

TEST REPORT

Report No.: 24030609HKG-005

Dyson Inc

Application For Original Grant of 47 CFR Part 15 Certification

FCC ID: QVHWP02001

This report contains the data of Bluetooth BLE (1Mbps) only

Prepared and Checked by:

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Signed on File

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Date: April 03, 2024

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TEST REPORT

GENERAL INFORMATION

Grantee:	Dyson Inc
Grantee Address:	1330 W Fulton St 5th Fl, Chicago, Illinois, 60607, United States
FCC Specification Standard:	FCC Part 15, October 1, 2022 Edition
FCC ID:	QVHWP02001
FCC Model(s):	WP 02
Type of EUT:	Spread Spectrum Transmitter
Description of EUT:	Headphones
Brand Name:	dyson
Sample Receipt Date:	March 28, 2024
Date of Test:	March 28, 2024 to April 02, 2024
Report Date:	April 03, 2024
Environmental Conditions:	Temperature: +10 to 40°C Relative Humidity: 10 to 90%
Conclusion:	Test was conducted by client submitted sample. The submitted sample as received complied with the 47 CFR Part 15 Certification. This report contains the data of Bluetooth BLE (1Mbps) only

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SUMMARY OF TEST RESULT

Test Items	FCC Part 15 Section	Results
Antenna Requirement	15.203	Complied
Max. Conducted Output Power (Peak)	15.247(b)(3)&(4)	Complied
Min. 6dB RF Bandwidth	15.247(a)(2)	Complied
Max. Power Density (Average)	15.247(e)	Complied
Out of Band Antenna Conducted Emission	15.247(d)	Complied
Radiated Emission in Restricted Bands and Spurious Emissions	15.247(d), 15.209 & 15.109	Complied
AC Power Line Conducted Emission	15.207 & 15.107	Complied

Note: Pursuant to FCC Part 15 Section 15.215(c), the 20dB 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 expected variations in temperature and supply voltage were considered.

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

FCC Part 15, October 1, 2022 Edition

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EXHIBIT 1 GENERAL DESCRIPTION

1.1 Product Description

The Equipment Under Test (EUT), is a 2.4GHz Bluetooth Classic and Bluetooth BLE (1Mbps) Transceiver for a Bluetooth headset. For the Bluetooth Classic mode, the sample supplied operated on 79 channels, normally at 2402 – 2480MHz. The channels are separated with 1MHz spacing. For the Bluetooth BLE (1Mbps) mode, the sample supplied operated on 40 channels, normally at 2402 – 2480MHz. The channels are separated with 2MHz spacing.

The EUT is powered by 5.0VDC. After switching on the EUT, it can be paired up with a smartphone and will be used to play different sound based on the sound received from the paired smartphone.

The antenna(s) used in the EUT is integral, and the test sample is a prototype.

Peak Antenna Gain (Left Antenna): 1.02dBi

Peak Antenna Gain (Right Antenna): 2.43dBi

The circuit description is saved with filename: descri.pdf.

1.2 Test Methodology

Both AC power line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Preliminary radiated scans and all radiated measurements were performed in radiated emission test sites. All Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application. Antenna port conducted measurements were performed according to ANSI C63.10 (2013) and KDB Publication No. 558074 D01 v05r02 (April 02, 2019) All other measurements were made in accordance with the procedures in 47 CFR Part 2 and RSS-Gen Issue 5 Amendment 2, February 2021.

1.3 Test Facility

The radiated emission test site and antenna port conducted measurement facility used to collect the radiated data and conductive data are 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 fully placed on file with the FCC and Industry Canada No.: 2042H, CABID is "HKAP01".

1.4 Related Submittal(s) Grants

This is a single application for certification of a transceiver (Bluetooth BLE (1Mbps) Portion).

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EXHIBIT 2 SYSTEM TEST CONFIGURATION

2.1 Justification

For radiated emissions testing, the equipment under test (EUT) was setup to transmit / receive continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, all cables (if any) were manipulated to produce worst case emissions.

The EUT was powered by 5.0VDC during test.

For the measurements, the EUT was attached to a plastic stand if necessary and placed on the wooden turntable at 0.8m height from the ground plane for emission testing at or below 1GHz and 1.5m for emission measurements above 1GHz. If the base unit attached to peripherals, they were connected and operational (as typical as possible).

The signal was maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization were varied during the search for maximum signal level. The antenna height was varied from 1 to 4 meters. Radiated emissions were taken at three meters unless the signal level was too low for measurement at that distance. If necessary, a pre-amplifier was used and/or the test was conducted at a closer distance.

For any intentional radiator powered by AC power line, measurements of the radiated signal level of the fundamental frequency component of the emission was performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.

