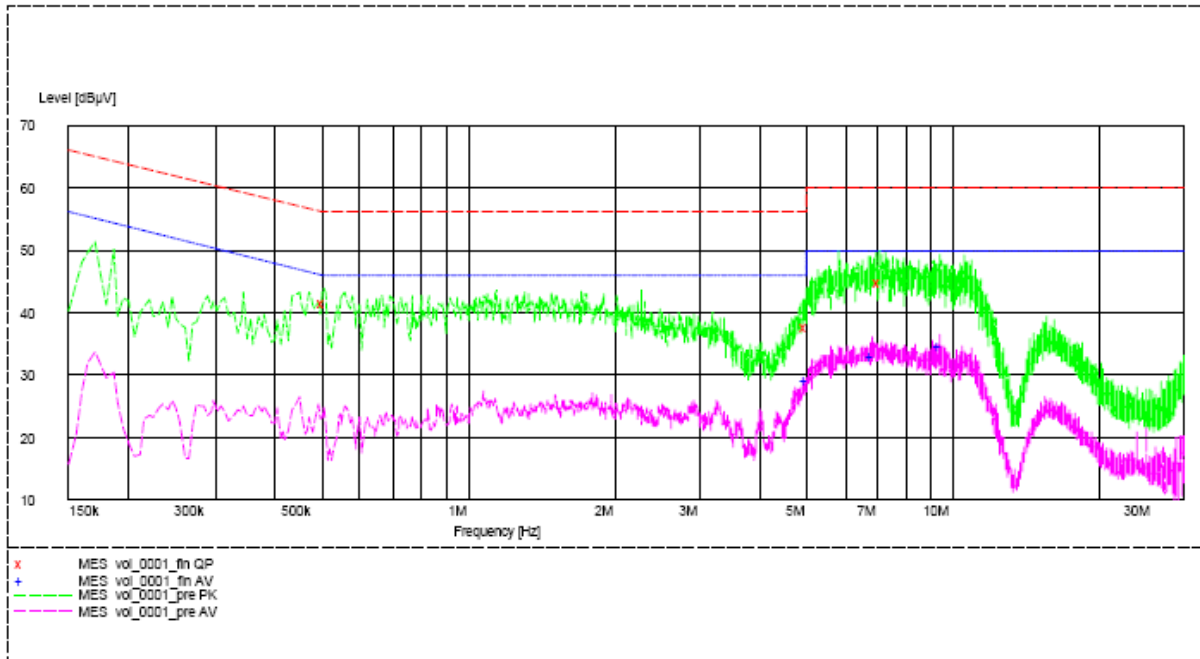
Frequency Range [MHz]	Quasi-Peak Limits [dB $\mu$ V]	Average [dB $\mu$ V]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

\* Decreases with the logarithm of the frequency.

Limits for Conducted Emissions Test, please refer to limit lines (Quasi-Peak and Average) in the following diagram.

### Results of Bluetooth mode (N): PASS

Please refer to the following diagram for individual results.



Conductor Live or Neutral	Frequency MHz	Quasi-peak		Average	
		Level dB $\mu$ V	Limit dB $\mu$ V	Level dB $\mu$ V	Limit dB $\mu$ V
Neutral	0.505	41.5	56.0	-*-	-*-
Neutral	4.975	37.6	56.0	-*-	-*-
Neutral	7.085	44.6	60.0	-*-	-*-
Neutral	4.970	-*-	-*-	29.0	46.0
Neutral	6.855	-*-	-*-	33.2	50.0
Neutral	9.390	-*-	-*-	34.4	50.0

**Remarks:**

Calculated measurement uncertainty (0.15MHz – 30MHz): 3.25dB

-\*- Emission(s) that is far below the corresponding limit line.

