

TEST REPORT

Report No.: 20111235HKG-001

McIntosh Laboratory Inc

Application For Certification
(Original Grant)

FCC ID: BWY-MB20

IC: 2483A-MB20

Transceiver

Prepared and Checked by:

Approved by:

Signed On File
Wong Cheuk Ho, Herbert
Lead Engineer

Wong Kwok Yeung, Kenneth
Senior Lead Engineer
Date: January 14, 2021

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TEST REPORT

GENERAL INFORMATION

Grantee:	McIntosh Laboratory Inc
Grantee Address:	2 Chambers Street, Binghamton, NY 13903, United States of America
Contact Person:	Leon Savidge
Tel:	+1 607-352-2415
Fax:	+1 607-723-3636
e-mail:	savidge@mcintoshlabs.com
Manufacturer:	Dongguan Kwan Hong Electronics Co., Ltd.
Manufacturer Address:	No.5, Shichangxiang Chang' an Town, Dongguan City, Guangdong Province, China.
Brand Name:	McIntosh
Model / HVIN:	MB20
PMN:	MB20
Type of EUT:	Transceiver
Description of EUT:	Bluetooth Transceiver
Serial Number:	AHYPP14
FCC ID / IC:	BWY-MB20 / 2483A-MB20
Date of Sample Submitted:	November 27, 2020
Date of Test:	November 27, 2020 to January 06, 2021
Report No.:	20111235HKG-001
Report Date:	January 14, 2021
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%
Conclusion:	Test was conducted by client submitted sample. The submitted sample as received complied with the 47 CFR Part 15 / RSS-210 Issue 10 Certification.

TEST REPORT

SUMMARY OF TEST RESULT

Test Specification	Reference	Results
Transmitter Power Line Conducted Emissions	15.207 / RSS-Gen 8.8	Pass
Radiated Emission Radiated Emission on the Bandedge	15.249, 15.209 / RSS-210 B.10, RSS-210 4.4	Pass
Radiated Emission in Restricted Bands	15.205 / RSS-210 4.1	Pass

The equipment under test is found to be complying with the following standards:

- FCC Part 15, October 1, 2019 Edition
- RSS-210 Issue 10, December 2019
- RSS-Gen Issue 5 Amendment 1, March 2019

Note: 1. The EUT uses a permanently attached antenna which, in accordance to section 15.203, is considered sufficient to comply with the provisions of this section.
2. Pursuant to FCC part 15 Section 15.215(c), the 20 dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered.

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1.0 GENERAL DESCRIPTION

1.1 Product Description

The Equipment Under Test (EUT) is MB20 Bluetooth Transceiver (Model/HVIN: MB20) which contains a Bluetooth module for wireless audio features. The EUT is powered by USB port (5VDC).

Antenna Type: external, detachable, with reverse-SMA connector

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

1.2 Related Submittal(s) Grants

This is a single application for certification of a transceiver.

1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). All radiated measurements were performed in an 3m Chamber. Preliminary scans were performed in the 3m Chamber only to determine worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the “**Justification Section**” of this Application.

1.4 Test Facility

The 3m Chamber and conducted measurement facility used to collect the radiated data is located at Workshop No. 3, G/F., World-Wide Industrial Centre, 43-47 Shan Mei Street, Fo Tan, Sha Tin, N.T., Hong Kong SAR, China. This test facility and site measurement data have been placed on file with the FCC and IC No. 2042H.

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2.0 SYSTEM TEST CONFIGURATION

2.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.10 (2013).

The device was powered by an adaptor with USB port (5VDC) output during test.

For maximizing emissions, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data reported in Exhibit 3.0.

The rear of unit shall be flushed with the rear of the table.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was mounted to a plastic stand if necessary and placed on the wooden turntable, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

All relevant operation modes have been tested, and the worst-case data is included in this report.

2.2 EUT Exercising Software

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use.

2.3 Special Accessories

There are no special accessories necessary for compliance of this product.

2.4 Measurement Uncertainty

Decision Rule for compliance: For FCC/IC standard, the measured value must be within the limits of applicable standard without accounting for the measurement uncertainty. For EN/IEC/HKTA/HKTC standard, conformity rules will be used as per standard directly excepted EN/IEC 61000-3-2, EN/IEC 61000-3-3, HKTA1004, HKCA1008, HKTA1019, HKTA1020, HKTA1041 and HKTA1044. For these excepted or not mentioned standards, Cl 4.2.2 of ILAC-G8:09/2019 decision rules will be reference and guard band will be equal to our measurement uncertainty with 95% confidence level (k=2). In case, the measured value is within guard band region, undetermined decision will be used.

Uncertainty and Compliance - Unless the standard specifically states that measured values are to be extended by the measurement uncertainty in determining compliance, all compliance determinations are based on the actual measured value.