Radiated emission measurement for transmitter were performed 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 to 40 GHz, whichever is lower.

Emission that are directly caused by digital circuits in the transmit path and transmitter portion were measured, and the limit are according to FCC Part 15 Section 15.209. Digital circuitries used to control additional functions other than the operation of the transmitter are subject to FCC Part 15 Section 15.109 Limits.

Detector function for radiated emissions was in peak mode. Average readings, when required, were 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 section 4.8.3.

Determination of pulse desensitization was made according to *Hewlett Packard Application Note 150-2, Spectrum Analysis... Pulsed RF*. The effective period (Teff) was referred to Exhibit 4.8.3. With the resolution bandwidth 3MHz and spectrum analyzer IF bandwidth 3dB, the pulse desensitization factor was 0dB.

For AC power line-conducted emission test, the EUT along with its peripherals were placed on a 1.0m(W)x1.5m(L) and 0.8m in height wooden table and 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 50ohm coupling impedance for measuring instrument. The LISN housing, measuring instrument case, reference ground plane, and vertical ground plane were bounded together. The excess power cable between the EUT and the LISN was bundled.

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

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

For simultaneous transmission, both Left and Right Antenna are also transmitting when taking radiated emission for determining worst-case spurious emission.

2.2 EUT Exercising Software

The EUT exercise program (Non Signaling Test Tool(20201203)) used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use.

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2.3 Details of EUT and Description of 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.

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.

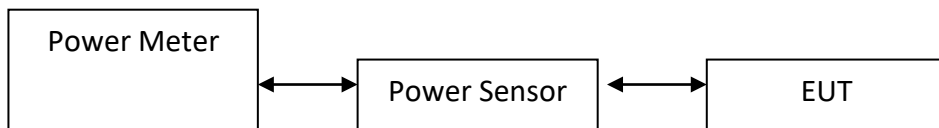
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EXHIBIT 3 TEST RESULTS

3.1 Maximum Conducted (Peak) Output Power at Antenna Terminals

RF Conduct Measurement Test Setup

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



The antenna port of the EUT was connected to the input of a spectrum analyzer.

- ☒ The antenna power of the EUT was connected to the input of a power meter. Power was read directly and cable loss correction was added to the reading to obtain power at the EUT antenna terminals. The measurement procedure 8.3.2.3 was used.
- ☐ The EUT should be configured to transmit continuously (at a minimum duty cycle of 98%) at full power over the measurement duration. The measurement procedure AVG1 was used.

Left Antenna (BLE, 1 Mbps) Peak Antenna Gain = 1.02 dBi (Refer to Test Data3.pdf)

Frequency (MHz)	Output in dBm	Output in mW
Low Channel: 2402 (P.9)	3.30	2.1
Middle Channel: 2440 (P.28)	5.15	3.3
High Channel: 2480 (P.45)	4.31	2.7

Right Antenna (BLE, 1 Mbps) Peak Antenna Gain = 2.43 dBi (Refer to Test Data4.pdf)

Frequency (MHz)	Output in dBm	Output in mW
Low Channel: 2402 (P.9)	4.54	2.8
Middle Channel: 2440 (P.28)	5.52	3.6
High Channel: 2480 (P.45)	4.38	2.7

Cable loss: 0.5 dB External Attenuation: 0 dB

Cable loss, external attenuation: ☒ included in OFFSET function
☐ added to SA raw reading

Left Antenna (BLE, 1 Mbps)

Max. Conducted (Peak) Output Level = 5.15 dBm

Right Antenna (BLE, 1 Mbps)

Max. Conducted (Peak) Output Level = 5.52 dBm

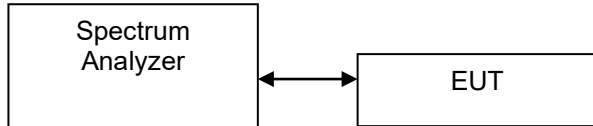
Limits:

1W (30dBm) for antennas with gains of 6dBi or less.

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3.2 Minimum 6dB RF Bandwidth

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



The antenna port of the EUT was connected to the input of a spectrum analyzer. The EBW measurement procedure was used. A PEAK output reading was taken, a DISPLAY line was drawn 6dB lower than PEAK level. The 6dB bandwidth was determined from where the channel output spectrum intersected the display line.

