

LIGHTUPTOYS.COM LLC

# TEST REPORT

**SCOPE OF WORK**

FCC TESTING—101Q323U033

**REPORT NUMBER**

SZHH01756056-001

**ISSUE DATE**

Dec 29, 2022

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**LIGHTUPTOYS.COM LLC****Application For Certification****FCC ID: 2A9OKPYMANT-B****WSW23 PYM Tech Ant Man****Model: 101Q323U033****2.4GHz Transceiver****Report No.: SZHH01756056-001**

We hereby certify that the sample of the above item is considered to comply with the requirements of FCC Part 15, Subpart C for Intentional Radiator, mention 47 CFR [10-1-21]

Prepared and Checked by:

Approved by:

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Assistant Supervisor

---

*Peter Kang*  
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Date: Dec 29, 2022

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**MEASUREMENT/TECHNICAL REPORT**

This report concerns (check one):      Original Grant       Class II Change

Equipment Type: DXX - Part 15 Low Power Communication Device Transmitter

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)?      Yes       No

If yes, defer until: \_\_\_\_\_  
date

Company Name agrees to notify the Commission by: \_\_\_\_\_  
date  
of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37?      Yes       No

If no, assumed Part 15, Subpart C for intentional radiator – the new 47 CFR [10-1-20 Edition] provision.

Report prepared by:

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**Table of Contents**

<b>1.0 Summary of Test Result</b> .....	4
<b>2.0 General Description</b> .....	5
2.1 Product Description .....	5
2.2 Related Submittal(s) Grants .....	5
2.3 Test Methodology .....	5
2.4 Test Facility.....	5
<b>3.0 System Test Configuration</b> .....	6
3.1 Justification .....	6
3.2 EUT Exercising Software .....	6
3.3 Special Accessories .....	6
3.4 Equipment Modification.....	6
3.5 Measurement Uncertainty .....	7
3.6 Support Equipment List and Description .....	7
<b>4.0 Emission Results</b> .....	8
4.1 Radiated Test Results .....	8
4.1.1 Field Strength Calculation .....	8
4.1.2 Radiated Emission Configuration Photograph .....	9
4.1.3 Radiated Emissions .....	9
4.1.4 Transmitter Spurious Emissions .....	12
<b>5.0 Equipment Photographs</b> .....	16
<b>6.0 Product Labelling</b> .....	16
<b>7.0 Technical Specifications</b> .....	16
<b>8.0 Instruction Manual</b> .....	16
<b>9.0 Miscellaneous Information</b> .....	17
9.1 Bandedge Plot .....	17
9.2 20dB Bandwidth.....	20
9.3 Discussion of Pulse Desensitization .....	21
9.4 Calculation of Average Factor.....	21
9.5 Emissions Test Procedures.....	22
<b>10.0 Test Equipment List</b> .....	24

**1.0 Summary of Test Result**

Applicant: LIGHTUPTOYS.COM LLC

Applicant Address: 8512 COMMERCE PARK DRIVE, SELLERSBURG, Indiana United States

MODEL: 101Q323U033

FCC ID: 2A9OKPBMANT-B

Test Specification	Reference	Results
Transmitter Radiated Emission Band edge	15.249 &15.209 &15.205	Pass
20dB Bandwidth	15.215(c)	Pass

Notes: The EUT uses an Integral Antenna which in accordance to Section 15.203 is considered sufficient to comply with the provisions of this section.

**2.0 General Description****2.1 Product Description**

The equipment under test (EUT) is a WSW23 PYM Tech Ant Man with Bluetooth 5.0 (Single Mode EDR) function operating in 2402-2480MHz. The EUT is powered by DC 9.0V(6 x 1.5V AA batteries). For more detail information pls. refer to the user manual.

Antenna Type: Integral antenna

Modulation Type: GFSK,  $\pi/4$ -DQPSK and 8-DPSK

Antenna Gain: 0dBi Max

Bluetooth Version: 5.0 (Single Mode EDR)

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

**2.2 Related Submittal(s) Grants**

This is an application for certification of a transceiver for the WSW23 PYM Tech Ant Man which has Bluetooth function, and related report for FCC SDOC is subjected to report number: SZHH01756056-002 and the corresponding unit which associated with this EUT is subjected to FCC certification with FCC ID: 2A9OKPYMANT-A.

**2.3 Test Methodology**

Radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Radiated emission measurement was performed in Semi-anechoic chamber. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the 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. All other measurements were made in accordance with the procedures in part 2 of CFR 47.

**2.4 Test Facility**

The Semi-Anechoic chamber used to collect the radiated data is **Intertek Testing Services Shenzhen Ltd. Longhua Branch** and located at 101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community, GuanHu Subdistrict, LongHua District, Shenzhen, P.R. China. This test facility and site measurement data have been fully placed on file with the FCC (Registration Number: CN1188).