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### 3.1.4 Power Spectral Density

Test Requirement: FCC 47CFR 15.247(e)  
Test Method: ANSI C63.10:2013  
Test Date: 2018-06-14  
Mode of Operation: Tx mode

Ambient Temperature: 25°C      Relative Humidity: 51%      Atmospheric Pressure: 101 kPa

#### Test Method:

The RF output of the EUT was connected to the spectrum analyzer. Set the fundamental frequency as the center frequency of the spectral analyzer. Use RBW=3kHz, VBW= 10KHz, Set the span to 1.5 times the DTS channel bandwidth. Detector = peak, Sweep time = auto couple, Trace mode = max hold. Measure the Power Spectral Density (PSD) and record the results in dBm.

#### Test Setup:

As Test Setup of clause 3.1.1 in this test report.

#### Test Limit:

The maximum power spectral density (PSD) shall not exceeded 8dBm in any 3kHz band.

#### Results of Tx Mode GFSK (Tx:2402MHz to 2480MHz) : Pass (Tx Unit)

##### Maximum power spectral density

Transmitter Frequency (MHz)	Maximum Power spectral density level / 3kHz band (dBm)	Maximum Power spectral density / 3kHz band limit
2402.0	-15.57	8dBm
2440.0	-16.15	8dBm
2480.0	-16.15	8dBm

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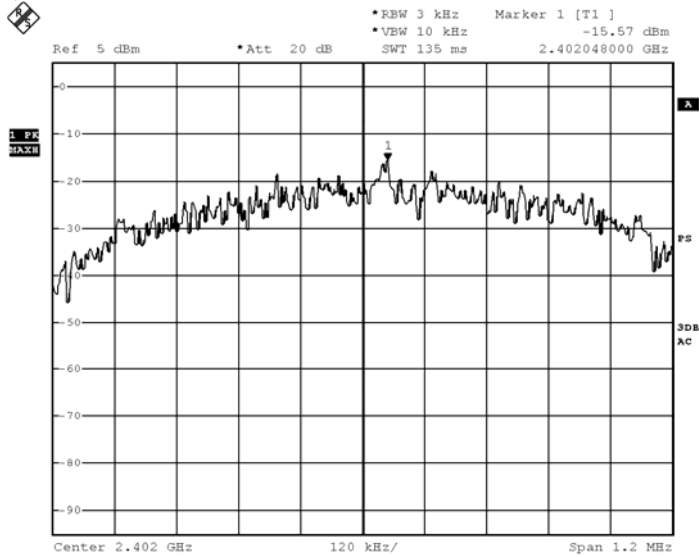


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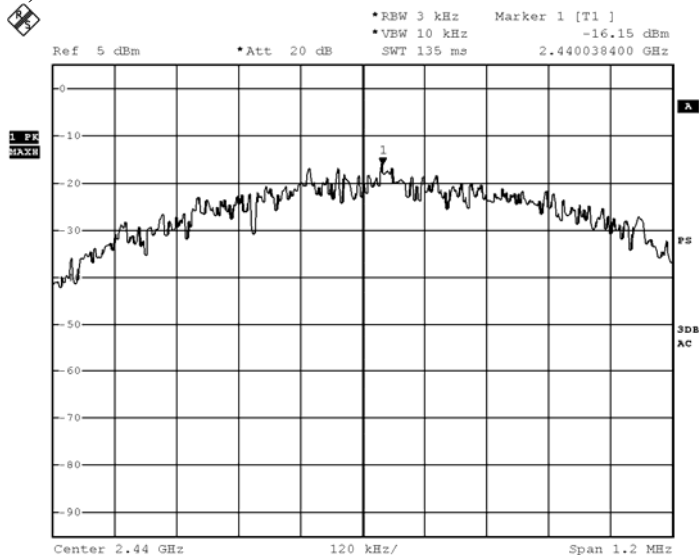
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Tx mode GFSK (Tx: 2402MHz to 2480MHz)  
CH 0 (2402.0 MHz)



CH 19 (2440.0 MHz)



