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RF EXPOSURE REPORT

OF

Applicant: Murata Manufacturing Co., Ltd.

1-10-1, Higashikotari, Nagaokakyo-shi, Kyoto 617-8555

Japan

Product Name: Communication Module

Brand Name: muRata

Model No.: LBEE6ZZ2AJ

Model Difference: N/A

Report Number: ER/2020/B0049

FCC ID: VPYLB2AJ

IC: 772C-LB2AJ

FCC Rule Part Part 2.1091

IC Rule: RSS-102 issue 5 Mar. 19, 2015

Issue Date: Feb. 08, 2021

We hereby certify that:

The above equipment was verified by SGS Taiwan Ltd. The evaluation in this report is in compliance with the above rule(s).

The results of this report relate only to the sample identified in this report.

Approved By: ____

John Yeh / Asst. Manager





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Revision History								
Report Number	Revision	Description	Issue Date	Remark				
ER/2020/B0049	Rev.00	Original.	Feb. 08, 2021	Revised By: Yuri Tsai				

Note:

1 · Disclaimer

Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.



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DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

General:

Product Name:	Communication Module
Brand Name:	muRata
Model No.:	LBEE6ZZ2AJ
Model Difference:	N/A
Hardware Version:	1.0
Software Version:	1.0
EUT Series No.:	2AJ-1
Power Supply:	3.85 Vdc

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1.2 **Antenna Information:**

1.2.1 BT

Antenna Type	Supplier	Port	Antenna Part No.	Freq.	Peak Antenna Gain (dBi)	Worst Antenna Gain
Patch	TE	Port-BT	955-011-901	2.4GHz	-1.9	V

WLAN 2.4GHz

Antenna Type	Supplier	Port	Antenna Part No.	Freq.	Directional gain (dBi)	Worst Antenna Gain
Patch	TE	Port-WLAN2 Port-WLAN1	955-011-901	2.4GHz	0.44	V

1.2.2 **WLAN 5GHz**

Antenna Type	Supplier	Port	Antenna Part No.	Freq.	Directional gain (dBi)	Worst Antenna Gain
Patch	TE	Port-WLAN1 Port-WLAN2	955-011-901	5GHz	-0.54	V

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1.3 **Rated Power**

1.3.1 **Bluetooth**

Mode	Freq. Range (MHz)	Channels	Modulation Technology	Max Output Power (dBm)	Peak Antenna Gain (dBi)	EIRP (dBm)	Worst Case
BR+EDR	2402-2480	79	GFSK + π/4DQPSK + 8DPSK	3.80	-1.9	1.9	
BLE	2402-2480	40	GFSK	7.66		5.76	V
Modulation type: GFSK GFSK + π/4DQPSK + 8DPSK							

WLAN 2.4GHz

Mode	Freq. Range (MHz)	Channels	Modulation Technology	Max Output Power (dBm)	Directional gain (dBi)	EIRP (dBm)	Worst Case		
802.11b/g/n/ax_HT20	2412-2462	11	DSSS & OFDM & OFDMA	21.87	0.44	22.31	٧		
802.11n/ax_HT40	2422-2452	7	OFDM & OFDMA	20.92	0.44	21.36			
		CCK, DQPSK, DBPSK for DSSS in 802.11b							
Modulation type:		64QAM, 16QAM, QPSK, BPSK for OFDM in 802.11g 64QAM, 16QAM, QPSK, BPSK for OFDM in 802.11n							
		1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDMA in 802.11ax							

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1.3.2 WLAN 5GHz (FCC):

802.11	Freq. Range (MHz)	Modulation Technology	Max. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Worst Case
	5150~5250	OFFIN	12.99	-2.3	10.69	
	5250~5350		12.96	-2.3	10.66	
а	5470~5725	OFDM,	12.98	-2.3	10.68	
	5725~5850		12.99	-2.3	10.69	

802.11	Freq. Range (MHz)	Modulation Technology	Max. Output Power (dBm)	Directional gain (dBi)	EIRP (dBm)	Worst Case
n HT	5150~5250		15.97	-0.54	15.43	
ac_VHT	5250~5350		15.98	-0.54	15.44	
ax_HE	5470~5725		15.99	-0.54	15.45	V
20M	5725~5850		15.98	-0.54	15.44	
n HT	5150~5250		15.99	-0.54	15.45	
ac_VHT	5250~5350	OFDM,	15.95	-0.54	15.41	
ax_HE	5470~5725	OFDMA	15.91	-0.54	15.37	
40M	5725~5850		15.95	-0.54	15.41	
	5150~5250		15.99	-0.54	15.45	
ac_VHT ax_HE 80M	5250~5350		15.96	-0.54	15.42	
	5470~5725		15.98	-0.54	15.44	
	5725~5850		15.97	-0.54	15.43	

	64QAM, 16QAM, QPSK, BPSK for OFDM in 802.11a
	64QAM, 16QAM, QPSK, BPSK for OFDM in 802.11n
Modulation type	256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM in 802.11ac
	1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDMA in
	802.11ax

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1.3.3 WLAN 5GHz (IC):

802.11	Freq. Range (MHz)	Modulation Technology	Max. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Worst Case
	5150~5250	OFDM	12.99	-2.3	10.69	
а	5250~5350		12.96	-2.3	10.66	
	5470~5725	OFDM	12.98	-2.3	10.68	
	5725~5850		12.99	-2.3	10.69	