## 3.0 System Test Configuration

### 3.1 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 EUT is powered by DC 9.0V(6 x 1.5V AA batteries) during the test, only the worst data was reported in this report.

All packets DH1, DH3 & DH5 mode in modulation type GFSK,  $\pi/4$ -DQPSK and 8-DPSK were tested and only the worst data was reported in this report.

For maximizing emissions below 30 MHz, the EUT was rotated through 360°, the bottom of the loop antenna was placed 1 meter above the ground, and the antenna polarization was changed. 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 Section 4.

The EUT and transmitting antenna was centered on the turntable.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was placed on a turn table, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

### 3.2 EUT Exercising Software

The EUT exercise program (provided by client) used during testing was designed to exercise the various system components in a manner similar to a typical use.

Test software: FCC\_assist\_1.0.2.2

### 3.3 Special Accessories

No special accessories used.

### 3.4 Equipment Modification

Any modifications installed previous to testing by LIGHTUPTOYS.COM LLC will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Longhua Branch.

**3.5 Measurement Uncertainty**

When determining the test conclusion, the Measurement Uncertainty of test has been considered.

**3.6 Support Equipment List and Description**

Description	Manufacturer	Remark
Battery box (Provided by Applicant)	Provided by Applicant	FAC-014191-22102
Ant Man (Provided by Applicant)	Provided by Applicant	N/A

**4.0 Emission Results**

Data is included worst-case configuration (the configuration which resulted in the highest emission levels).

**4.1 Radiated Test Results**

A sample calculation, configuration photographs and data tables of the emissions are included.

**4.1.1 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 dB $\mu$ V/m

                  RA = Receiver Amplitude (including preamplifier) in dB $\mu$ V

                  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:

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

Assume a receiver reading of 62.0 dB $\mu$ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB, and the resultant average factor was -10 dB. The net field strength for comparison to the appropriate emission limit is 32 dB $\mu$ V/m. This value in dB $\mu$ V/m was converted to its corresponding level in  $\mu$ V/m.

$$RA = 62.0 \text{ dB}\mu\text{V}$$

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

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

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

$$PD = 0 \text{ dB}$$

$$AV = -10 \text{ dB}$$

$$FS = 62 + 7.4 + 1.6 - 29 + 0 = 42 \text{ dB}\mu\text{V/m}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(42 \text{ dB}\mu\text{V/m})/20] = 125.9 \mu\text{V/m}$$

**4.1.2 Radiated Emission Configuration Photograph**

For electronic filing, the worst case radiated emission configuration photograph is saved with filename: radiated photos. pdf.

**4.1.3 Radiated Emissions**

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.

