Application Note

Type 1XL/2XS Wi-Fi™ + Bluetooth® + Module

NXP 88W9098 Chipset for 802.11a/b/g/n/ac/ax 2x2 MIMO + Bluetooth 5.3
Radio Law Certification Application Note - Rev. 2.0

- Design Name: Type 1XL / Type 2XS
- P/N: LBEE5ZZ1XL-774 / LBEE5ZZ2XS-846

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About This Document

Murata's Type 1XL / 2XS is a very high-performance module based on NXP 88W9098 combo chipset, supporting IEEE 802.11a/b/g/n/ac/ax + Bluetooth 5.3 BR/EDR/LE. This application note provides radio law certification user manual. It is designed to ensure that module manufacturers correctly communicate the necessary information to host manufacturers that incorporate their modules. Refer to Type 1XL Datasheet and Type 2XS Datasheet for module specification.

Audience & Purpose

The intended audience of this document are the manufacturers and host manufacture that will integrate this module to their modules.

Document Conventions

Table 1 describes the document conventions.

Table 1: Document Conventions

Conventions	Description
	Warning Note Indicates very important note. Users are strongly recommended to review.
	Info Note Intended for informational purposes. Users should review.
	Menu Reference Indicates menu navigation instructions. **Example**: Insert➔Tables➔Quick Tables➔Save Selection to Gallery
	External Hyperlink This symbol indicates a hyperlink to an external document or website. **Example**: Murata Click on the text to open the external link.
	Internal Hyperlink This symbol indicates a hyperlink within the document. **Example**: Operating Conditions Click on the text to open the link.
`Console input/output or code snippet`	**Console I/O or Code Snippet** This text ***Style*** denotes console input/output or a code snippet.
`# Console I/O comment` `// Code snippet comment`	**Console I/O or Code Snippet Comment** This text ***Style*** denotes a console input/output or code snippet comment. • Console I/O comment (preceded by "#") is for informational purposes only and does not denote actual console input/output. • Code Snippet comment (preceded by "//") may exist in the original code.

1 General Information for Radio Regulatory Certification

This section contains the following topics:

- Application model part number
- Markings/Dimensions
- Pin Layout
- Operating Conditions
- Package Label
- Country of Origin

1.1 Application Model Part Number

Application model part number: **LBEE5ZZ1XL**

1.2 Labels

Figure 1 shows the module labels. **Table 2** and **Table 3** describe the marking and dimension labels.

Figure 1: Labels

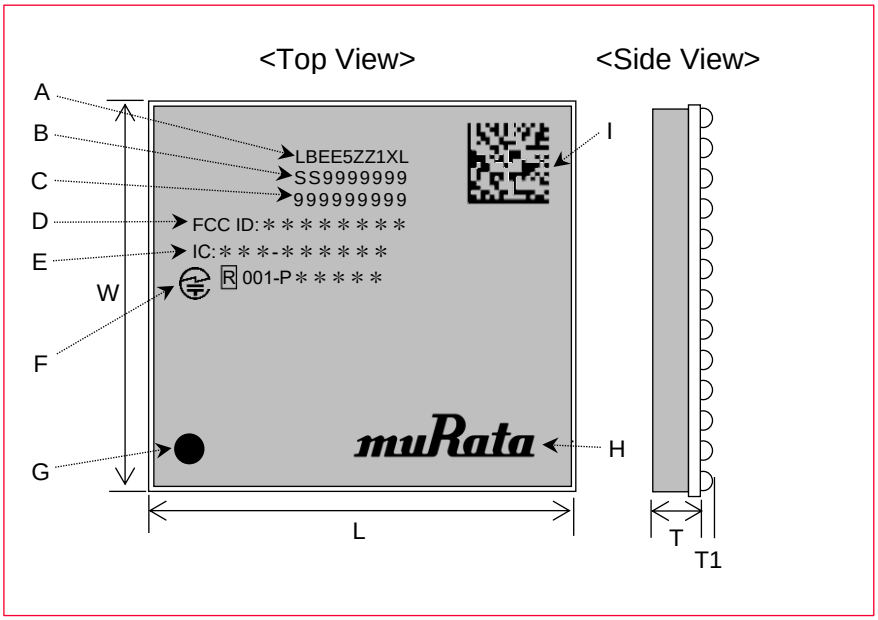


Table 2: Marking Labels

Marking Label	Meaning
A	Module Type: LBEE5ZZ1XL or LBEE5ZZ2XS
B	Production Process Number
C	Serial Number
D	FCC ID

Marking Label	Meaning
E	ISED ID
F	Japan certification mark & ID
G	Pin-1 Marking
H	Murata logo
I	2D code

Table 3: Dimension Labels

L	W	T
19.1 millimeter	16.5 millimeter	2.1 millimeter

1.3 Pin Layout

Figure 2 shows the pin layout.