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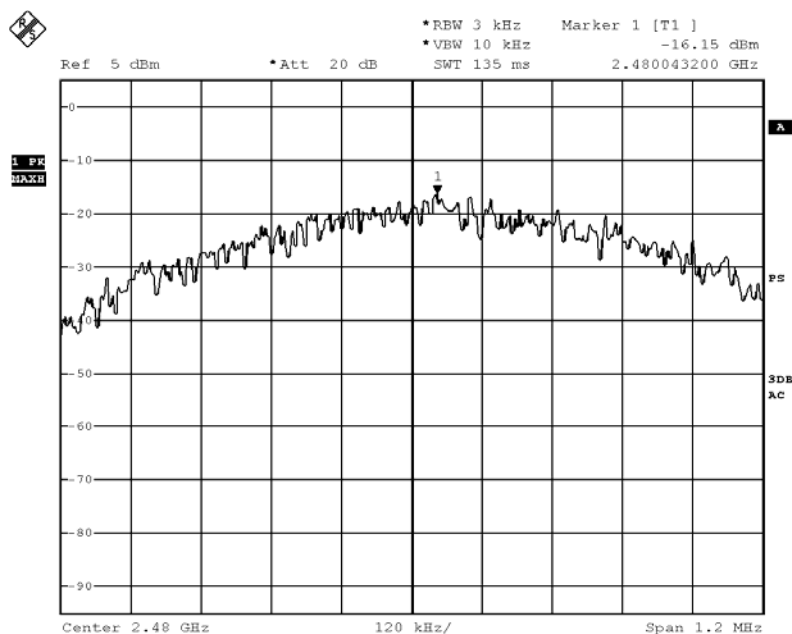


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CH 39 (2480.0 MHz)



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### 3.1.5 6dB Spectrum Bandwidth Measurement

Test Requirement: FCC 47CFR 15.247(a)(2)  
Test Method: ANSI C63.10:2013  
Test Date: 2018-06-13  
Mode of Operation: Tx mode

Ambient Temperature: 25°C      Relative Humidity: 51%      Atmospheric Pressure: 101 kPa

#### Test Method:

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.

#### Test Setup:

As Test Setup of clause 3.1.1 in this test report.

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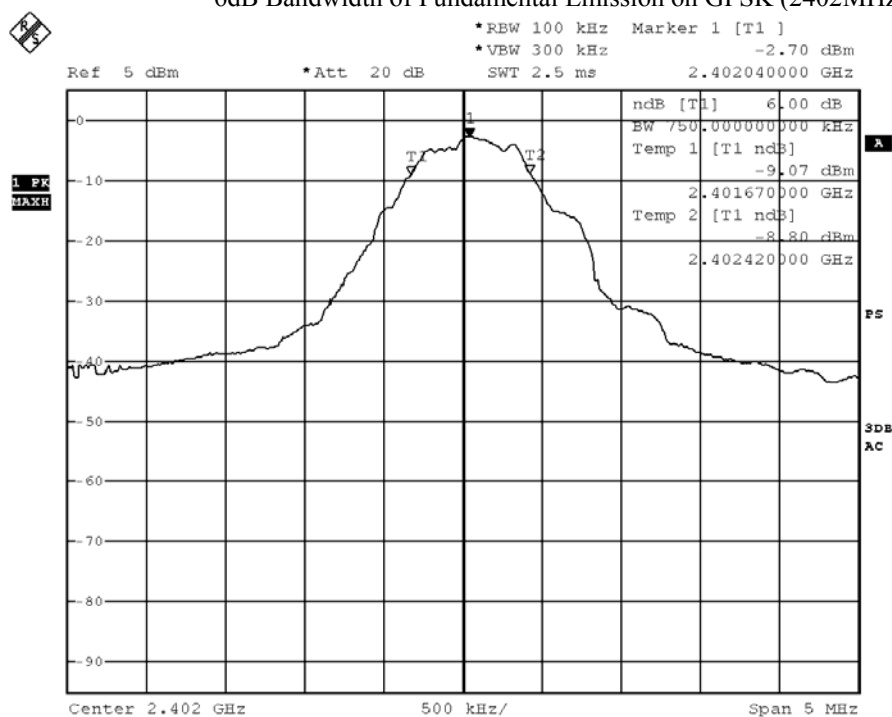
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**Limits for 6dB Spectrum Bandwidth Measurement:**