Worst Case Radiated Emission  
at  
214.760000 MHz

Judgement: Passed by 5.6 dB

***TEST PERSONNEL:***

*Sign on file*

Terry Tang, Assistant Supervisor  
*Typed/Printed Name*

Dec 26, 2022

*Date*

Applicant: LIGHTUPTOYS.COM LLC

Date of Test: Dec 26, 2022

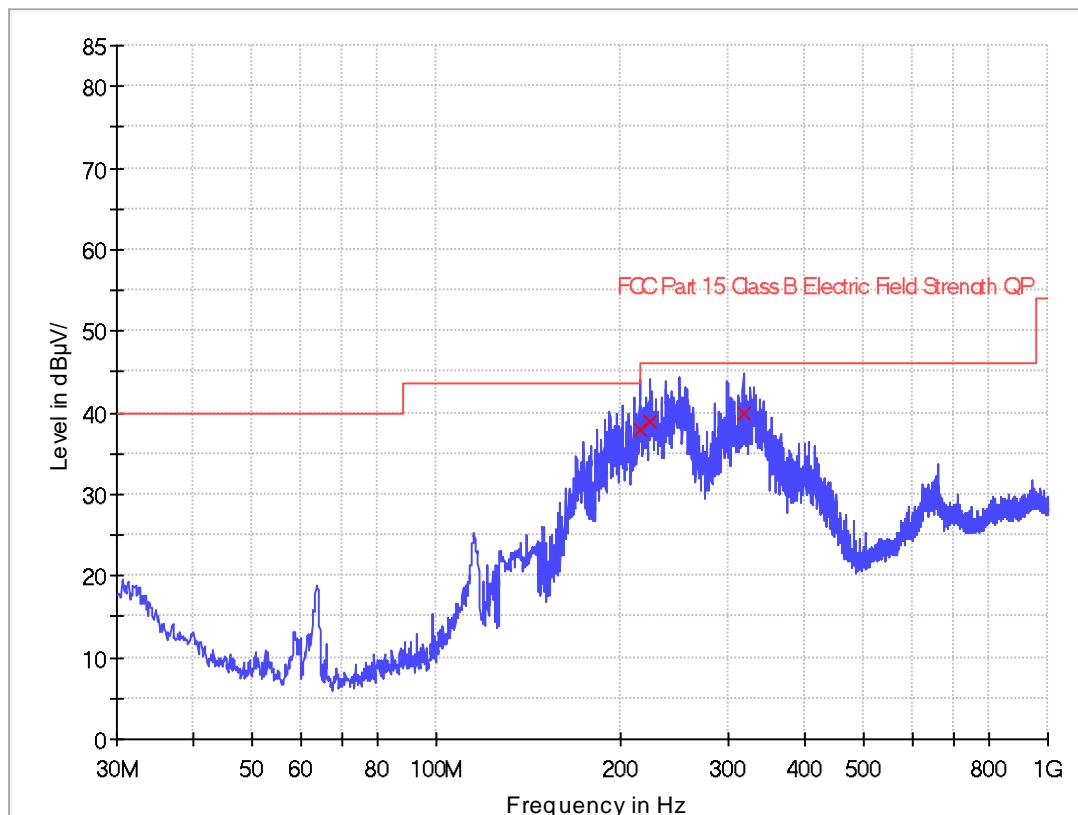
Model: 101Q323U033

Worst Case Operating Mode:

BT Link

ANT Polarity: Horizontal

FCC Part 15



Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dB $\mu$ V/m)
214.760000	37.9	1000.0	120.000	H	13.1	5.6	43.5
223.757500	38.8	1000.0	120.000	H	13.5	7.2	46.0
317.362500	39.8	1000.0	120.000	H	16.9	6.2	46.0

Remark:

1. Corr. (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB)
2. Quasi Peak (dB $\mu$ V/m) = Corr. (dB/m) + Read Level (dB $\mu$ V)
3. Margin (dB) = Limit Line (dB $\mu$ V/m) – Level (dB $\mu$ V/m)

Applicant: LIGHTUPTOYS.COM LLC

Date of Test: Dec 26, 2022

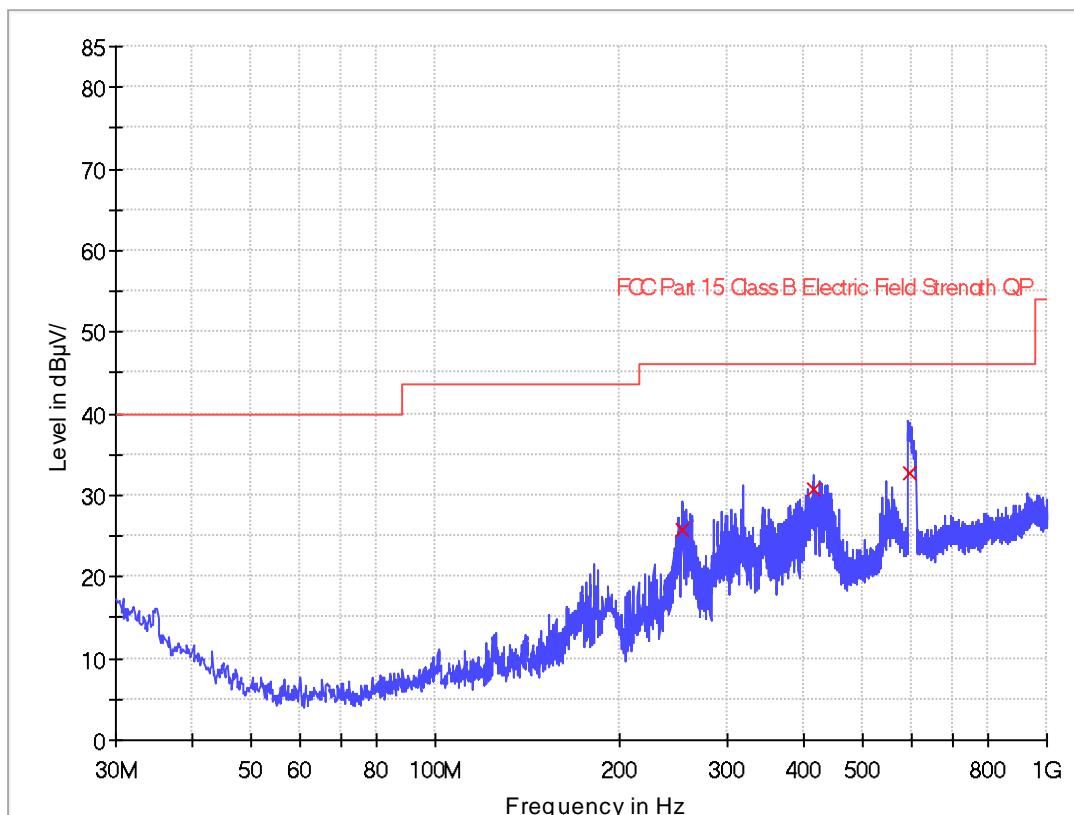
Model: 101Q323U033

Worst Case Operating Mode:

BT Link

ANT Polarity: Vertical

FCC Part 15



Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dB $\mu$ V/m)
253.585000	25.7	1000.0	120.000	V	15.1	20.3	46.0
414.560000	30.7	1000.0	120.000	V	20.1	15.3	46.0
595.752500	32.7	1000.0	120.000	V	23.5	13.3	46.0

Remark:

1. Corr. (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB)
2. Quasi Peak (dB $\mu$ V/m) = Corr. (dB/m) + Read Level (dB $\mu$ V)
3. Margin (dB) = Limit Line (dB $\mu$ V/m) – Level (dB $\mu$ V/m)

**4.1.4 Transmitter Spurious Emissions (Radiated)**

Worst Case Radiated Emission  
at  
4960.000 MHz

For electronic filing, the worst case radiated emission configuration photograph is saved with filename: radiated photos. pdf.

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.

Judgement: Passed by 22.9 dB

***TEST PERSONNEL:***

*Sign on file*

Terry Tang, Assistant Supervisor  
*Typed/Printed Name*

Dec 26, 2022

*Date*

Applicant: LIGHTUPTOYS.COM LLC

Date of Test: Dec 26, 2022

Worst Case Operating Mode:

Model: 101Q323U033

Transmitting

Table 1

**Radiated Emissions**

(2402MHz)

Polarization	Frequency (MHz)	Reading (dB $\mu$ V)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Net at 3m (dB $\mu$ V/m)	Peak Limit at 3m (dB $\mu$ V/m)	Margin (dB)
Horizontal	2402.000	84.3	36.7	28.1	75.7	114.0	-38.3
Horizontal	4804.000	51.0	36.7	35.5	49.8	74.0	-24.2

Polarization	Frequency (MHz)	Reading (dB $\mu$ V)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Average Factor (-dB)	Net at 3m (dB $\mu$ V/m)	Average Limit at 3m (dB $\mu$ V/m)	Margin (dB)
Horizontal	2402.000	84.3	36.7	28.1	22.5	53.2	94.0	-40.8
Horizontal	4804.000	51.0	36.7	35.5	22.5	27.3	54.0	-26.7

Notes: 1. Peak detector is used for the emission measurement.

2. All measurements were made at 3 meter. Harmonic emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz.

Applicant: LIGHTUPTOYS.COM LLC

Date of Test: Dec 26, 2022

Worst Case Operating Mode:

Model: 101Q323U033

Transmitting

Table 2

**Radiated Emissions**

(2441MHz)

Polarization	Frequency (MHz)	Reading (dB $\mu$ V)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Net at 3m (dB $\mu$ V/m)	Peak Limit at 3m (dB $\mu$ V/m)	Margin (dB)
Horizontal	2441.000	83.5	36.7	28.1	74.9	114.0	-39.1
Horizontal	4882.000	49.9	36.7	35.5	48.7	74.0	-25.3

Polarization	Frequency (MHz)	Reading (dB $\mu$ V)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Average Factor (-dB)	Net at 3m (dB $\mu$ V/m)	Average Limit at 3m (dB $\mu$ V/m)	Margin (dB)
Horizontal	2441.000	83.5	36.7	28.1	22.5	52.4	94.0	-41.6
Horizontal	4882.000	49.9	36.7	35.5	22.5	26.2	54.0	-27.8

Notes: 1. Peak detector is used for the emission measurement.

2. All measurements were made at 3 meter. Harmonic emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz.

Applicant: LIGHTUPTOYS.COM LLC

Date of Test: Dec 26, 2022

Worst Case Operating Mode:

Model: 101Q323U033

Transmitting

**Table 3****Radiated Emissions**

(2480MHz)

Polarization	Frequency (MHz)	Reading (dB $\mu$ V)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Net at 3m (dB $\mu$ V/m)	Peak Limit at 3m (dB $\mu$ V/m)	Margin (dB)
Horizontal	2480.000	85.6	36.7	28.1	77.0	114.0	-37.0
Horizontal	4960.000	52.3	36.7	35.5	51.1	74.0	-22.9

Polarization	Frequency (MHz)	Reading (dB $\mu$ V)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Average Factor (-dB)	Net at 3m (dB $\mu$ V/m)	Average Limit at 3m (dB $\mu$ V/m)	Margin (dB)
Horizontal	2480.000	85.6	36.7	28.1	22.5	54.5	94.0	-39.5
Horizontal	4960.000	52.3	36.7	35.5	22.5	28.6	54.0	-25.4

Notes: 1. Peak detector is used for the emission measurement.

2. All measurements were made at 3 meter. Harmonic emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz.

## 5.0 Equipment Photographs

For electronic filing, the photographs of the tested EUT are saved with filename: external photos.pdf & internal photos.pdf.