Figure 2: Pin Layout

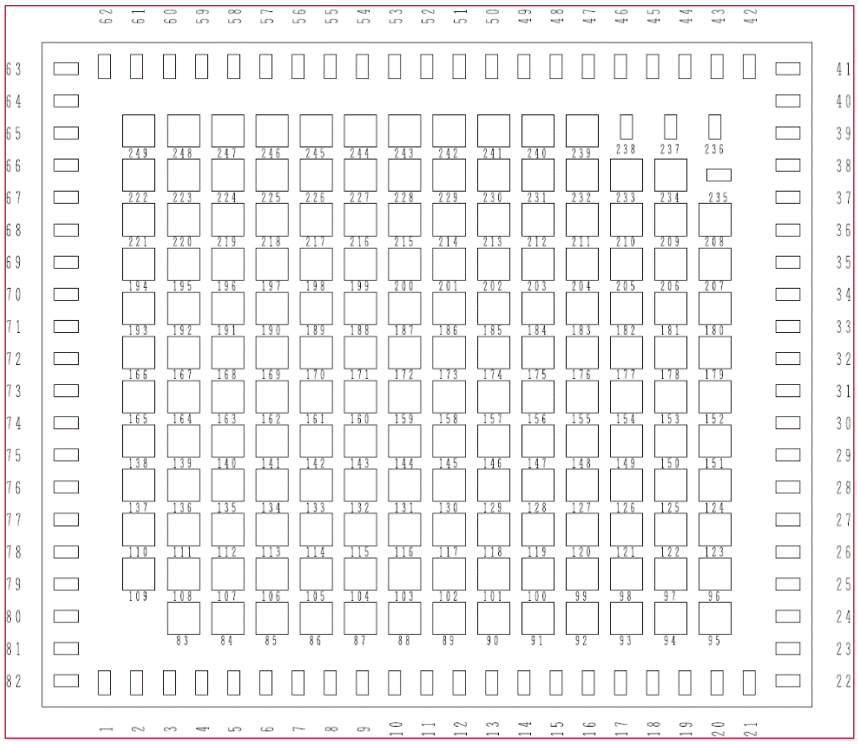


Table 4 describes the pins.

Table 4: Terminal Configurations

No.	Terminal Name	No.	Terminal Name	No.	Terminal Name	No.	Terminal Name
1	GND	24	PCIE_CLK_P	47	GPIO[31]	70	GPIO[22]
2	GND	25	GND	48	GPIO[29]	71	GPIO[23]
3	CONFIG_HOST[0]	26	PCIE_TX_P	49	GPIO[30]	72	GPIO[19]
4	CONFIG_HOST[1]	27	PCIE_TX_N	50	GPIO[28]	73	GPIO[18]
5	CONFIG_HOST[2]	28	GND	51	GPIO[3]	74	GPIO[17]
6	GPIO[1]	29	PCIE_RX_N	52	GPIO[2]	75	GND
7	GPIO[0]	30	PCIE_RX_P	53	GPIO[11]	76	WL_B_ANT/ WL_B_BT_ANT