2.5 Support Equipment List and Description

1. 8 X 2m long analog audio cable with termination
2. 2 X 2m long digital audio cable with termination
(Provided by Intertek)
3. 1 X USB cable with length of 1.2 meter long
4. AC-DC adaptor (Model: GPE013B-050240-Z, Input: 100-240VAC 50/60Hz; Output: 5VDC 2.4A)
(Provided by Applicant)

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3.0 EMISSION RESULTS

Data is included of the worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

3.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any), Average Factor (optional) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG - AV$$

where FS = Field Strength in dB μ V/m

RA = Receiver Amplitude (including preamplifier) in dB μ V

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

AV = Average Factor in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows:

$$FS = RR + LF$$

where FS = Field Strength in dB μ V/m

RR = RA - AG - AV in dB μ V

LF = CF + AF in dB

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB are added. The amplifier gain of 29 dB and average factor of 5 dB are subtracted, giving a field strength of 27 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

$$RA = 52.0 \text{ dB}\mu\text{V/m}$$

$$AF = 7.4 \text{ dB}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$AV = 5.0 \text{ dB}$$

$$FS = RR + LF$$

$$FS = 18 + 9 = 27 \text{ dB}\mu\text{V/m}$$

$$RR = 18.0 \text{ dB}\mu\text{V}$$

$$LF = 9.0 \text{ dB}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(27 \text{ dB}\mu\text{V/m})/20] = 22.4 \mu\text{V/m}$$

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3.2 Radiated Emission Configuration Photograph

The worst case in radiated emission was found at 944.954 MHz

For electronic filing, the worst-case radiated emission configuration photographs are saved with filename: radiated photos.pdf.

3.3 Radiated Emission Data

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Judgment: Passed by 3.0 dB

3.4 Conducted Emission Configuration Photograph

The worst case in line-conducted emission was found at 0.614 MHz

For electronic filing, the worst-case line-conducted configuration photographs are saved with filename: conducted photo.pdf.

3.5 Conducted Emission Data

For electronic filing, the graph and data table of conducted emission is saved with filename: conducted.pdf.

Judgment: Pass by 11.8 dB

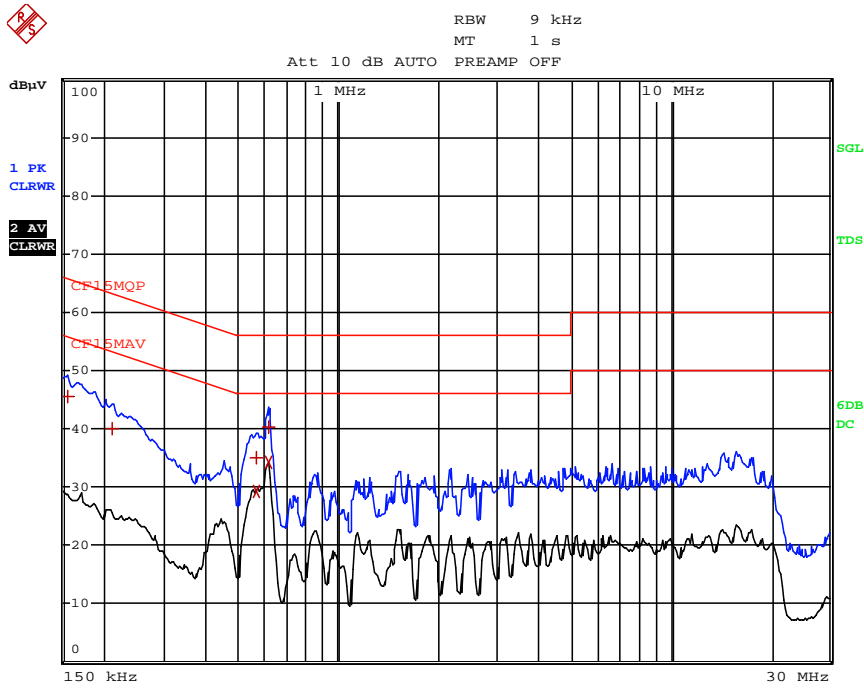
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CONDUCTED EMISSION

Model: MB20

Date of Test: January 06, 2021

Worst-Case Operating Mode: Bluetooth Operating



EDIT PEAK LIST (Final Measurement Results)				
TRACE		FREQUENCY	LEVEL dBμV	DELTA LIMIT dB
Trace1:	CF15MQP			
Trace2:	CF15MAV			
Trace3:	---			
1	Quasi Peak	154.5 kHz	45.44 L1	-20.31
1	Quasi Peak	213 kHz	39.91 N	-23.17
1	Quasi Peak	564 kHz	35.11 N	-20.88
2	CISPR Average	564 kHz	29.22 N	-16.77
1	Quasi Peak	613.5 kHz	40.40 N	-15.59
2	CISPR Average	613.5 kHz	34.18 N	-11.81

Note: Measurement Uncertainty is ±4.2dB at a level of confidence of 95%.

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RADIATED EMISSIONS

Model: MB20

Date of Test: January 06, 2021

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 1
Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Lowest Channel

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	2402.000	74.1	33	29.4	70.5	94.0	-23.5
V	4804.000	30.9	33	34.9	32.8	54.0	-21.2
V	7206.000	26.6	33	37.9	31.5	54.0	-22.5
V	9608.000	24.4	33	40.4	31.8	54.0	-22.2
V	12010.000	26.7	33	40.5	34.2	54.0	-19.8
V	14412.000	28.2	33	40.0	35.2	54.0	-18.8

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	2402.000	91.1	33	29.4	87.5	114.0	-26.5
V	4804.000	44.3	33	34.9	46.2	74.0	-27.8
V	7206.000	39.7	33	37.9	44.6	74.0	-29.4
V	9608.000	37.5	33	40.4	44.9	74.0	-29.1
V	12010.000	39.7	33	40.5	47.2	74.0	-26.8
V	14412.000	41.4	33	40.0	48.4	74.0	-25.6

- NOTES:
1. Peak Detector Data unless otherwise stated.
 2. Average detector is applied according to ANSI C63.10.
 3. All measurements were made at 3 meters.
 4. Negative sign in the column shows value below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
 7. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

TEST REPORT

Model: MB20
Date of Test: January 06, 2021
Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 2
Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Middle Channel