## 6.0 Product Labelling

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

## 7.0 Technical Specifications

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

## 8.0 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.

## 9.0 Miscellaneous Information

This miscellaneous information includes details of the measured bandedge, 20dB Bandwidth, the test procedure and calculation of factor such as pulse desensitization.

### 9.1 Bandedge Plot

The test plots are attached as below. From the below plots, the field strength of any emissions outside of the specified frequency band are attenuated to the general radiated emission limits in section 15.209. It fulfils the requirement of 15.249(d).

#### Peak Measurement

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

##### **(i) Lower channel 2402.000MHz:**

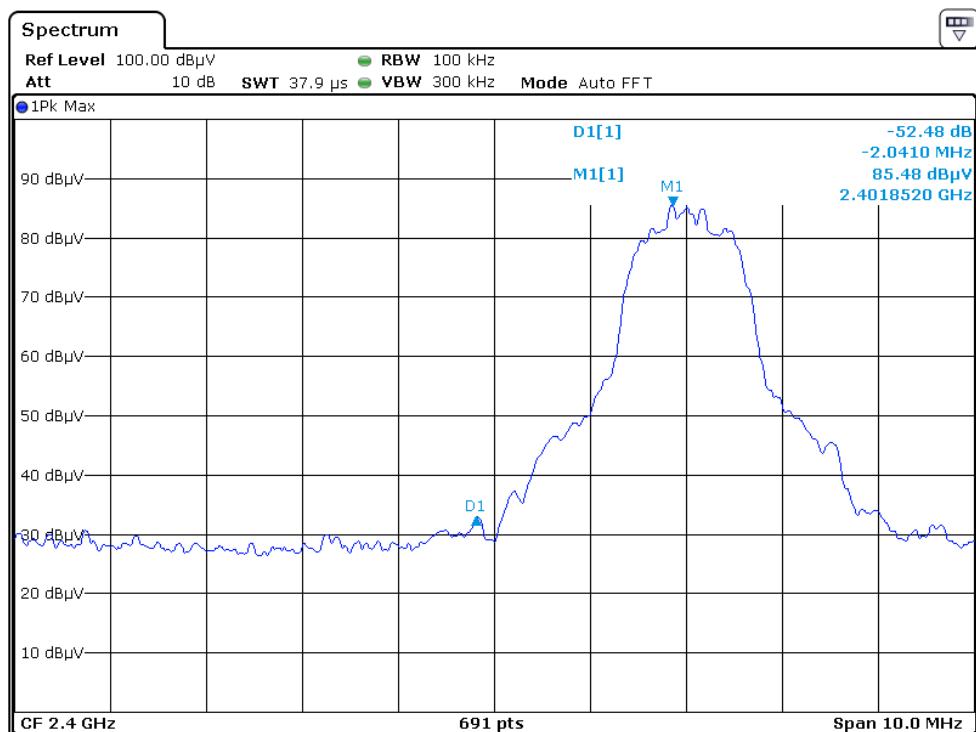
$$\begin{aligned}\text{Peak Resultant field strength} &= \text{Fundamental emissions (peak value)} - \text{delta from} \\ &\quad \text{the bandedge plot} \\ &= 75.7 \text{ dB}\mu\text{V/m} - 46.2 \text{ dB} \\ &= 29.5 \text{ dB}\mu\text{V/m}\end{aligned}$$

##### **(ii) Upper channel 2480.000MHz:**

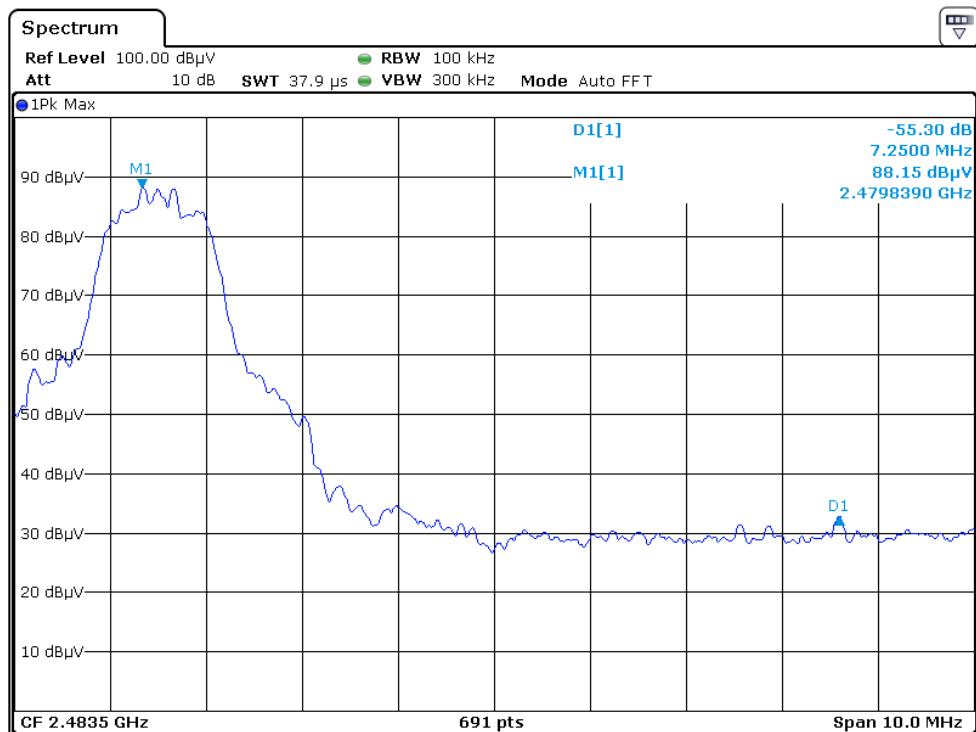
$$\begin{aligned}\text{Peak Resultant field strength} &= \text{Fundamental emissions (peak value)} - \text{delta from the bandedge plot} \\ &= 77.0 \text{ dB}\mu\text{V/m} - 48.7 \text{ dB} \\ &= 28.3 \text{ dB}\mu\text{V/m}\end{aligned}$$

