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Report No.: TMWK2210004212KS

FCC ID: VPYLB1ZM
Ref. No.: T201215W01-MF

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Rev.: 02

RF Exposure Evaluation Report

FCC 47 CFR § 2.1091

for

Communication Module

Model Name.: LBEE5QD1ZM

Trade Name: muRata

Prepared for:

**Murata Manufacturing Co., Ltd.
1-10-1, Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan**

Prepared by

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New Taipei City, Taiwan.
Issue Date: November 22, 2022**

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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	December 11, 2020	Initial Issue	ALL	Mita Wu
01	January 7, 2021	See the following Note Rev.(01)	ALL	Allison Chen
02	November 22, 2022	See the following Note Rev.(02)	ALL	Doris Chu

Note:

Rev.(01)

1. This test report is an addendum to the original test report T200915W04-MF, the EUTs represent the original and this test report are assessed as identical in hardware and software, measurement results in the original report are fully leveraged in this test report without further verification test.

Rev.(02)

1. Changed antenna type to chip antenna (molex / 2119640001). This test report is an addendum to the original test report T201215W01-MF, the EUTs represent the original and this test report are assessed as identical in hardware and software, measurement results in the original report are fully leveraged in this test report without further verification test.

2. Other information, please refer to the T201215W01 and this test report.

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1 Attestation of Test Results

Applicant Name	Murata Manufacturing Co., Ltd.
Model Name	LBEE5QD1ZM
Applicable Standards	FCC 47 CFR § 2.1091 KDB 447498 D04 FCC 47 CFR § 1.1307 FCC 47 CFR § 1.1310 Published RF exposure KDB procedures
Receive EUT Date:	October 19, 2022
Compliance Certification Services Inc. , tested the above equipment in accordance with the requirements set forth in the above standards. Determination of compliance is based on the results of the compliance measurement,not taking into account measurement instrumentation uncertainty.All indications of Pass/Fail in this report are opinions expressed by Compliance Certification Services Inc, based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.	
Approved & Released By: 	
Sky Zhou Asst. Section Manager Compliance Certification Services Inc.	



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2 Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1091, the following FCC Published RF exposure [KDB](#) procedures:

- 447498 D04 Interim General RF Exposure Guidance v01
- 865664 D02 RF Exposure Reporting v01r02



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3 Device Under Test (DUT) Information

3.1 DUT Description

Product	Communication Module
Trade Name	muRata
Model No.	LBEE5QD1ZM
Model Discrepancy	N/A
Sample Stage	Identical prototype