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
V	2440.000	73.8	33	29.4	70.2	94.0	-23.8
V	4880.000	39.9	33	34.9	41.8	54.0	-12.2
V	7320.000	34.6	33	37.9	39.5	54.0	-14.5
H	9760.000	26.8	33	40.4	34.2	54.0	-19.8
H	12200.000	32.1	33	40.5	39.6	54.0	-14.4
V	14640.000	36.2	33	38.4	41.6	54.0	-12.4

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
V	2440.000	92.4	33	29.4	88.8	114.0	-25.2
V	4880.000	52.9	33	34.9	54.8	74.0	-19.2
V	7320.000	47.7	33	37.9	52.6	74.0	-21.4
H	9760.000	40.0	33	40.4	47.4	74.0	-26.6
H	12200.000	45.3	33	40.5	52.8	74.0	-21.2
V	14640.000	49.4	33	38.4	54.8	74.0	-19.2

- NOTES:
1. Peak Detector Data unless otherwise stated.
 2. Average detector is applied according to ANSI C63.10.
 3. All measurements were made at 3 meters.
 4. Negative sign in the column shows value below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
 7. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

TEST REPORT

Model: MB20
Date of Test: January 06, 2021
Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 3
Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Highest Channel

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
V	2480.000	74.4	33	29.4	70.8	94.0	-23.2
V	4960.000	39.6	33	34.9	41.5	54.0	-12.5
V	7440.000	24.5	33	37.9	29.4	54.0	-24.6
V	9920.000	24.8	33	40.4	32.2	54.0	-21.8
V	12400.000	26.9	33	40.5	34.4	54.0	-19.6
V	14880.000	29.0	33	38.4	34.4	54.0	-19.6

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
V	2480.000	91.4	33	29.4	87.8	114.0	-26.2
V	4960.000	52.7	33	34.9	54.6	74.0	-19.4
V	7440.000	37.7	33	37.9	42.6	74.0	-31.4
V	9920.000	38.0	33	40.4	45.4	74.0	-28.6
V	12400.000	40.1	33	40.5	47.6	74.0	-26.4
V	14880.000	42.2	33	38.4	47.6	74.0	-26.4

- NOTES:
1. Peak Detector Data unless otherwise stated.
 2. Average detector is applied according to ANSI C63.10.
 3. All measurements were made at 3 meters.
 4. Negative sign in the column shows value below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
 7. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

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Model: MB20
Date of Test: January 06, 2021
Worst-Case Operating Mode: Transmitting (Bluetooth 4.0 BLE)

Table 4
Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Lowest Channel

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
V	2402.000	77.4	33	29.4	73.8	94.0	-20.2
V	4804.000	33.9	33	34.9	35.8	54.0	-18.2
V	7206.000	34.3	33	37.9	39.2	54.0	-14.8
H	9608.000	27.0	33	40.4	34.4	54.0	-19.6
V	12010.000	33.3	33	40.5	40.8	54.0	-13.2
V	14412.000	31.2	33	40.0	38.2	54.0	-15.8

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
V	2402.000	93.2	33	29.4	89.6	114.0	-24.4
V	4804.000	43.6	33	34.9	45.5	74.0	-28.5
V	7206.000	43.9	33	37.9	48.8	74.0	-25.2
H	9608.000	36.8	33	40.4	44.2	74.0	-29.8
V	12010.000	43.0	33	40.5	50.5	74.0	-23.5
V	14412.000	40.8	33	40.0	47.8	74.0	-26.2

- NOTES:
1. Peak Detector Data unless otherwise stated.
 2. Average detector is applied according to ANSI C63.10.
 3. All measurements were made at 3 meters.
 4. Negative sign in the column shows value below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
 7. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

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Model: MB20
Date of Test: January 06, 2021
Worst-Case Operating Mode: Transmitting (Bluetooth 4.0 BLE)

Table 5
Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Middle Channel

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	2440.000	76.2	33	29.4	72.6	94.0	-21.4
V	4880.000	39.9	33	34.9	41.8	54.0	-12.2
V	7320.000	36.7	33	37.9	41.6	54.0	-12.4
H	9760.000	30.1	33	40.4	37.5	54.0	-16.5
V	12200.000	35.7	33	40.5	43.2	54.0	-10.8
V	14640.000	39.4	33	38.4	44.8	54.0	-9.2

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	2440.000	92.4	33	29.4	88.8	114.0	-25.2
V	4880.000	49.6	33	34.9	51.5	74.0	-22.5
V	7320.000	46.5	33	37.9	51.4	74.0	-22.6
H	9760.000	39.8	33	40.4	47.2	74.0	-26.8
V	12200.000	45.3	33	40.5	52.8	74.0	-21.2
V	14640.000	49.1	33	38.4	54.5	74.0	-19.5

- NOTES:
1. Peak Detector Data unless otherwise stated.
 2. Average detector is applied according to ANSI C63.10.
 3. All measurements were made at 3 meters.
 4. Negative sign in the column shows value below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
 7. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

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Model: MB20
Date of Test: January 06, 2021
Worst-Case Operating Mode: Transmitting (Bluetooth 4.0 BLE)

Table 6
Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Highest Channel

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	2480.000	76.8	33	29.4	73.2	94.0	-20.8
V	4960.000	41.7	33	34.9	43.6	54.0	-10.4
V	7440.000	32.9	33	37.9	37.8	54.0	-16.2
V	9920.000	28.8	33	40.4	36.2	54.0	-17.8
H	12400.000	30.3	33	40.5	37.8	54.0	-16.2
V	14880.000	32.2	33	38.4	37.6	54.0	-16.4