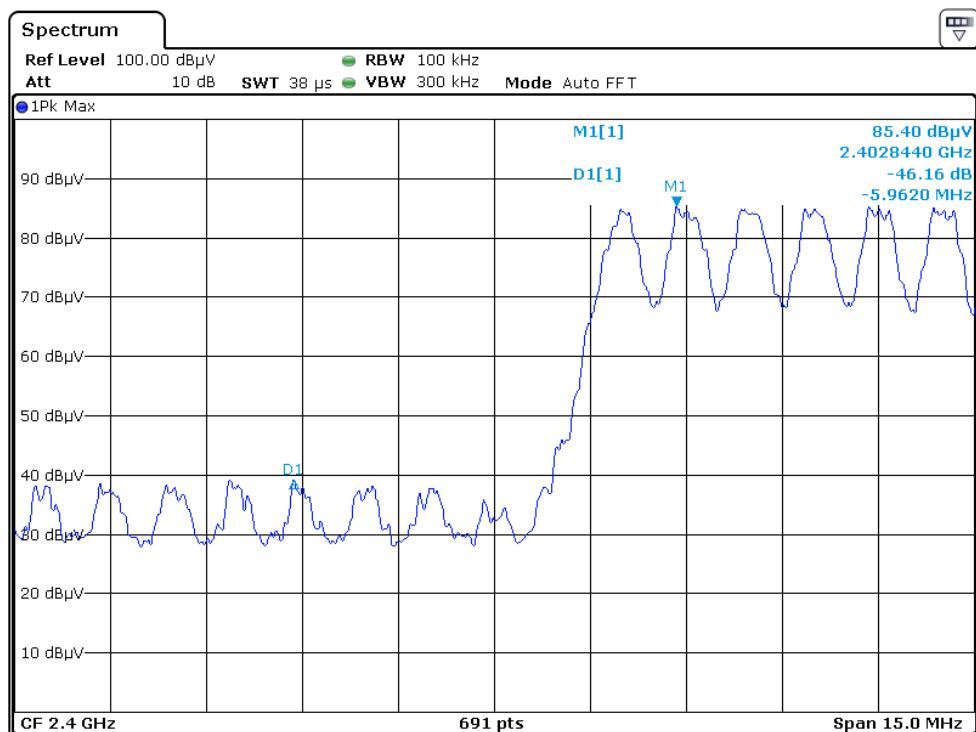
The resultant field strength meets the general radiated emission limit in section 15.209, which does not exceed 74dB $\mu$ V/m (Peak Limit) and 54dB $\mu$ V/m (Average Limit).