Left Antenna (BLE, 1 Mbps) (Refer to Test Data3.pdf)

Frequency (MHz)	6dB Bandwidth (kHz)
Low Channel: 2402 (P.4)	673.268
Middle Channel: 2440 (P.26)	693.070
High Channel: 2480 (P.43)	693.070

Right Antenna (BLE, 1 Mbps) (Refer to Test Data4.pdf)

Frequency (MHz)	6dB Bandwidth (kHz)
Low Channel: 2402 (P.4)	732.674
Middle Channel: 2440 (P.26)	732.674
High Channel: 2480 (P.43)	712.872

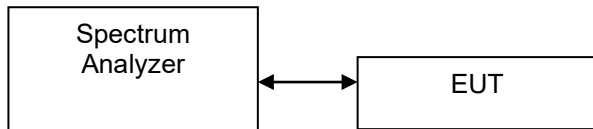
Limits:

6dB bandwidth shall be at least 500kHz.

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3.3 Minimum Power Spectral Density

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



Antenna output of the EUT was coupled directly to spectrum analyzer. The measurement procedure 10.2 PKPSD was used. If an external attenuator and/or cable was used, these losses are compensated for using the OFFSET function of the analyser.

Left Antenna (BLE, 1 Mbps) (Refer to Test Data3.pdf)

Frequency (MHz)	PSD in 100kHz (dBm)
Low Channel: 2402 (P.10)	4.348
Middle Channel: 2440 (P.32)	5.219
High Channel: 2480 (P.49)	4.319

Right Antenna (BLE, 1 Mbps) (Refer to Test Data4.pdf)

Frequency (MHz)	PSD in 100kHz (dBm)
Low Channel: 2402 (P.10)	4.845
Middle Channel: 2440 (P.32)	5.444
High Channel: 2480 (P.49)	3.631

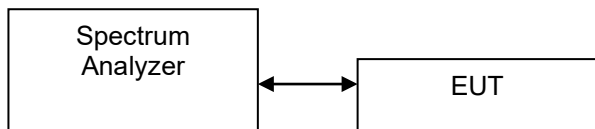
Cable Loss: 0.5dB

Limit: 8dBm in 3kHz

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3.4 Out of Band Conducted Emissions

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



The maximum conducted (peak) output power was used to demonstrate compliance as described in 9.1. Then the display line (in red) shown in the following plots denotes the limit at 20dB below maximum measured in-band peak PSD level in 100 KHz bandwidth.

The measurement procedures under sections 11 of KDB558074 D01 v05r02 (April 2, 2019) were used.

Furthermore, delta measurement technique for measuring bandedge emissions was incorporated in the test of the edge at 2483.5MHz.

Limits:

All spurious emission and up to the tenth harmonic was measured and they were found to be at least 20dB below the maximum measured in-band peak PSD level.

Left Antenna (BLE, 1 Mbps) (Refer to Test Data3.pdf)

Frequency (MHz)	Out of Band Conducted Emissions	Band Edge
Low Channel: 2402	P.18	P.12
Middle Channel: 2440	P.35	N/A
High Channel: 2480	P.57	P.51

Right Antenna (BLE, 1 Mbps) (Refer to Test Data4.pdf)

Frequency (MHz)	Out of Band Conducted Emissions	Band Edge
Low Channel: 2402	P.18	P.12
Middle Channel: 2440	P.35	N/A
High Channel: 2480	P.57	P.51

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3.5 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

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

Where	FS	=	Field Strength in dBμV/m
	RA	=	Receiver Amplitude (including preamplifier) in dBμV
	CF	=	Cable Attenuation Factor in dB
	AF	=	Antenna Factor in dB
	AG	=	Amplifier Gain in dB
	PD	=	Pulse Desensitization in dB
	AV	=	Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

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

Example:

Assume a receiver reading of 62.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29.0 dB is subtracted. The pulse desensitization factor of the spectrum analyzer is 0.0 dB, and the resultant average factor is -10.0 dB. The net field strength for comparison to the appropriate emission limit is 32.0 dBμV/m. This value in dBμV/m is converted to its corresponding level in μV/m.

$$\begin{aligned}
 RA &= 62.0 \text{ dB}\mu\text{V} \\
 AF &= 7.4 \text{ dB} \\
 CF &= 1.6 \text{ dB} \\
 AG &= 29.0 \text{ dB} \\
 PD &= 0.0 \text{ dB} \\
 AV &= -10.0 \text{ dB} \\
 FS &= 62.0 + 7.4 + 1.6 - 29.0 + 0.0 + (-10.0) = 32.0 \text{ dB}\mu\text{V/m}
 \end{aligned}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(32.0 \text{ dB}\mu\text{V/m})/20] = 39.8 \text{ } \mu\text{V/m}$$

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3.6 Transmitter Radiated Emissions in Restricted Bands and Spurious Emissions

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.