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	2480.000	91.8	33	29.4	88.2	114.0	-25.8
V	4960.000	51.5	33	34.9	53.4	74.0	-20.6
V	7440.000	42.6	33	37.9	47.5	74.0	-26.5
V	9920.000	38.4	33	40.4	45.8	74.0	-28.2
H	12400.000	40.1	33	40.5	47.6	74.0	-26.4
V	14880.000	42.0	33	38.4	47.4	74.0	-26.6

- NOTES:
1. Peak Detector Data unless otherwise stated.
 2. Average detector is applied according to ANSI C63.10.
 3. All measurements were made at 3 meters.
 4. Negative sign in the column shows value below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
 7. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

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Model: MB20

Date of Test: January 06, 2021

Worst-Case Operating Mode: Bluetooth Operating

Table 7
Pursuant to FCC Part 15 Section 15.209 / RSS-210 4.4 Requirement

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Limit at 3m (dBµV/m)	Margin (dB)
V	49.822	39.4	16	11.0	34.4	40.0	-5.6
V	58.374	37.2	16	11.0	32.2	40.0	-7.8
V	124.212	35.5	16	14.0	33.5	43.5	-10.0
V	143.368	35.8	16	14.0	33.8	43.5	-9.7
V	191.142	34.5	16	16.0	34.5	43.5	-9.0
H	565.198	27.8	16	28.0	39.8	46.0	-6.2
V	944.954	26.0	16	33.0	43.0	46.0	-3.0

- NOTES:
1. Quasi-Peak Detector Data unless otherwise stated.
 2. All measurements were made at 3 meters.
 3. Negative sign in the column shows value below limit.
 4. Horn antenna is used for the emission over 1000MHz.
 5. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
 6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

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4.0 EQUIPMENT PHOTOGRAPHS

For electronic filing, the photographs are saved with filename: external photos.pdf and internal photos.pdf.

5.0 PRODUCT LABELLING

For electronics filing, the FCC ID label artwork and the label location are saved with filename: label.pdf.

6.0 TECHNICAL SPECIFICATIONS

For electronic filing, the block diagram and schematic of the tested EUT are saved with filename: block.pdf and circuit.pdf respectively.

7.0 INSTRUCTION MANUAL

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States and Canada.

TEST REPORT

8.0 MISCELLANEOUS INFORMATION

The miscellaneous information includes details of the test procedure and measured bandwidth / calculation of factor such as pulse desensitization and averaging factor (calculation and timing diagram).

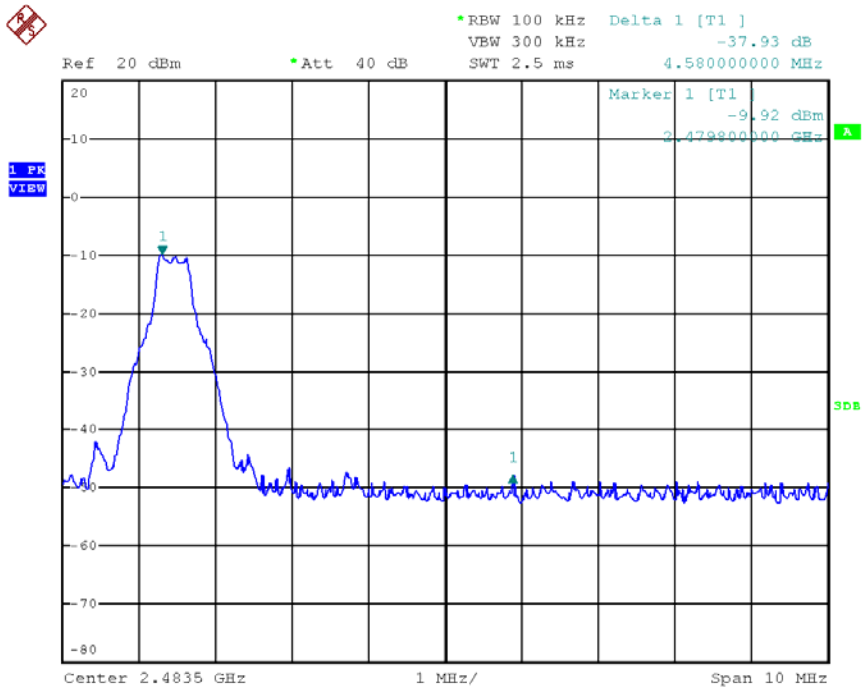
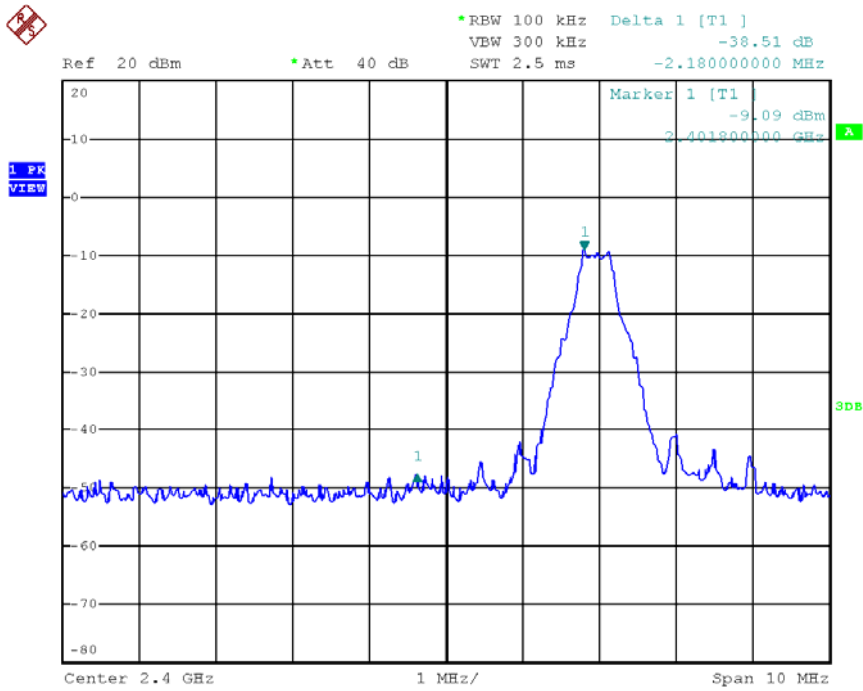
8.1 Radiated Emission on the Bandedge