3.2 Wireless Technologies

Frequency bands	☒ Bluetooth: 2402MHz-2480MHz ☒ 802.11b/g/n HT20: 2412 MHz ~ 2462 MHz ☒ 802.11a/n HT20 / ac20: 5180MHz ~ 5240MHz / 5260 ~ 5320MHz 5500 ~ 5700MHz / 5745MHz ~ 5825MHz ☒ 802.11n HT40 / ac40: 5190MHz ~ 5230MHz / 5270 ~ 5310MHZ 5510 ~ 5670MHz / 5755MHz ~ 5795MHz ☒ 802.11ac VHT80: 5210MHz / 5290MHz / 5530 MHz~5610MHz / 5775MHz ☐ Others																																													
Exposure classification	☐ Occupational/Controlled exposure (S = 5mW/cm ²) ☒ General Population/Uncontrolled exposure (S=1mW/cm ²)																																													
Antenna Specification	Chip Antenna BT Gain: 2.7 dBi WIFI 2.4GHz Gain: 2.7 dBi WIFI 5GHz Gain: 2.2 dBi <table><tr><td>Bluetooth</td><td>Gain :</td><td>2.70 dBi</td><td>(Numeric gain: 1.86)</td><td>Worst</td></tr><tr><td>WIFI 2.4GHz</td><td>Gain :</td><td>2.70 dBi</td><td>(Numeric gain: 1.86)</td><td>Worst</td></tr><tr><td>WIFI 5GHz</td><td>Gain :</td><td>2.20 dBi</td><td>(Numeric gain: 1.66)</td><td>Worst</td></tr></table>				Bluetooth	Gain :	2.70 dBi	(Numeric gain: 1.86)	Worst	WIFI 2.4GHz	Gain :	2.70 dBi	(Numeric gain: 1.86)	Worst	WIFI 5GHz	Gain :	2.20 dBi	(Numeric gain: 1.66)	Worst																											
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Maximum tune up power	<table><tr><td>BT</td><td>5.50 dBm</td><td>(3.548 mW)</td></tr><tr><td>BLE</td><td>5.50 dBm</td><td>(3.548 mW)</td></tr><tr><td>2.4GHz</td><td></td><td></td></tr><tr><td>IEEE 802.11b Mode:</td><td>19.00 dBm</td><td>(79.433 mW)</td></tr><tr><td>IEEE 802.11g Mode:</td><td>19.00 dBm</td><td>(79.433 mW)</td></tr><tr><td>IEEE 802.11n HT 20 Mode:</td><td>18.00 dBm</td><td>(63.096 mW)</td></tr><tr><td>IEEE 802.11ac VHT 20 Mode:</td><td>18.00 dBm</td><td>(63.096 mW)</td></tr><tr><td>5GHz</td><td></td><td></td></tr><tr><td>IEEE 802.11a Mode:</td><td>17.00 dBm</td><td>(50.119 mW)</td></tr><tr><td>IEEE 802.11n HT 20 Mode:</td><td>16.50 dBm</td><td>(44.668 mW)</td></tr><tr><td>IEEE 802.11n HT 40 Mode:</td><td>16.50 dBm</td><td>(44.668 mW)</td></tr><tr><td>IEEE 802.11ac VHT 20 Mode:</td><td>16.50 dBm</td><td>(44.668 mW)</td></tr><tr><td>IEEE 802.11ac VHT 40 Mode:</td><td>16.50 dBm</td><td>(44.668 mW)</td></tr><tr><td>IEEE 802.11ac VHT 80 Mode:</td><td>16.00 dBm</td><td>(39.811 mW)</td></tr></table>				BT	5.50 dBm	(3.548 mW)	BLE	5.50 dBm	(3.548 mW)	2.4GHz			IEEE 802.11b Mode:	19.00 dBm	(79.433 mW)	IEEE 802.11g Mode:	19.00 dBm	(79.433 mW)	IEEE 802.11n HT 20 Mode:	18.00 dBm	(63.096 mW)	IEEE 802.11ac VHT 20 Mode:	18.00 dBm	(63.096 mW)	5GHz			IEEE 802.11a Mode:	17.00 dBm	(50.119 mW)	IEEE 802.11n HT 20 Mode:	16.50 dBm	(44.668 mW)	IEEE 802.11n HT 40 Mode:	16.50 dBm	(44.668 mW)	IEEE 802.11ac VHT 20 Mode:	16.50 dBm	(44.668 mW)	IEEE 802.11ac VHT 40 Mode:	16.50 dBm	(44.668 mW)	IEEE 802.11ac VHT 80 Mode:	16.00 dBm	(39.811 mW)
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Notes:

1. For more details, please refer to the User's manual of the EUT.
2. Disclaimer: Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.
3. The tune up power referred the AVG power of the test report T201215W01-RP1, T201215W01-RP2, T201215W01-RP3, T201215W01-RP4 for RF Exposure assessment purpose.

4 Maximum Permissible Exposure

4.1 Limits for Maximum Permissible Exposure (MPE)

Table 1 - Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	* 100	6
3.0-30	1842/f	4.89/f	* 900/f ²	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* 100	30
1.34-30	824/f	2.19/f	* 180/f ²	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
<u>1,500-100,000</u>			1.0	30

4.2 MPE Calculation Method

Calculation

Given $E = \frac{\sqrt{30 \times P \times G}}{d}$ & $S = \frac{E^2}{377}$

Where E = Field strength in Volts / meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{377 d^2}$$

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = d \text{ (m)} / 100$$

Yields

$$S = \frac{30 \times (P/1000) \times G}{377 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \text{ Equation 1}$$