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

3.6.1 Radiated Emission Configuration Photograph

Worst Case Restricted Band Radiated Emission (Left Antenna) at 14412 MHz and 14640 MHz

Worst Case Restricted Band Radiated Emission (Right Antenna) at 14412 MHz

The worst case radiated emission configuration photographs are saved with filename:
Setup Photos.pdf

3.6.2 Radiated Emission Data

The data in tables 1-7 list the significant emission frequencies, the limit and the margin of compliance.

Judgement:

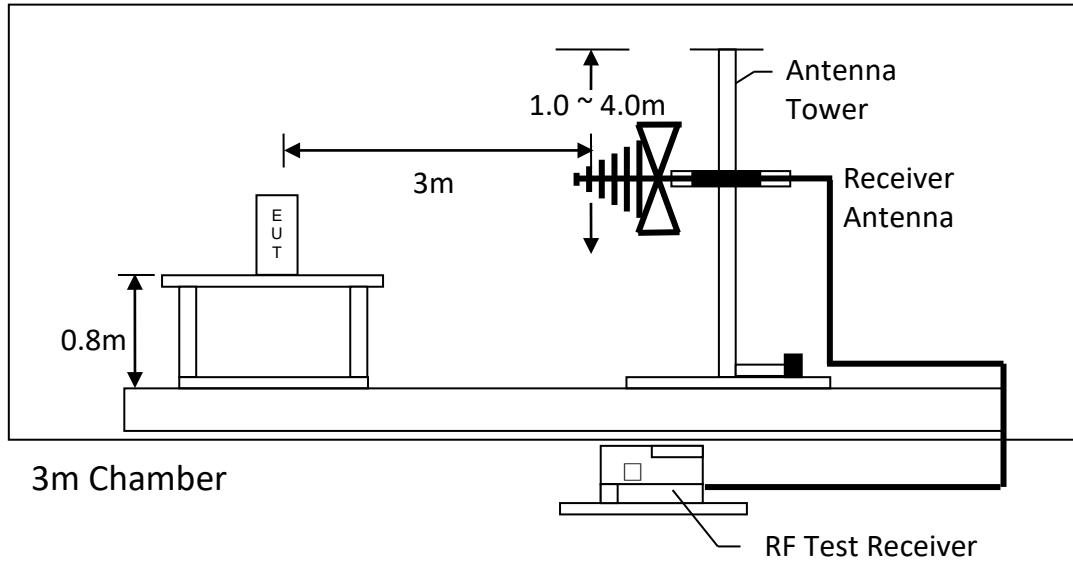
Left Antenna – Passed by 13.0 dB margin

Right Antenna –Passed by 12.6 dB margin

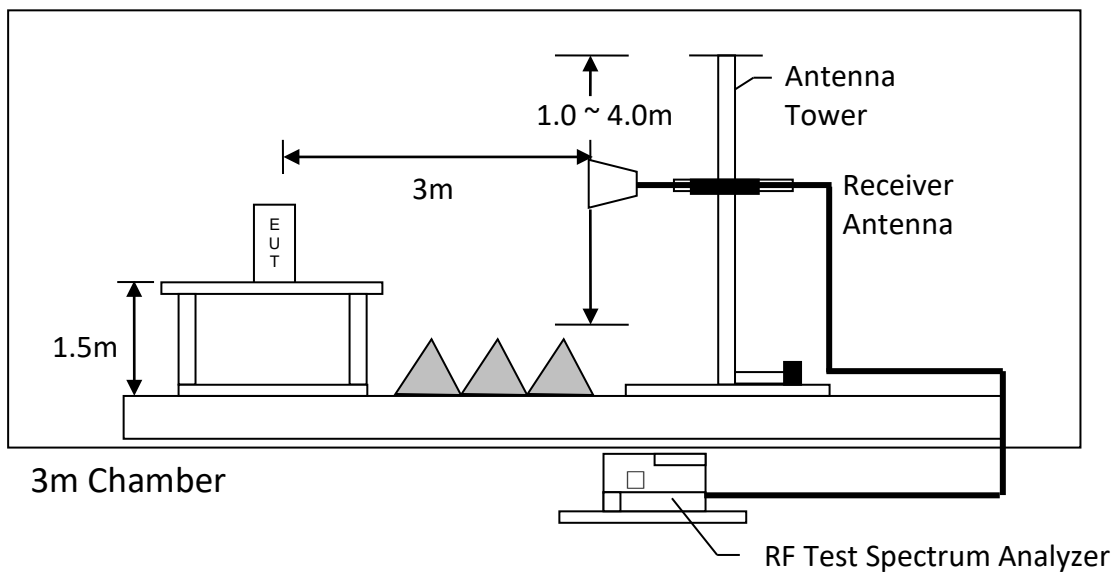
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3.6.3 Radiated Emission Test Setup

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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RADIATED EMISSION DATA