From the following plots, they show that the fundamental emissions are confined in the specified band (2400MHz to 2483.5MHz). In case of the fundamental emissions are within two standard bandwidths from the bandedge, the delta measurement technique is used for determining bandedge compliance. Standard bandwidth is the bandwidth specified by ANSI C63.10 (2013) for frequency being measured.

Emissions radiated outside of the specified frequency bands, except harmonics, are attenuated by 50dB below the level of the fundamental or to the general radiated emissions limits in Section 15.209 / RSS-210 4.4, whichever is the lesser attenuation, which meet the requirement of part 15.249(d) / RSS-210 B.10.

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PEAK MEASUREMENT (Bluetooth 3.0)



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PEAK MEASUREMENT (Bluetooth 3.0)

Bandedge compliance is determined by applying marker-delta method, i.e. (Bandedge Plot).

Lower bandedge

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the plot

=87.5 dB μ V/m – 38.5 dB

=49.0 dB μ V/m

Average Resultant field strength = Fundamental emissions (average value) – delta from the plot

=70.5 dB μ V/m – 38.5 dB

=32.0 dB μ V/m

Upper bandedge

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the plot

=87.8 dB μ V/m – 37.9 dB

=49.9 dB μ V/m

Average Resultant field strength = Fundamental emissions (average value) – delta from the plot

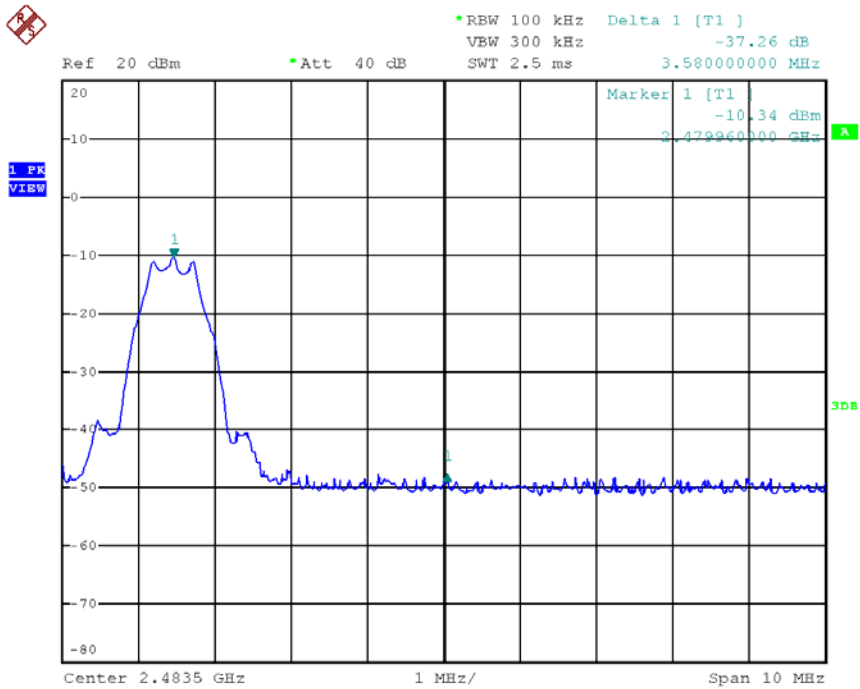
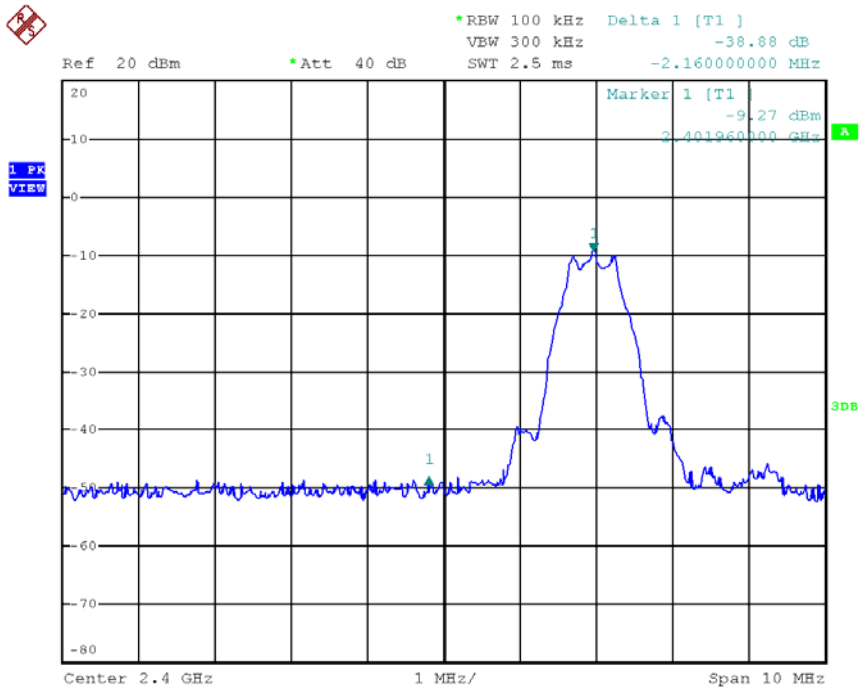
=70.8 dB μ V/m – 37.9 dB