Hopping function off  
Lowest frequency Channel

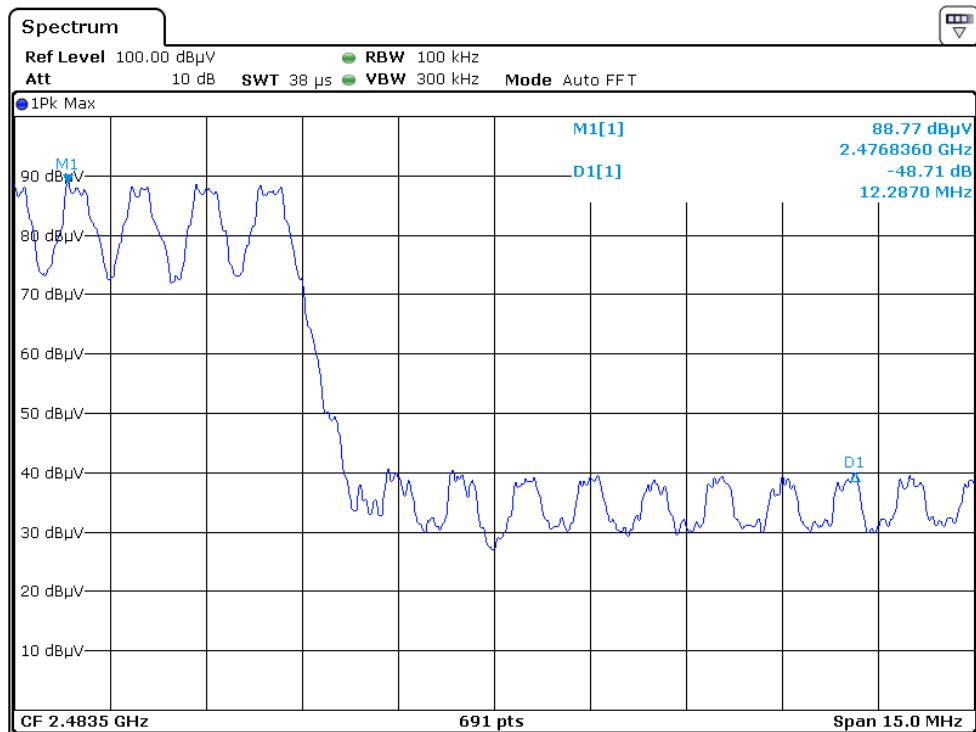


Highest frequency Channel



Hopping function on  
 Lowest frequency Channel


## Highest frequency Channel

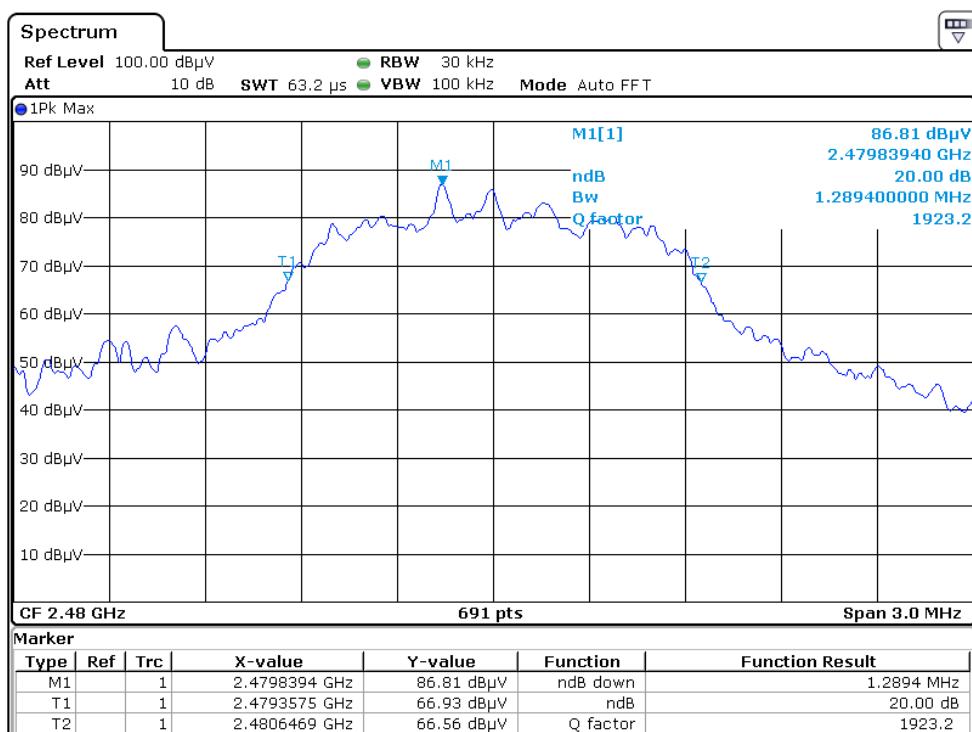
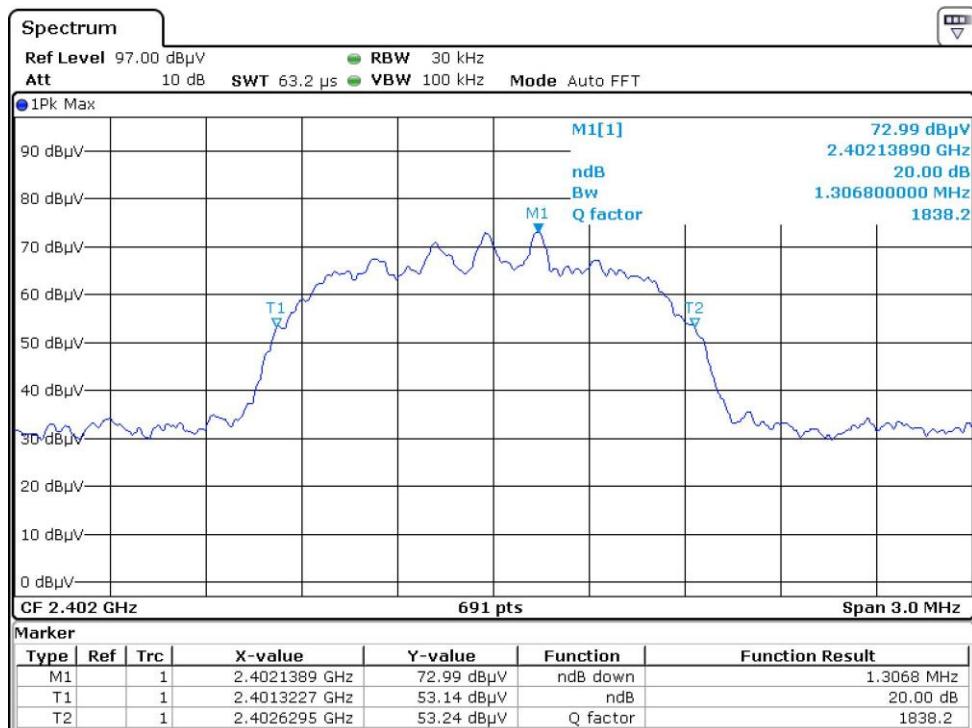