Mode: TX-Channel 2402

Table 1, Left Antenna BLE 1Mbps

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (average) (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
H	2390.000	43.0	33	29.4	39.4	54.0	-14.6
V	4804.000	27.1	33	34.9	29.0	54.0	-25.0
H	7206.000	28.1	33	37.9	33.0	54.0	-21.0
H	9608.000	27.4	33	40.4	34.8	54.0	-19.2
H	12010.000	29.9	33	40.5	37.4	54.0	-16.6
V	14412.000	34.0	33	40.0	41.0	54.0	-13.0

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)
H	2390.000	57.0	33	29.4	53.4	74.0	-20.6
V	4804.000	41.8	33	34.9	43.7	74.0	-30.3
H	7206.000	41.4	33	37.9	46.3	74.0	-27.7
H	9608.000	40.5	33	40.4	47.9	74.0	-26.1
H	12010.000	43.1	33	40.5	50.6	74.0	-23.4
V	14412.000	47.4	33	40.0	54.4	74.0	-19.6

- Notes:
1. Peak detector is used for the emission measurement.
 2. Average detector is used for the average data of emission measurement.
 3. All measurements were made at 3 meters.
 4. Negative value in the margin column shows emission below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205.
 7. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

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RADIATED EMISSION DATA

Mode: TX-Channel 2440

Table 2, Left Antenna BLE 1Mbps

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (average) (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
V	4880.000	26.7	33	34.9	28.6	54.0	-25.4
V	7320.000	28.2	33	37.9	33.1	54.0	-20.9
V	9760.000	28.4	33	40.4	35.8	54.0	-18.2
H	12200.000	30.3	33	40.5	37.8	54.0	-16.2
V	14640.000	35.6	33	38.4	41.0	54.0	-13.0

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	4880.000	39.7	33	34.9	41.6	74.0	-32.4
V	7320.000	41.5	33	37.9	46.4	74.0	-27.6
V	9760.000	41.7	33	40.4	49.1	74.0	-24.9
H	12200.000	43.8	33	40.5	51.3	74.0	-22.7
V	14640.000	49.2	33	38.4	54.6	74.0	-19.4

- Notes:
1. Peak detector is used for the emission measurement.
 2. Average detector is used for the average data of emission measurement.
 3. All measurements were made at 3 meters.
 4. Negative value in the margin column shows emission below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205.
 7. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

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RADIATED EMISSION DATA

Mode: TX-Channel 2480

Table 3, Left Antenna BLE 1Mbps

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (average) (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
V	2483.500	44.0	33	29.4	40.4	54.0	-13.6
H	4960.000	29.1	33	34.9	31.0	54.0	-23.0
H	7440.000	28.2	33	37.9	33.1	54.0	-20.9
H	9920.000	27.8	33	40.4	35.2	54.0	-18.8
H	12400.000	30.4	33	40.5	37.9	54.0	-16.1
H	14880.000	35.1	33	38.4	40.5	54.0	-13.5

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	2483.500	57.7	33	29.4	54.1	74.0	-19.9
H	4960.000	42.1	33	34.9	44.0	74.0	-30.0
H	7440.000	42.2	33	37.9	47.1	74.0	-26.9
H	9920.000	41.4	33	40.4	48.8	74.0	-25.2
H	12400.000	43.7	33	40.5	51.2	74.0	-22.8
H	14880.000	48.2	33	38.4	53.6	74.0	-20.4

- Notes:
1. Peak detector is used for the emission measurement.
 2. Average detector is used for the average data of emission measurement.
 3. All measurements were made at 3 meters.
 4. Negative value in the margin column shows emission below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205.
 7. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

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RADIATED EMISSION DATA

Mode: TX-Channel 2402

Table 4, Right Antenna BLE 1Mbps

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (average) (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
V	2390.000	43.1	33	29.4	39.5	54.0	-14.5
V	4804.000	26.9	33	34.9	28.8	54.0	-25.2
V	7206.000	27.8	33	37.9	32.7	54.0	-21.3
V	9608.000	28.8	33	40.4	36.2	54.0	-17.8
V	12010.000	29.8	33	40.5	37.3	54.0	-16.7
V	14412.000	34.4	33	40.0	41.4	54.0	-12.6

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	2390.000	56.4	33	29.4	52.8	74.0	-21.2
V	4804.000	40.1	33	34.9	42.0	74.0	-32.0
V	7206.000	41.0	33	37.9	45.9	74.0	-28.1
V	9608.000	42.1	33	40.4	49.5	74.0	-24.5
V	12010.000	44.2	33	40.5	51.7	74.0	-22.3
V	14412.000	47.6	33	40.0	54.6	74.0	-19.4