=32.9 dB μ V/m

The resultant field strength meets the general radiated emission limit in Section 15.209 / RSS-210 4.4, which does not exceed 74 dB μ V/m (Peak Limit) and 54 dB μ V/m (Average Limit).

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PEAK MEASUREMENT (Bluetooth 4.0 BLE)



TEST REPORT

PEAK MEASUREMENT (Bluetooth 4.0 BLE)

Bandedge compliance is determined by applying marker-delta method, i.e. (Bandedge Plot).

Lower bandedge

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the plot

=89.6 dB μ V/m – 38.9 dB

=50.7 dB μ V/m

Average Resultant field strength = Fundamental emissions (average value) – delta from the plot

=73.8 dB μ V/m – 38.9 dB

=34.9 dB μ V/m

Upper bandedge

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the plot

=88.2 dB μ V/m – 37.3 dB

=50.9 dB μ V/m

Average Resultant field strength = Fundamental emissions (average value) – delta from the plot

=73.2 dB μ V/m – 37.3 dB

=35.9 dB μ V/m

The resultant field strength meets the general radiated emission limit in Section 15.209 / RSS-210 4.4, which does not exceed 74 dB μ V/m (Peak Limit) and 54 dB μ V/m (Average Limit).

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8.2 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. The effective period (T_{eff}) is approximately $625\mu s$ for a digital "1" bit which illustrated on technical specification, with a resolution bandwidth (3dB) of 1MHz, so the pulse desensitivity factor is 0dB.

8.3 Calculation of Average Factor

The average factor is not applicable for this device as the transmitted signal is a continuously signal.

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8.4 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services Hong Kong Ltd. in the measurements of transmitter operating under the Part 15, Subpart C rules.

The transmitting equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately 0.8m in height above the ground plane for emission measurement at or below 1GHz and 1.5m in height above the ground plane for emission measurement above 1GHz. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjusted through all three orthogonal axis to obtain maximum emission levels. The antenna height and polarization are also varied during the testing to search for maximum signal levels. The height of the antenna is varied from one to four meters.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in Exhibit 8.3.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.

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8.4 Emissions Test Procedures (cont'd)

The EUT is warmed up for 15 minutes prior to the test.

AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

Conducted measurements were made as described in ANSI C63.10 (2013).

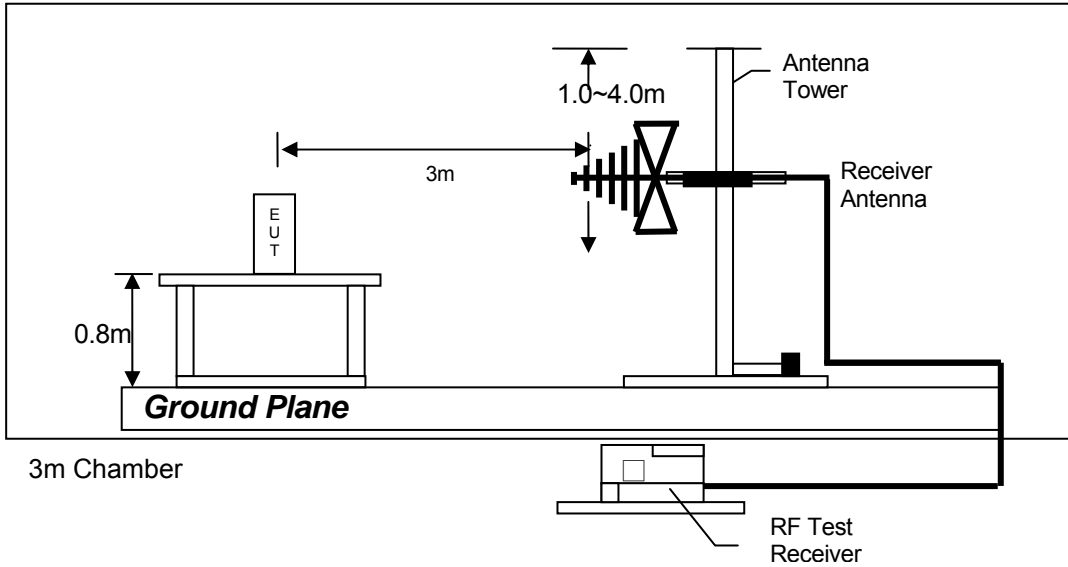
The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater when frequency is below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report (See Exhibit 8.1). Above 1000 MHz, a resolution bandwidth of 3 MHz is used.

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the forbidden bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, unless otherwise reported. Measurements taken at a closer distance are so marked.

