

RF EXPOSURE REPORT



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

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

Product Name: Communication Module

Brand Name: muRata

Model No.: For FCC :
LBES5PL2EL, LBEE5PL2DL
For ISCED :
LBES5PL2EL-SANT, LBES5PL2EL-DANT,
LBEE5PL2DL-SANT, LBEE5PL2DL-DANT

Model Difference: Refer to section 1.3

Report Number: TESA2211000527ES

FCC ID VPYLBES5PL2EL

IC: 772C-LBES5PL2EL

Issue Date: Mar. 22, 2023

Date of EUT Received: Nov. 25, 2022

Approved By

John Yeh

We hereby certify that:

The above equipment was evaluated by SGS Taiwan Ltd. The evaluation in this report is in compliance with FCC Rule Part §1.1307 and RSS-102.

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

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Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
TESA2211000527ES	00	Original	Mar. 02, 2023	Yami Kuo	
TESA2211000527ES	01	Revise applicant's address and model difference	Mar. 22, 2023	Yami Kuo	*

Note:

- 1、The remark "*" indicates modification of the report upon requests from certification body.
- 2、Variant information of model numbers is provided by the applicant, test results of this report are applicable to the sample EUT(s) received.

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1 DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

1.1 Product Description

Product Name:	Communication Module	
Brand Name:	muRata	
Model No.:	For FCC	LBES5PL2EL, LBEE5PL2DL
	For ISED	LBES5PL2EL-SANT, LBES5PL2EL-DANT, LBEE5PL2DL-SANT, LBEE5PL2DL-DANT
Model Difference:	Refer to section 1.3	
Hardware Version:	1	
Firmware Version:	N/A	
EUT Series No.:	BT、BLE、IEEE 802.15.4: ANT0: L#1、ANT1: R#1 WLAN2.4G、5G: L#4	
Power Supply:	3.3Vdc, 1.8Vdc	

1.2 Evaluation site

Laboratory	Site Address		FCC Designation number	ISED Company Number	CAB Identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	<input type="checkbox"/>	No. 134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, 24803, Taiwan.	TW0027	4620A	TW3702
	<input checked="" type="checkbox"/>	No. 2, Keji 1st Rd., Guishan Township, Taoyuan County, 333 Taiwan.	TW0028	4620E	
	<input type="checkbox"/>	1F, No. 8, Alley 15, Lane 120, Sec. 1, Nei Hu Road, Nei Hu District, Taipei City, 222 Taiwan.	TW0029	23862	

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1.3 Model Difference

1. There are 4 HVINs with 2 PMNs as below

a. The LBES5PL2EL-SANT and LBES5PL2EL-DANT are electrically identical.

HVIN	PMN	Chip on C101	RF functionss
LBES5PL2EL-SANT	LBES5PL2EL	IW612	WLAN 2.4GHz,5GHz, BT,BLE, IEEE802.15.4
LBES5PL2EL-DANT			

b. The LBEE5PL2DL-SANT and LBEE5PL2DL-DANT are electrically identical.

HVIN	PMN	Chip on C101	RF functions
LBEE5PL2DL-SANT	LBEE5PL2DL	IW611	WLAN 2.4GHz,5GHz, BT,BLE
LBEE5PL2DL-DANT			

2. In addition, there are 2 HMNs, the differences between the HMN(s) are

HMN	HVIN	Antenna connector(s)	WLAN	BT	BLE	IEEE802.15.4
P2ML10229-D	LBES5PL2EL-DANT	2 (ANT0, ANT1)	ANT0	ANT1	ANT1	ANT1
	LBEE5PL2DL-DANT					NA
P2ML10229-S	LBES5PL2EL-SANT	1 (ANT0)	ANT0	ANT0	ANT0	ANT0
	LBEE5PL2DL-SANT					NA

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2 DETERMINATION OF FCC MPE EXEMPTION

2.1 FCC

2.1.1 Single RF Source

As per §1.1307(b)(3)(i),

- (A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);
- (B) Or 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);

Note: when 10-g extremity SAR applies, SAR test exemption may be considered by applying a factor of 2.5 to the SAR-based exemption thresholds.

- (C) Or 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).

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**Table 1 to § 1.1307(b)(3)(i)(C) –
Single RF Sources Subject to Routine Environmental Evaluation**

RF Source frequency (MHz)			Minimum Distance			Threshold ERP (W)
fL		fH	$\lambda_L / 2\pi$		$\lambda_H / 2\pi$	
0.3	-	1.34	159m	-	35.6m	1920 R ²
1.34	-	30	35.6m	-	1.6m	3450 R ² /f ²
30	-	300	1.6m	-	159mm	3.83 R ²
300	-	1500	159mm	-	31.8mm	0.0128 R ² f
1500	-	100000	31.8mm	-	0.5mm	19.2R ²

R= minimum separation distance in meter

f = frequency in MHz

2.1.2 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.