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802.11	Freq. Range (MHz)	Modulation Technology	Max. Output Power (dBm)	Directional gain (dBi)	EIRP (dBm)	Worst Case
	5150~5250		15.94	-0.54	15.4	
n_HT	5250~5350		15.61	-0.54	15.07	
ac_VHT 20M	5470~5725		15.92	-0.54	15.38	
	5725~5850		15.76	-0.54	15.22	
	5150~5250		15.83	-0.54	15.29	
n_HT	5250~5350	OFDM	15.65	-0.54	15.11	
ac_VHT 40M	5470~5725	OFDIVI	15.91	-0.54	15.37	
	5725~5850		15.95	-0.54	15.41	
	5150~5250		15.54	-0.54	15	
ac_VHT	5250~5350		15.54	-0.54	15	
80M	5470~5725		15.98	-0.54	15.44	
	5725~5850		15.97	-0.54	15.43	
	5150~5250		15.97	-0.54	15.43	
ax_HE	5250~5350		15.98	-0.54	15.44	
20M	5470~5725		15.99	-0.54	15.45	V
	5725~5850	15.98	-0.54	15.44		
	5150~5250		15.99	-0.54	15.45	
ax_HE	5250~5350	OFDMA	15.95	-0.54	15.41	
40M	5470~5725	OFDIVIA	15.81	-0.54	15.27	
	5725~5850		15.89	-0.54	15.35	
	5150~5250		15.99	-0.54	15.45	
ax_HE	5250~5350		15.96	-0.54	15.42	
80M	5470~5725		15.83	-0.54	15.29	
	5725~5850		15.96	-0.54	15.42	

	64QAM, 16QAM, QPSK, BPSK for OFDM in 802.11a
	64QAM, 16QAM, QPSK, BPSK for OFDM in 802.11n
Modulation type	256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM in 802.11ac
	1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDMA in
	802.11ax

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2 FCC MAXIMUM PERMISSIBLE EXPOSURE (MPE)

2.1 FCC Standard Applicable

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This is a Mobile device, the MPE is required.

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for Maximum Permissive Exposure (MPE)

Frequency Range	Electric Field	Magnetic Field	Power Density	Averaging Time			
(MHz)	Strength (V/m)	Strength (A/m)	(mW/cm ²)	(minute)			
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			
300-1500	1	1	f/1500	30			
1500-15000	/	1	1.0	30			

f = frequency in MHz

Prediction of MPE limit at a given distance

 $S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

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^{* =} Plane-wave equipment power density



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2.2 ISED Standard Applicable

This submittal(s) (test report) is intended to comply with RSS-102 issue 5 Radio frequency Radiation Exposure requirement.

This is a Mobile device, the MPE is required.

Limits for Maximum Permissive Exposure (MPE)

RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)						
Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field Strength (A/m rms)	Power Density (W/m²)	Reference Period (minutes)		
0.003-10	83	90	-	Instantaneous*		
0.1-10	-	0.73/ f	-	6**		
1.1-10	87/ f ^{0.5}	-	-	6**		
10-20	27.46	0.0728	2	6		
20-48	58.07/ f ^{0.25}	0.1540/ f ^{0.25}	8.944/ f ^{0.5}	6		
48-300	22.06	0.05852	1.291	6		
300-6000	3.142 f ^{0.3417}	$0.008335 f^{0.3417}$	$0.02619f^{0.6834}$	6		
6000-15000	61.4	0.163	10	6		
15000-150000	61.4	0.163	10	616000/ f ^{1.2}		
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10-4 f ^{0.5}	6.67 x 10-5 <i>f</i>	616000/ f ^{1.2}		

F = frequency in MHz

Maximum Permissible Exposure (MPE) Evaluation

Prediction of MPE limit at a given distance

S=PG/4πR²

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

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^{* =} Based on nerve stimulation (NS).

^{** =} Based on specific absorption rate (SAR)



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2.3 **Power Density Calculation (Worst Case)**

FCC Standalone MPE

Operation Mode	Evaluation Frequency (MHz)	Operation Distance (cm)	Max. output Power (dBm)	Antenna Gain (dBi)	Max. output Power EIRP (mW)	Power Density (PD) (mW/cm²)	Limit (mW/cm²)	Pass / Fail	Power Density / Limit
BT	2442.00	20	7.66	-1.90	3.77	0.001	1.000	Pass	0.001
WLAN 2.4G	2412.00	20	21.87	0.44	170.22	0.034	1.000	Pass	0.034
WLAN 5G	5700.00	20	15.99	-0.54	35.08	0.007	1.000	Pass	0.007

ISED Standalone MPE

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Operation Mode	Evaluation Frequency (MHz)	Operation Distance (cm)	Max. output Power (dBm)	Antenna Gain (dBi)	Output Power EIRP (mW)	Power Density (PD) (W/m²)	Limit (W/m²)	Pass / Fail	Power Density / Limit
BT	2442.00	20	7.66	-1.90	3.77	0.007	5.412	Pass	0.001
WLAN 2.4G	2412.00	20	21.87	0.44	170.22	0.339	5.366	Pass	0.063
WLAN 5G	5700.00	20	15.99	-0.54	35.08	0.070	9.658	Pass	0.007

Collocated Power Density Calculation 2.4

FCC Collocated MPE

Max BT PD / Limit	Max 2.4G WLAN PD / Limit	Max 5G WLAN PD / Limit	Σ(Power Density / Limit) of BT+ WLAN
0.001	0.034	0.007	0.042

ISED Collocated MPE

1025 CONCOCCO III 2									
Max BT PD / Limit	Max 2.4G WLAN PD / Limit	Max 5G WLAN PD / Limit	Σ(Power Density / Limit) of BT+ WLAN						
0.001	0.063	0.007	0.071						

Note:

- 1. Σ(E- Field Strength / Limit): This is a summation of [(E- Field Strength for each transmitter/antenna included in the simultaneous transmission) / (corresponding MPE limit)].
- 2. Considering the collocated transmitters, the aggregated (E- Field Strength /limit) is smaller than 1, and MPE of collocated transmitters is compliant

~ End of Report ~

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