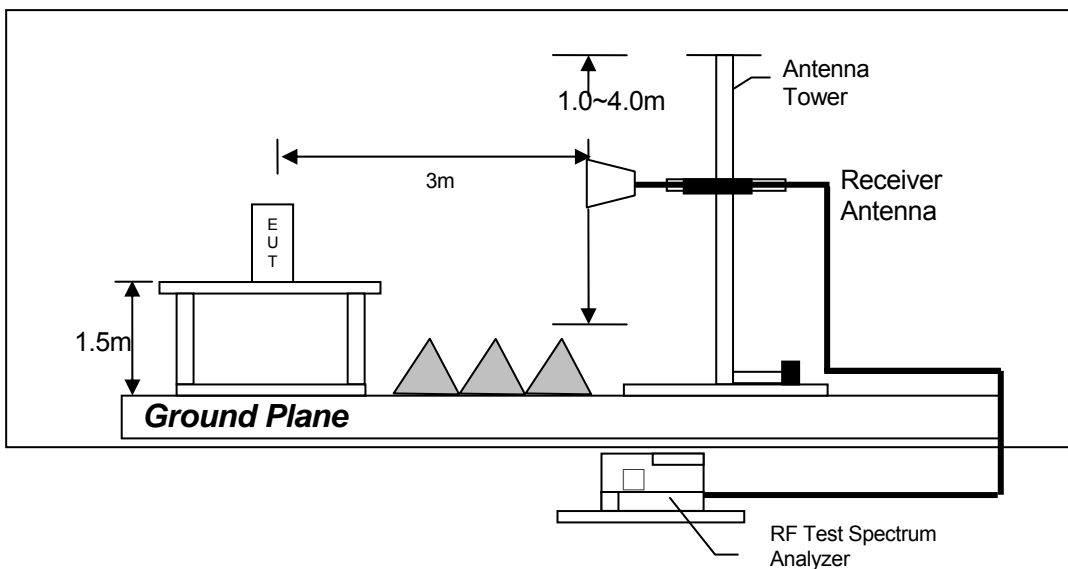
TEST REPORT

8.4.1 Radiated Emission Test Setup

The figure below shows the test setup, which is utilized to make these measurements.



Test setup of radiated emissions up to 1GHz



Test setup of radiated emissions above 1GHz

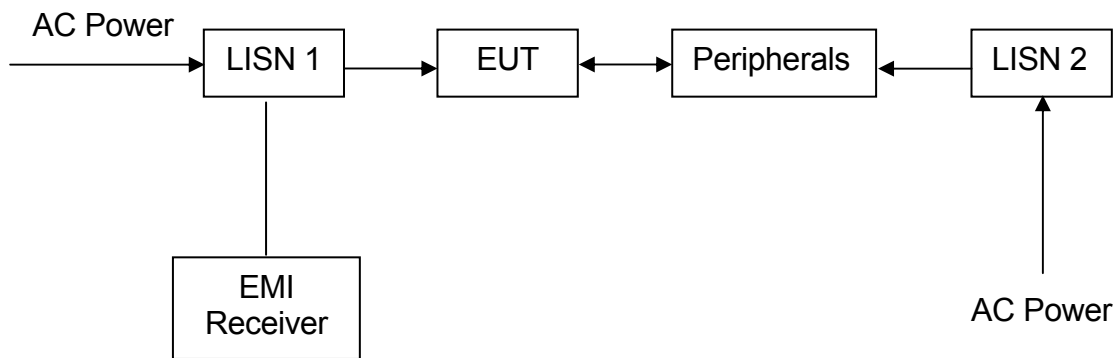
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8.4.2 Conducted Emission Test Procedures

For tabletop equipment, the EUT along with its peripherals were placed on a 1.0m(W)×1.5m(L) and 0.8m in height wooden table. For floor-standing equipment, the EUT and all cables were insulated, if required, from the ground plane by up to 12 mm of insulating material. The EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane. The EUT was connected to power mains through a line impedance stabilization network (LISN), which provided 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. The excess power cable between the EUT and the LISN was bundled.

All connecting cables of EUT and peripherals were moved to find the maximum emission.

8.4.3 Conducted Emission Test Setup



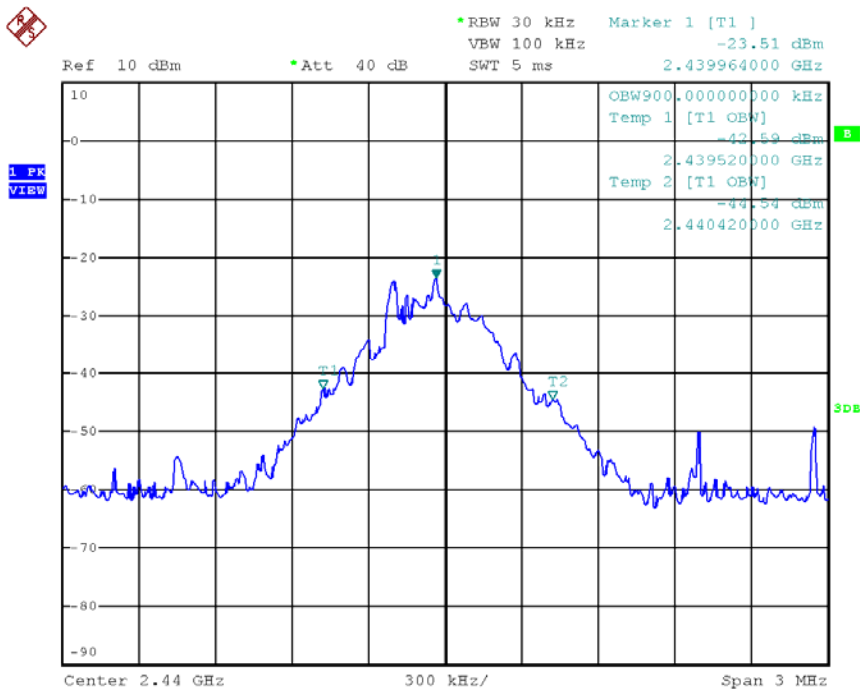
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8.5 Occupied Bandwidth