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

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2.1.3 Single RF Source Evaluation Results

Operation Mode (Port0)	Frequency (MHz)	Max. tune-up power (dBm)	Peak gain (dBi)	ERP (dBm)	ERP (W)	Permissible Minimum separation distance ($\lambda/2\pi$) (m)	R = actual Minimum separation distance(m)	ERP _{th} (W)	ERP/ERP _{th}	Simultaneous transmission modes			
										1	2	3	4
BT / BLE	2480	16	3.6	17.45	0.056	0.0193	0.200	0.768	0.073				
IEEE 802.15.4	2475	18	3.6	19.45	0.088	0.0193	0.200	0.768	0.115				
WLAN 2.4G	2437	20	3.6	21.45	0.140	0.0196	0.200	0.768	0.182	V		V	
WLAN 5G	5785	18	4.6	20.45	0.111	0.0083	0.200	0.768	0.145		V		V

Operation Mode (Port1)	Frequency (MHz)	Max. tune-up power (dBm)	Peak gain (dBi)	ERP (dBm)	ERP (W)	Permissible Minimum separation distance ($\lambda/2\pi$) (m)	R = actual Minimum separation distance(m)	ERP _{th} (W)	ERP/ERP _{th}	Simultaneous transmission modes			
										1	2	3	4
BT / BLE	2480	16	3.2	17.05	0.051	0.0193	0.200	0.768	0.066	V	V		
IEEE 802.15.4	2475	18	3.2	19.05	0.080	0.0193	0.200	0.768	0.104			V	V

Note: For conservativeness, the lowest uplink frequency of each band is used to determine the minimum separation distance of that band. All the single RF source results (P or ERP) are less than their corresponding threshold (P_{th} or ERP_{th}), so they are exempt from RF exposure testing.

2.2 Multiple RF Sources Evaluation Results

Simultaneous transmission modes	Σ ERP/ERP _{th}	Criteria
1	0.248	1
2	0.211	1
3	0.286	1
4	0.249	1

Note:

1. $\Sigma(ERP/ERP_{th})$: This is a summation of [(ERP of RF source / exemption threshold ERP for RF source)].
Considering the collocated transmitters, the aggregated (ERP/ERP_{th}) is smaller than 1, and MPE of collocated transmitters is compliant

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3 ISED MAXIMUM PERMISSIBLE EXPOSURE (MPE)

3.1 Standard Applicable

According to RSS-102 issue 5 §2.5.2 RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);

at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $22.48/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;

at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);

at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;

This is a Mobile device, at which separation distance between the user and the device's antenna is 20cm. Therefore, section 2.5.2 shall be complied with.

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3.2 Maximum Permissible Exposure (MPE) Exemption

Operation Mode (Port0)	Evaluation Frequency (MHz)	Max. output Power include Tolerance (dBm)	Antenna Gain (dBi)	Max. EIRP (W)	Limit (W)	Max. EIRP / Limit	Pass / Fail	Simultaneous transmission modes			
								1	2	3	4
BT / BLE	2480.00	16	3.60	0.09	2.736	0.033	Pass				
IEEE 802.15.4	2475.00	18	3.60	0.14	2.732	0.051	Pass				
WLAN 2.4G	2437.00	20	3.60	0.23	2.703	0.085	Pass	V		V	
WLAN 5G	5785.00	18	4.60	0.18	4.880	0.037	Pass		V		V

Operation Mode (Port1)	Evaluation Frequency (MHz)	Max. output Power include Tolerance (dBm)	Antenna Gain (dBi)	Max. EIRP (W)	Limit (W)	Max. EIRP / Limit	Pass / Fail	Simultaneous transmission modes			
								1	2	3	4
BT / BLE	2480.00	16	3.20	0.08	2.736	0.029	Pass	V	V		
IEEE 802.15.4	2475.00	18	3.20	0.13	2.732	0.048	Pass			V	V

Note: For conservativeness, the lowest uplink frequency of each band is used to determine the MPE limit of that band.

3.2.1 Exemption evaluation for simultaneous transmission

Simultaneous transmission modes	Σ Max. EIRP/Limit	Criteria
1	0.114	1
2	0.066	1
3	0.133	1
4	0.085	1

Note:

1. Σ (EIRP / Limit): This is a summation of [(EIRP for each transmitter/antenna included in the simultaneous transmission) / (corresponding exemption limit)].

~ End of Report ~

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