- Notes:
1. Peak detector is used for the emission measurement.
 2. Average detector is used for the average data of emission measurement.
 3. All measurements were made at 3 meters.
 4. Negative value in the margin column shows emission below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205.
 7. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

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RADIATED EMISSION DATA

Mode: TX-Channel 2440

Table 5, Right Antenna BLE 1Mbps

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (average) (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
H	4880.000	27.0	33	34.9	28.9	54.0	-25.1
V	7320.000	28.4	33	37.9	33.3	54.0	-20.7
V	9760.000	29.0	33	40.4	36.4	54.0	-17.6
V	12200.000	30.1	33	40.5	37.6	54.0	-16.4
H	14640.000	35.6	33	38.4	41.0	54.0	-13.0

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)
H	4880.000	40.1	33	34.9	42.0	74.0	-32.0
V	7320.000	42.1	33	37.9	47.0	74.0	-27.0
V	9760.000	41.8	33	40.4	49.2	74.0	-24.8
V	12200.000	43.2	33	40.5	50.7	74.0	-23.3
H	14640.000	49.0	33	38.4	54.4	74.0	-19.6

- Notes:
1. Peak detector is used for the emission measurement.
 2. Average detector is used for the average data of emission measurement.
 3. All measurements were made at 3 meters.
 4. Negative value in the margin column shows emission below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205.
 7. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

TEST REPORT

RADIATED EMISSION DATA

Mode: TX-Channel 2480

Table 6, Right Antenna BLE 1Mbps

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (average) (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
V	2483.500	44.2	33	29.4	40.6	54.0	-13.4
H	4960.000	27.7	33	34.9	29.6	54.0	-24.4
H	7440.000	28.3	33	37.9	33.2	54.0	-20.8
H	9920.000	27.7	33	40.4	35.1	54.0	-18.9
V	12400.000	30.2	33	40.5	37.7	54.0	-16.3
H	14880.000	35.0	33	38.4	40.4	54.0	-13.6

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	2483.500	57.9	33	29.4	54.3	74.0	-19.7
H	4960.000	41.2	33	34.9	43.1	74.0	-30.9
H	7440.000	41.8	33	37.9	46.7	74.0	-27.3
H	9920.000	42.1	33	40.4	49.5	74.0	-24.5
V	12400.000	43.6	33	40.5	51.1	74.0	-22.9
H	14880.000	48.9	33	38.4	54.3	74.0	-19.7

- Notes:
1. Peak detector is used for the emission measurement.
 2. Average detector is used for the average data of emission measurement.
 3. All measurements were made at 3 meters.
 4. Negative value in the margin column shows emission below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205.
 7. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

TEST REPORT

RADIATED EMISSION DATA

Mode: Normal Operating

Table 7, Left and Right Antenna

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
V	49.699	27.1	16	11.0	22.1	40.0	-17.9
V	116.905	25.7	16	14.0	23.7	43.5	-19.8
H	176.794	21.1	16	19.0	24.1	43.5	-19.4
V	214.233	18.0	16	17.0	19.0	43.5	-24.5
H	334.628	23.4	16	24.0	31.4	46.0	-14.6
H	341.936	22.5	16	24.0	30.5	46.0	-15.5

- Notes:
1. Quasi-Peak detector are used for the emission measurement.
 2. All measurements were made at 3 meters.
 3. Negative value in the margin column shows emission below limit.
 4. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205.
 5. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

TEST REPORT

3.7 Transmitter Duty Cycle Calculation

Not Applicable – No average factor is required

3.8 AC Power Line Conducted Emission

- ☐ Not Applicable – EUT is only powered by battery for operation.
- ☒ EUT connects to AC power line. Emission Data is listed in following pages.
- ☐ Base Unit connects to AC power line and has transmission. Handset connects to AC power line but has no transmission. Emission Data of Base Unit is listed in following pages.

3.8.1 AC Power Line Conducted Emission Configuration Photograph

Worst Case Line-Conducted Configuration at 0.150 MHz.

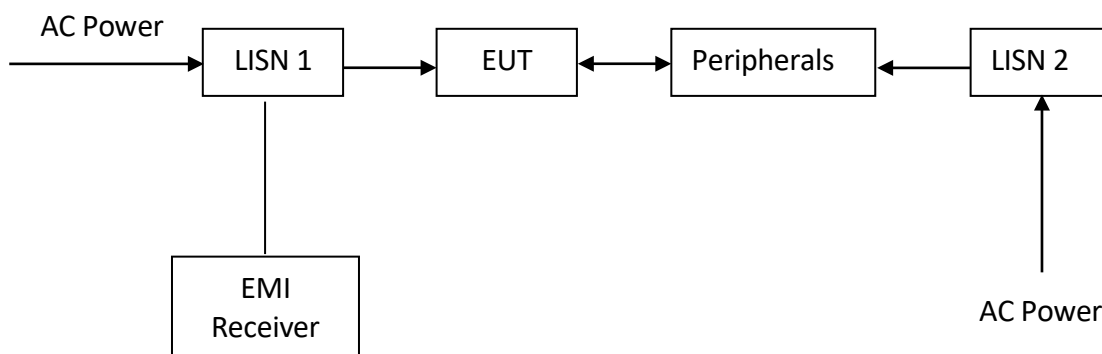
The worst-case line conducted configuration photographs are attached in the Appendix and saved with filename: Setup Photos.pdf.