## Test Report

Intertek Report No.: SZHH01756056-001

## 9.2 20dB bandwidth

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 excepted variations in temperature and supply voltage were considered. The test plots are reported as below.



**9.3 Discussion of Pulse Desensitization**

Pulse desensitivity is not applicable for this device. The effective period (Teff) is approximately 625 $\mu$ s for Bluetooth. With a resolution bandwidth (3dB) of 1MHz, so the pulse desensitivity factor is 0dB.

**9.4 Calculation of Average Factor**

Based on the Bluetooth Specification Version 5.0 (EDR mode) and worst case AFH mode, transmitter ON time is independent of packet type (DH1, DH3 and DH5) and packet length, the AFH mode Duty cycle connection factor as below:

Channel hop rate = 800 hops/second (AFH Mode)

Adjusted channel hop rate for DH5 mode = 133.33 hops/second

Time per channel hop = 1 / 133.33 hops/second = 7.5 ms

Time to cycle through all channels = 7.5 x 20 channels = 150 ms

Number of times transmitter hits on one channel = 100 ms / 150 ms = 1 time(s)

Worst case dwell time = 7.5 ms

Duty cycle connection factor =  $20\log_{10} (7.5\text{ms} / 100\text{ms}) = -22.5 \text{ dB}$

**9.5 Emissions Test Procedures**

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

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.10 - 2013.

The transmitting equipment under test (EUT) is placed on a styrene turntable which is four feet in diameter and approximately 0.8 meter up to 1GHz and 1.5 meter above 1GHz in height above the ground plane. 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 axes to obtain maximum emission levels. The antenna height and polarization are varied during the testing to search for maximum signal levels.

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 section 9.4.

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.

**9.5 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.

The IF bandwidth used for measurement of radiated signal strength was 10 kHz for emission below 30 MHz and 120 kHz for emission from 30 MHz to 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. Above 1000 MHz, a resolution bandwidth of 1 MHz is used (RBW 3MHz used for fundamental emission).

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the restricted 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, but those measurements taken at a closer distance are so marked.

**10.0 Test Equipment List**

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ061-13	BiConiLog Antenna	ETS	3142E	00217919	13-Jul-2022	13-Jul-2025
SZ185-04	EMI Receiver	R&S	ESR7	102466	14-Nov-2022	14-Nov-2023
SZ061-09	Horn Antenna	ETS	3115	00092346	14-Oct-2022	14-Oct-2025
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	18-May-2021	18-May-2023
SZ061-15	Double-RidgedWaveguide Horn Antenna	ETS	3116C-PA	00224718	6-Jul-2022	6-Jul-2024
SZ056-06	Spectrum Analyzer	R&S	FSV40	101101	19-Dec-2022	19-Dec-2023
SZ181-04	Preamplifier	Agilent	8449B	3008A02474	16-May-2022	16-May-2023
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	12-Dec-2021	12-Dec-2024
SZ062-02	RF Cable	RADIALL	RG 213U	--	15-Aug-2022	15-May-2023
SZ062-05	RF Cable	RADIALL	0.04-26.5GHz	--	15-Aug-2022	15-May-2023
SZ062-12	RF Cable	RADIALL	0.04-26.5GHz	--	15-Aug-2022	15-May-2023
SZ067-04	Notch Filter	Micro-Tronics	BRM50702-02	--	15-Aug-2022	15-May-2023

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