Center Frequency [MHz]	6dB Bandwidth [KHz]	FCC Limits [kHz]
2402.0	750.0	> 500

6dB Bandwidth of Fundamental Emission on GFSK (2402MHz)



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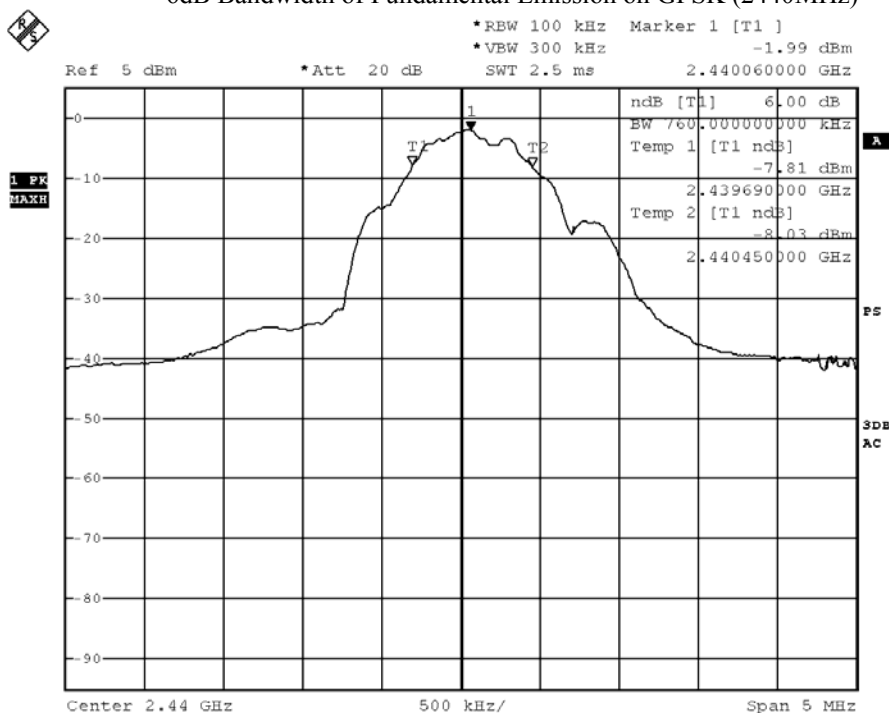
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**Limits for 6dB Spectrum Bandwidth Measurement:**

Frequency Range	6dB Bandwidth	FCC Limits
[MHz]	[KHz]	[kHz]
2440.0	760.0	> 500

**6dB Bandwidth of Fundamental Emission on GFSK (2440MHz)**



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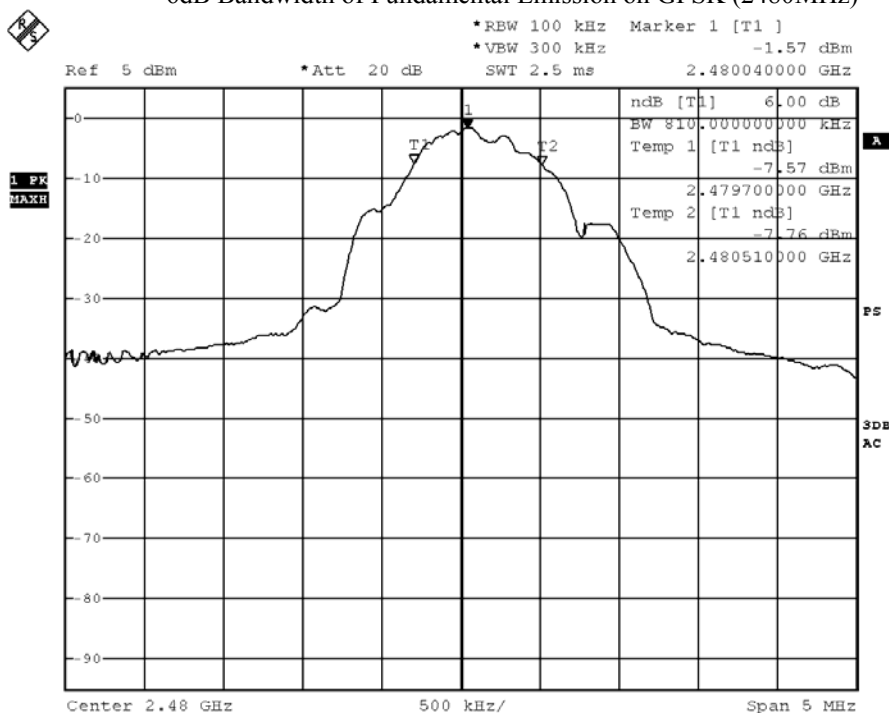
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**Limits for 6dB Spectrum Bandwidth Measurement:**