No.	Terminal Name	No.	Terminal Name	No.	Terminal Name	No.	Terminal Name
8	GPIO[14]	31	GND	54	GPIO[10]	77	GND
9	GPIO[4]	32	NC	55	GPIO[9]	78	GND
10	GPIO[6]	33	NC	56	GPIO[8]	79	GND
11	GPIO[5]	34	GND	57	GPIO[12]	80	WL_A_ANT
12	GPIO[7]	35	VIO_SD	58	GPIO[13]	81	GND
13	GPIO[16]	36	SD_CLK	59	GPIO[24]	82	GND
14	GPIO[15]	37	SD_CMD	60	GPIO[25]	83-234	GND
15	PDn	38	SD_D[0]	61	GPIO[26]	235	RF_CNTL0_N
16	GND	39	SD_D[1]	62	GPIO[27]	236	RF_CNTL3_P
17	VDD33	40	SD_D[2]	63	GND	237	RF_CNTL2_N
18	VDD33	41	GND	64	GND	238	RF_CNTL1_P
19	VIO	42	SD_D[3]	65	BT_RF_OUT	239-248	GND
20	VDD18	43	PCIE_PERSTn	66	GND	249	NC
21	VDD18	44	PCIE_CLKREQn	67	GND		
22	GND	45	PCIE_WAKEn	68	NC		
23	PCIE_CLK_N	46	W_DISABLE1n	69	GND		

Pin No. 65: LBEE5ZZ1XL is “BT_RF_OUT”　LBEE5ZZ2XS is “NC”.

1.4 Operating Conditions

Table 5 describes the operating conditions.

Table 5: Operating Conditions

Parameter		Minimum	Typical	Maximum	Unit
Operating Temperature		-40	25	60	°C
Supply Voltage	VDD33	3.14	3.3	3.46	V
	VDD18	1.71	1.8	1.89	V
	VIO	1.71 3.14	1.8 3.3	1.89 3.46	V
	VIO_SD	1.71 3.14	1.8 3.3	1.89 3.46	V

VIO, VIO_SD have two systems, 1.8V system and 3.3V system. However, these do not affect the RF characteristics.

1.5 Package Label

Figure 3 shows the package and **Figure 4** and **Figure 5** shows an example of the package label for Type 1XL and 2XS modules.

Figure 3: Package (Humidity-proof packaging)

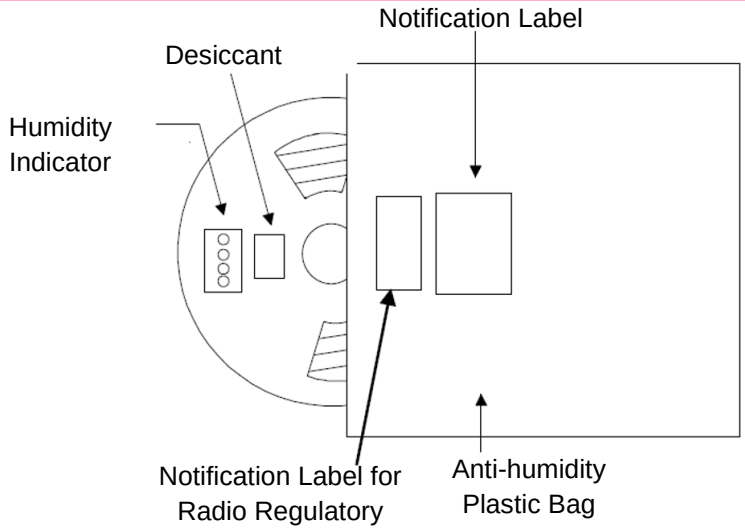


Figure 4: Package Label Display Example – Type 1XL

Figure 5: Package Label Display Example – Type 2XS

The package label may be attached on one side only.

1.6 Country of Origin

China

SHENZHEN MURATA TECHNOLOGY CO., LTD.

Some countries have applied for certification in two countries, China and Japan, in preparation for future factory changes, but the production site in the delivery specifications is the above-mentioned factory in China.

2 Radio Regulatory Certification Information by Country

This section contains the following country/region specific information:

- FCC (USA)
- ISED (Canada)
- EU
- Japan

2.1 FCC

Model Name: LBEE5ZZ1XL

FCC ID: VPYLBEE5ZZ1XL

This module is not sold to general end users directly. Therefore, there is no user manual of module. For the details about this module, please refer to the specification sheet of module. This module should be installed in the host device according to the interface specification (installation procedure)

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the end user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as shown in User manual.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC CAUTION

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

This device complies with below part 15 of the FCC Rules.

- Part 15 Subpart C
- Part 15 Subpart E

2.1.1 Setting RF Power

This section describes the RF power settings.

2.1.1.1 RF Power Setting for 2.4 GHz WLAN

Table 6, **Table 7**, and **Table 8** describes the RF power settings for 2.4 GHz WLAN.