Occupied Bandwidth Results: (Bluetooth 3.0)

Bluetooth (MHz)	Occupied Bandwidth (kHz)
Low Channel: 2402	864
Middle Channel: 2440	900
High Channel: 2480	858

The worst case is shown as below

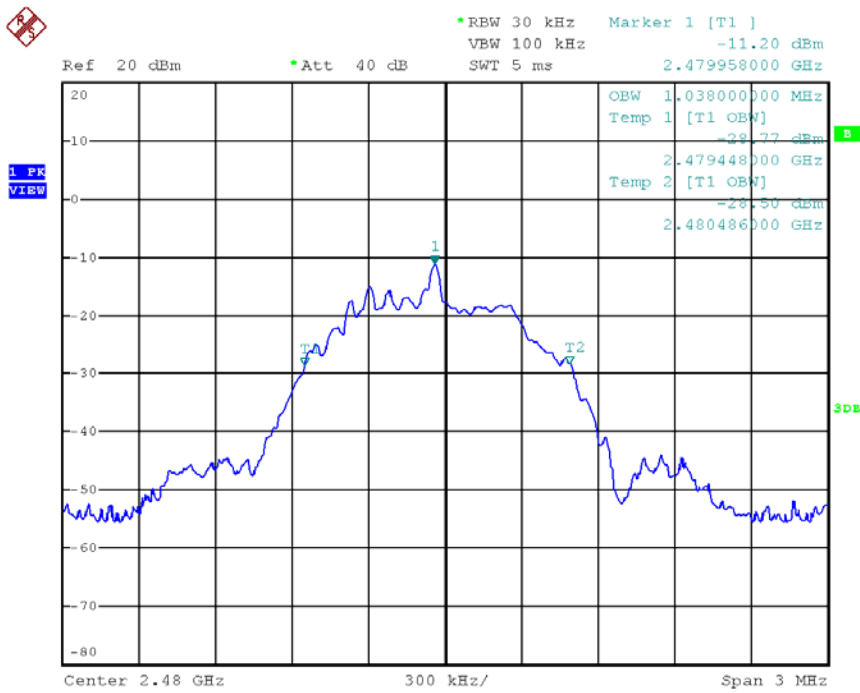


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Occupied Bandwidth Results: (Bluetooth 4.0 BLE)

Bluetooth (MHz)	Occupied Bandwidth (kHz)
Low Channel: 2402	1038
Middle Channel: 2440	1038
High Channel: 2480	1038

The worst case is shown as below



TEST REPORT

9.0 CONFIDENTIALITY REQUEST

For electronic filing, a preliminary copy of the confidentiality request is saved with filename: request.pdf.

10.0 EQUIPMENT LIST

1) Radiated Emissions Test

Equipment	EMI Test Receiver (9kHz to 3GHz)	Spectrum Analyzer	Biconical Antenna
Registration No.	EW-3156	EW-3281	EW-0571
Manufacturer	ROHDESCHWARZ	ROHDESCHWARZ	EMCO
Model No.	ESR26	FSV40	3104C
Calibration Date	September 30, 2020	March 04, 2020	July 23, 2019
Calibration Due Date	September 30, 2021	March 04, 2021	January 23, 2021

Equipment	Log Periodic Antenna	Double Ridged Guide Antenna	RF Cable 14m (1GHz to 26.5GHz)
Registration No.	EW-0447	EW-0194	EW-3151
Manufacturer	EMCO	EMCO	GREATBILLION
Model No.	3146	3115	SMA m/SHF5MPU /SMA m ra14m,26G
Calibration Date	September 25, 2019	September 26, 2019	March 04, 2020
Calibration Due Date	March 25, 2021	March 26, 2021	March 04, 2021

Equipment	14m Double Shield RF Cable (20MHz To 6GHz)	Active Loop H-field (9kHz to 30MHz)	Pyramidal Horn Antenna
Registration No.	EW-2074	EW-2313	EW-0905
Manufacturer	RADIALL	ELECTROMETRI	EMCO
Model No.	nm / RG142 / sma 14m	EM-6876	3160-09
Calibration Date	August 29, 2020	December 17, 2019	July 23, 2019
Calibration Due Date	August 29, 2021	June 17, 2021	January 23, 2021

2) Conducted Emissions Test

Equipment	EMI Test Receiver	Artificial Mains Network	RF Cable 80cm (RG142) (9kHz to 30MHz)
Registration No.	EW-2500	EW-2501	EW-2453
Manufacturer	ROHDESCHWARZ	ROHDESCHWARZ	RADIALL
Model No.	ESCI	ENV-216	RF Cable 120cm (RG142) (9kHz to 30MHz)
Calibration Date	January 09, 2020	September 11, 2020	January 07, 2020
Calibration Due Date	January 09, 2021	September 11, 2021	January 07, 2021

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3) Bandedge/Bandwidth Measurement

Equipment	14m Double Shield RF Cable (20MHz To 6GHz)	Spectrum Analyzer
Registration No.	EW-2074	EW-2329
Manufacturer	RADIALL	ROHDESCHWARZ
Model No.	nm / RG142 / sma 14m	FSP3
Calibration Date	August 29, 2020	September 17, 2020
Calibration Due Date	August 29, 2021	September 17, 2021

END OF TEST REPORT