3.8.2 AC Power Line Conducted Emission Data

The plot(s) and data in the following pages list the significant emission frequencies, the limit and the margin of compliance.

Passed by 11.5 dB margin

3.8.3 Conducted Emission Test Setup



The EUT along with its peripherals were placed on a 1.0m(W)×1.5m(L) and 0.8m in height wooden table and 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.

TEST REPORT

AC POWER LINE CONDUCTED EMISSION

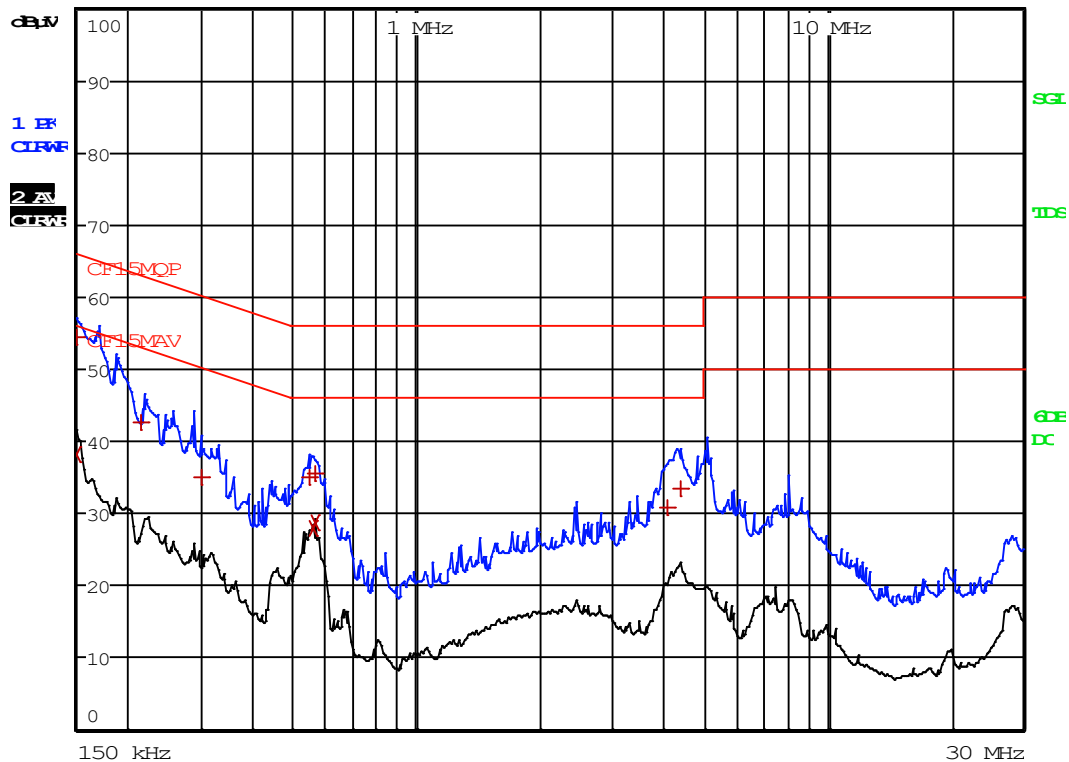
Worst Case: Normal Operating



RBW 9 kHz

MT 1 s

Att 10 dB AUTOC PREAMP OFF



TEST REPORT

AC POWER LINE CONDUCTED EMISSION

Worst Case: Normal Operating

EDIT PEAK LIST (Final Measurement Results)