Frequency Range	6dB Bandwidth	FCC Limits
[MHz]	[KHz]	[kHz]
2480.0	810.0	> 500

**6dB Bandwidth of Fundamental Emission on GFSK (2480MHz)**





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### 3.1.6 Band Edges Measurement

Test Requirement: FCC 47CFR 15.247  
Test Method: ANSI C63.10:2013  
Test Date: 2018-06-13  
Mode of Operation: Tx mode

Ambient Temperature: 25°C      Relative Humidity: 51%      Atmospheric Pressure: 101 kPa

#### Test Method:

The band edge is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. The RBW are set to 100kHz and VBW are set to 300kHz for this measurement.

#### Test Setup:

As Test Setup of clause 3.1.2 in this test report.

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### Band-edge Compliance of RF Conducted Emissions Measurement:

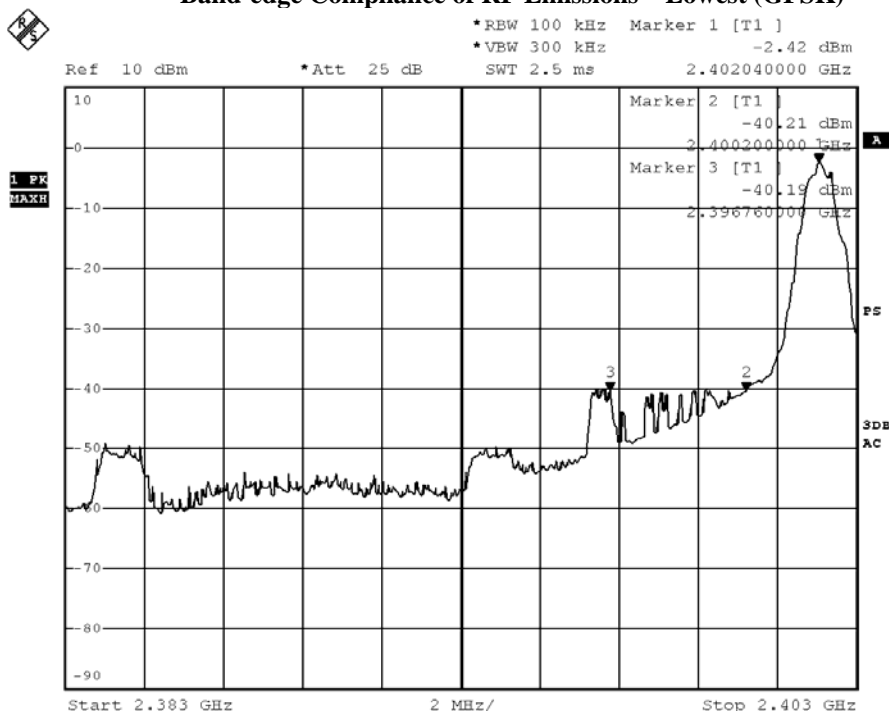
#### Limit :

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

Remark: Emissions under the fixed frequency mode and hopping mode have been investigated, the worst-case measurement results were recorded in the test report

Frequency Range [MHz]	Conducted Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	37.79