Where d = Distance in cm

P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²

If, Substituting the MPE safe distance using d = 20 cm into Equation 1:

$$S = 0.000199 \times P \times G$$

Calculation(continued)

Given $R = R_3 + 40 \log(3 / 0.2)$ or $R = R_3 + 40 \log(3 / 0.15)$ ↵

$$E = 10^{((R-12)/20)} \text{↵}$$

Where E = E field Strength↵

R₃ = Result Power on 3m↵

R = Result Power on 0.2m or 0.15m↵

4.3 MPE EXEMPTION

- (A) The available maximum time-averaged power is no more than 1 mW
- (B) The available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

- (C) Using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Single RF Sources Subject to Routine Environmental Evaluation	
RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$.
1.34-30	$3,450 R^2/f^2$.
30-300	$3.83 R^2$.
300-1,500	$0.0128 R^2 f$.
1,500-100,000	$19.2 R^2$.
Note: R is in meters, f is in MHz.	

4.4 Multiple RF sources

In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation),

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

5 MPE Exemption Option B

Bluetooth

Mode	Frequency (MHz)	R(m)	Max Tune-up power(dBm)	Max Tune-up power(mW)	Max Tune-up EIRP(dBm)	Max Tune-up ERP(dBm)	Max Tune-up ERP(mW)	ERP Threshold(mW)	MPE Exemption
BT	2480.00	0.2	5.50	3.55	8.20	6.05	4.027	3060	Complies
BLE	2480.00	0.2	5.50	3.55	8.20	6.05	4.027	3060	Complies

WIFI 2.4GHz

Mode	Frequency (MHz)	R(m)	Max Tune-up power(dBm)	Max Tune-up power(mW)	Max Tune-up EIRP(dBm)	Max Tune-up ERP(dBm)	Max Tune-up ERP(mW)	ERP Threshold(mW)	MPE Exemption
IEEE 802.11b	2462.00	0.2	19.00	79.43	21.70	19.55	90.157	3060	Complies
IEEE 802.11g	2437.00	0.2	19.00	79.43	21.70	19.55	90.157	3060	Complies
IEEE 802.11n HT 20	2437.00	0.2	18.00	63.10	20.70	18.55	71.614	3060	Complies
IEEE 802.11ac VHT 20	2437.00	0.2	18.00	63.10	20.70	18.55	71.614	3060	Complies

WIFI 5GHz(B1~B4)

Mode	Frequency (MHz)	R(m)	Max Tune-up power(dBm)	Max Tune-up power(mW)	Max Tune-up EIRP(dBm)	Max Tune-up ERP(dBm)	Max Tune-up ERP(mW)	ERP Threshold(mW)	MPE Exemption
IEEE 802.11a	5825.00	0.2	17.00	50.12	19.20	17.05	50.699	3060	Complies
IEEE 802.11n HT 20	5825.00	0.2	16.50	44.67	18.70	16.55	45.186	3060	Complies
IEEE 802.11n HT 40	5795.00	0.2	16.50	44.67	18.70	16.55	45.186	3060	Complies
IEEE 802.11ac VHT 20	5825.00	0.2	16.50	44.67	18.70	16.55	45.186	3060	Complies
IEEE 802.11ac VHT 40	5795.00	0.2	16.50	44.67	18.70	16.55	45.186	3060	Complies
IEEE 802.11ac VHT 80	5775.00	0.2	16.00	39.81	18.20	16.05	40.272	3060	Complies

6 Simultaneous Transmission Analysis

In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation),

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations	
Standalone	1	U-NII	+ BT

6.1 Sum of the WIFI 5GHz & Bluetooth

Mode	Frequency (MHz)	Max Tune-up ERP(mW)	ERP Threshold(mW)	simultaneous Transmission	simultaneous Transmission Limit
WIFI 5GHz	5825.00	50.699	3060.000	0.018	≤1
Bluetooth	2480.00	4.027	3060.000		



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7 Facilities

All measurement facilities used to collect the measurement data are located at

☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City, Taiwan.

END OF REPORT