Trace1: CF15MQP

Trace2: CF15MAV

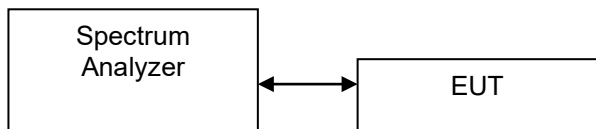
Trace3: ---

	TRACE	FREQUENCY	LEVEL dBμV	DELTA LIMIT dB
1	Quasi Peak	150 kHz	54.52 L1	-11.47
2	CISPR Average	150 kHz	38.13 L1	-17.86
1	Quasi Peak	217.5 kHz	42.64 N	-20.27
1	Quasi Peak	298.5 kHz	34.93 L1	-25.35
1	Quasi Peak	550.5 kHz	35.16 N	-20.83
2	CISPR Average	559.5 kHz	28.06 L1	-17.93
1	Quasi Peak	568.5 kHz	35.46 L1	-20.53
2	CISPR Average	568.5 kHz	28.78 L1	-17.21
1	Quasi Peak	4.1055 MHz	30.84 L1	-25.15
1	Quasi Peak	4.398 MHz	33.59 L1	-22.40

TEST REPORT

OCCUPIED BANDWIDTH

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



Occupied Bandwidth Results: (Left Antenna) (Refer to Test Data3.pdf)

Frequency (MHz)	Occupied Bandwidth (MHz)
Low Channel: 2402 (P.6)	1023
Middle Channel: 2440 (P.29)	1023
High Channel: 2480 (P.46)	1023

Occupied Bandwidth Results: (Right Antenna) (Refer to Test Data4.pdf)

Frequency (MHz)	Occupied Bandwidth (MHz)
Low Channel: 2402 (P.6)	1008
Middle Channel: 2440 (P.29)	1023
High Channel: 2480 (P.46)	1023

TEST REPORT

EXHIBIT 4 EQUIPMENT LIST

1) Radiated Emissions Test

Equipment	EMI Test Receiver (9kHz to 26.5GHz)	Biconical Antenna (30MHz to 300MHz)	Log Periodic Antenna
Registration No.	EW-3156	EW-3241	EW-3244
Manufacturer	ROHDESCHWARZ	EMCO	EMCO
Model No.	ESR26	3110C	3148B
Calibration Date	January 31, 2024	February 26, 2022	August 30, 2022
Calibration Due Date	January 31, 2025	May 26, 2024	May 30, 2024

Equipment	Double Ridged Guide Antenna (1GHz - 18GHz)	Active Loop Antenna (H-field) (9kHz to 30MHz)	RF Preamplifier (9kHz to 6000MHz)
Registration No.	EW-0194	EW-3326	EW-3006b
Manufacturer	EMCO	EMCO	SCHWARZBECK
Model No.	3115	6502	BBV9718
Calibration Date	May 10, 2023	January 05, 2024	October 20, 2023
Calibration Due Date	November 10, 2024	July 05, 2025	October 20, 2024

Equipment	2.4GHz Notch Filter	14m Double Shield RF Cable (9kHz - 6GHz)	RF Cable 14m (1GHz to 26.5GHz)
Registration No.	EW-3435	EW-2376	EW-2781
Manufacturer	MICROWAVE	RADIALL	GREATBILLION
Model No.	N0324413	n m/br56/bnc m 14m	SMA m/SHF5MPU /SMA m ra14m,26G
Calibration Date	September 26, 2023	September 19, 2023	January 16, 2024
Calibration Due Date	September 26, 2024	September 19, 2024	January 16, 2025

Equipment	12 metre RF Cable (1-40)GHz	Pyramidal Horn Antenna
Registration No.	EW-2774	EW-0905
Manufacturer	GREATBILLION	EMCO
Model No.	SMA m-m ra 12m 40G outdoor	3160-09
Calibration Date	January 16, 2024	December 15, 2023
Calibration Due Date	January 16, 2025	June 15, 2025

TEST REPORT

EXHIBIT 4 EQUIPMENT LIST (CONT'D)

2) Conducted Emissions Test

Equipment	RF Cable 240cm (RG142) (9kHz to 30MHz)	Artificial Mains Network	EMI Test Receiver (9kHz to 3GHz)
Registration No.	EW-2454	EW-3360	EW-3095
Manufacturer	RADIALL	ROHDESCHWARZ	ROHDESCHWARZ
Model No.	Bnc m st / 142 / bnc mra 240cm	ENV-216	ESCI
Calibration Date	June 13, 2023	April 25, 2023	January 18, 2024
Calibration Due Date	June 13, 2024	April 24, 2024	January 18, 2025

3) Conductive Measurement Test

Equipment	RF Power Meter with Power Sensor (N1921A)	EMI Test Receiver (9kHz to 26.5GHz)
Registration No.	EW-3309	EW-3156
Manufacturer	ROHDESCHWARZ	ROHDESCHWARZ
Model No.	NRP-Z81	ESR26
Calibration Date	February 14, 2023	January 31, 2024
Calibration Due Date	May 14, 2024	January 31, 2025

4) Control Software for Radiated Emission

Software Information	
Software Name	EMC32
Manufacturer	ROHDESCHWARZ
Software version	10.50.40

END OF TEST REPORT