### Band-edge Compliance of RF Emissions – Lowest (GFSK)



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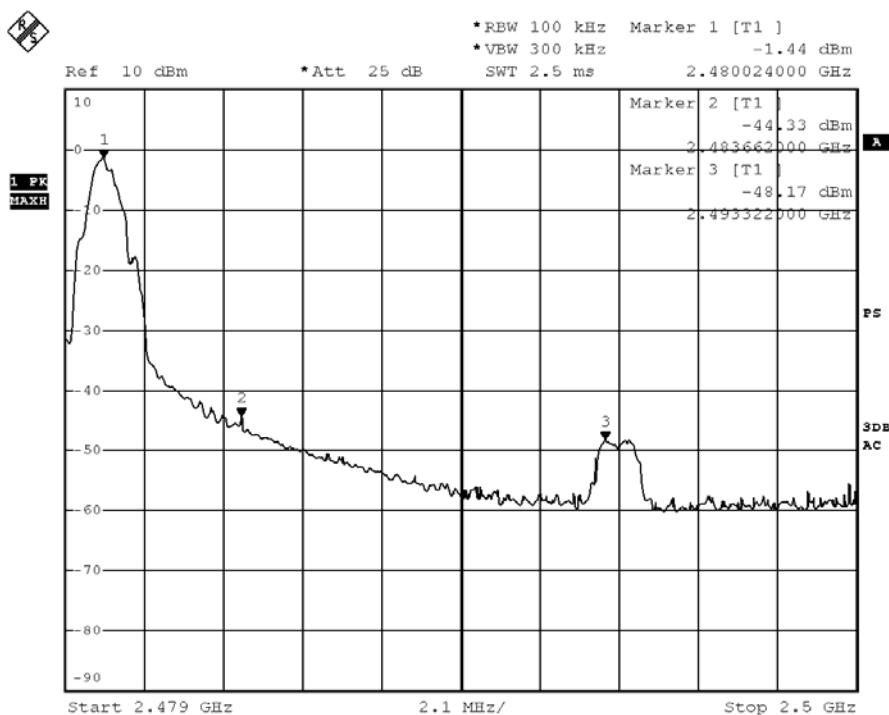
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**Band-edge Compliance of RF Conducted Emissions Measurement:**

Frequency Range [MHz]	Conducted Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	42.89

**Band-edge Compliance of RF Emissions – Highest (GFSK)**





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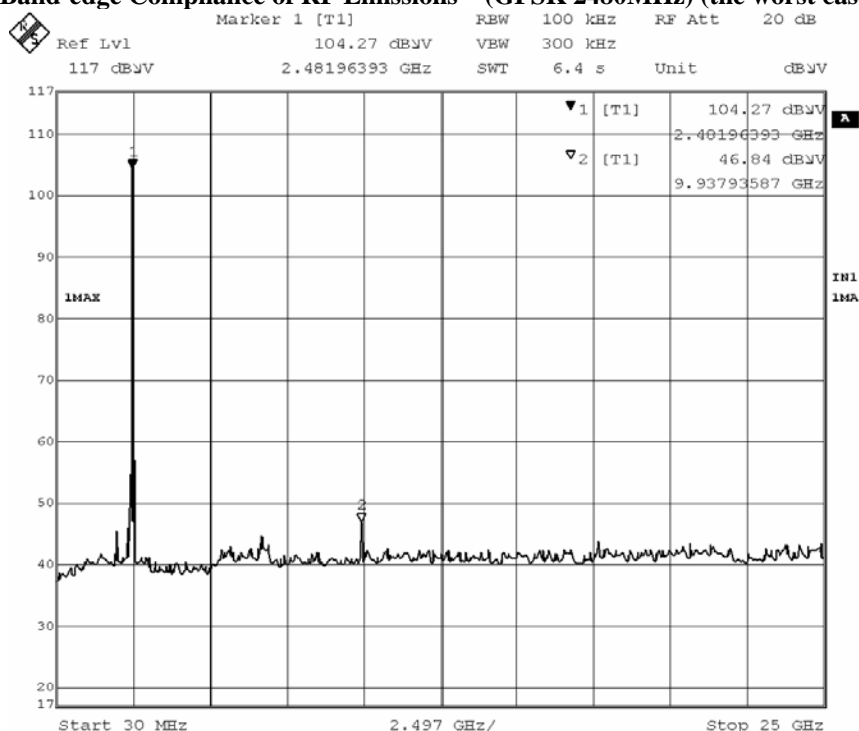
### Band-edge Compliance of RF Conducted Emissions Measurement:

#### Limit :

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

Remark: Emissions under the fixed frequency mode and hopping mode have been investigated, the worst-case measurement results were recorded in the test report

### Band-edge Compliance of RF Emissions – (GFSK 2480MHz) (the worst case)



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### Appendix A

#### List of Measurement Equipment

##### Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM215	MULTIDEVICE CONTROLLER	EMCO	2090	00024676	N/A	N/A
EM217	ELECTRIC POWERED TURNTABLE	EMCO	2088	00029144	N/A	N/A
EM218	ANECHOIC CHAMBER	ETS-LINDGREN	FACT-3	--	2018/01/24	2019/01/24
EM356	ANTENNA POSITIONING TOWER	ETS-LINDGREN	2171B	00150346	N/A	N/A
EM354	BICONILOG ANTENNA	ETS-LINDGREN	3143B	00142073	2018/03/29	2020/03/29
EM229	EMI TEST RECEIVER	R&S	ESIB40	100248	2018/06/01	2019/06/01
EM276	BROADBAND HORN ANTENNA	A-INFOMW	JTXLB-10180-SF	J2031090903007	2018/04/27	2020/04/27
EM300	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-09	00130130	2018/05/13	2019/05/13
EM301	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-10	00130988	2018/05/13	2019/05/13
EM302	PRECISION OMNIDIRECTIONAL DIPOLE (1 – 6GHZ)	SEIBERSDORF LABORATORIES	POD 16	161806/L	2018/05/11	2020/05/11
EM303	PRECISION OMNIDIRECTIONAL DIPOLE (6 – 18GHZ)	SEIBERSDORF LABORATORIES	POD 618	6181908/L	2018/05/11	2020/05/11
EM353	LOOP ANTENNA	ETS LINDGREN	6502	00206533	2018/04/16	2020/04/16
EM045	POWER METER	ROHDE & SCHWARZ	NRVD	843246/028	2017/10/14	2018/10/14

##### Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM119	LISN	R & S	ESH3-Z5	0831.5518.52	2017/11/29	2018/11/29
EM145	EMI TEST RECEIVER	R & S	ESCS 30	830245/021	2018/06/01	2019/06/01
EM179	IMPULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	357-8810.52/54	2018/01/11	2019/01/11
EM154	SHIELDING ROOM	SIEMENS MATSUSHITA COMPONENTS	N/A	803-740-057-99A	2017/02/02	2022/02/02
N/A	MEASUREMENT AND EVALUATION SOFTWARE	ROHDE & SCHWARZ	BSIB-K1	V1.20	N/A	N/A

Remarks:-

CM     Corrective Maintenance  
 N/A    Not Applicable  
 TBD    To Be Determined

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### Appendix B

#### Photographs of EUT

View of the product



View of the product



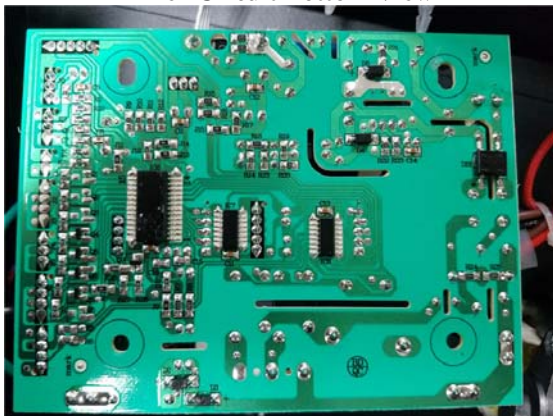
Inside View of the product



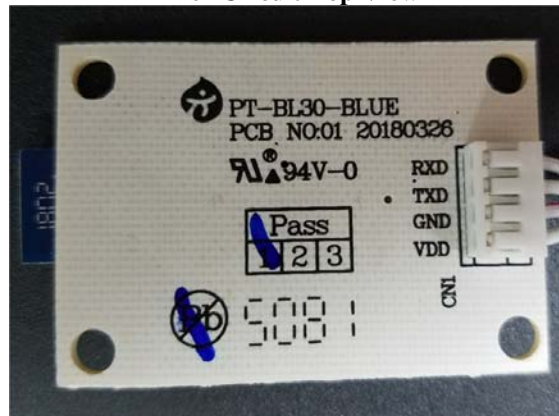
Inner Circuit Top View



Inner Circuit Bottom View



Inner Circuit Top View



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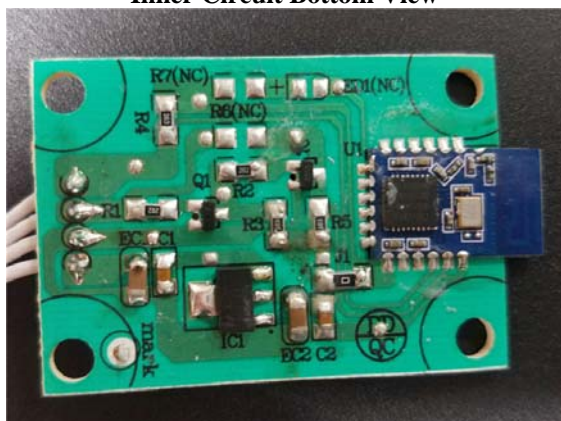
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### Photographs of EUT

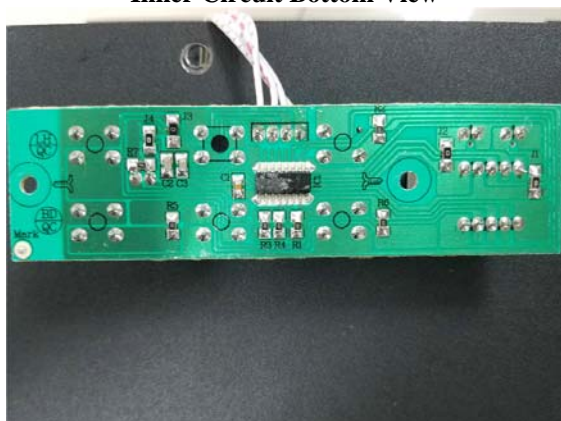
**Inner Circuit Bottom View**



**Inner Circuit Top View**



**Inner Circuit Bottom View**



**Inner Circuit Top View**



**Inner Circuit Bottom View**



**Inner Circuit Top View**



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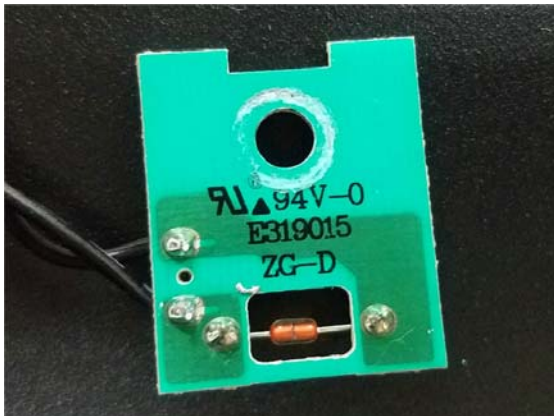
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### Photographs of EUT

Inner Circuit Bottom View



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### Photographs of EUT

**Measurement of Radiated Emission Test Set Up (9kHz to 30MHz)**



**Measurement of Radiated Emission Test Set Up (30MHz to 1000MHz)**



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### Photographs of EUT

**Measurement of Radiated Emission Test Set Up (Above 1000MHz)**



**Measurement of Conducted Emission Test Set Up**



**\*\*\*\*\* End of Test Report \*\*\*\*\***

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