Table 6: WLAN RF Power Setting - 2.4 GHz 802.11 b/g/n (HT20/40)/ac (VHT20/40) (FCC)

Mode	Rate/MCS index	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11b	All Rate	1, 11	14.0 ± 2.0
		2 ~ 10	18.0 ± 2.0
IEEE 802.11g	All rate	1, 11	10.0 ± 2.0
	6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps	2 ~ 10	17.0 ± 2.0
	48 Mbps, 54 Mbps	2 ~ 10	16.0 ± 2.0
IEEE 802.11n (HT20)	All MCS index	1	8.0 ± 2.0
	MCS0 ~ MCS2	2 ~ 10	16.0 ± 2.0
	MCS3 ~ MCS7	2 ~ 10	15.0 ± 2.0
	All MCS index	11	10.0 ± 2.0
IEEE 802.11n (HT40)	All MCS index	3	9.0 ± 2.0
		4 ~ 8	14.0 ± 2.0
		9	8.0 ± 2.0
IEEE 802.11ac (VHT20)	All MCS index	1	8.0 ± 2.0
	MCS0 ~ MCS2	2 ~ 10	16.0 ± 2.0
	MCS3 ~ MCS7	2 ~ 10	15.0 ± 2.0
	MCS8	2 ~ 10	14.0 ± 2.0
	All MCS index	11	10.0 ± 2.0
IEEE 802.11ac (VHT40)	All MCS index	3	9.0 ± 2.0
		4 ~ 8	14.0 ± 2.0
		9	8.0 ± 2.0

Table 7: WLAN RF Power Setting - 2.4 GHz 802.11ax (HE20) (FCC)

Mode	Rate / MCS index	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE20)	All MCS index	1	SU	8.0 ±2.0		
					242 tone (Full tone)	8.0 ±2.0
					26 tone	8.0 ±2.0
					52 tone	8.0 ±2.0
					106 tone	8.0 ±2.0
	MCS0 ~ MCS2	2 ~ 10	SU	16.0 ±2.0		
					242 tone (Full tone)	16.0 ±2.0
					26 tone	16.0 ±2.0
					52 tone	16.0 ±2.0
					106 tone	16.0 ±2.0
	MCS3 ~ MCS7	2 ~ 10	SU	15.0 ±2.0		
					242 tone (Full tone)	15.0 ±2.0
					26 tone	15.0 ±2.0
					52 tone	15.0 ±2.0

Mode	Rate / MCS index	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
					106 tone	15.0 ±2.0
	MCS8, MCS9	2 ~ 10	SU	14.0 ±2.0		
					242 tone (Full tone)	14.0 ±2.0
					26 tone	14.0 ±2.0
					52 tone	14.0 ±2.0
					106 tone	14.0 ±2.0
	MCS10, MCS11	2 ~ 10	SU	13.0 ±2.0		
					242 tone (Full tone)	13.0 ±2.0
					26 tone	13.0 ±2.0
					52 tone	13.0 ±2.0
					106 tone	13.0 ±2.0
	All MCS index	11	SU	10.0 ±2.0		
					242 tone (Full tone)	10.0 ±2.0
					26 tone	10.0 ±2.0
					52 tone	10.0 ±2.0
					106 tone	10.0 ±2.0

Table 8: WLAN RF Power Setting - 2.4 GHz 802.11ax (HE40) (FCC)

Mode	Rate / MCS index	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE40)	All MCS index	3	SU	9.0 ±2.0		
					484 tone (Full tone)	9.0 ±2.0
					26 tone	8.0 ±2.0
					52 tone	8.0 ±2.0
					106 tone	8.0 ±2.0
					242 tone	9.0 ±2.0
	MCS0 ~ MCS9	4 ~ 8	SU	14.0 ±2.0		
					484 tone (Full tone)	14.0 ±2.0
					26 tone	14.0 ±2.0
					52 tone	14.0 ±2.0
					106 tone	14.0 ±2.0
					242 tone	14.0 ±2.0
	MCS10, MCS11	4 ~ 8	SU	13.0 ±2.0		
					484 tone (Full tone)	13.0 ±2.0
					26 tone	13.0 ±2.0
					52 tone	13.0 ±2.0
					106 tone	13.0 ±2.0
					242 tone	13.0 ±2.0
	All MCS index	9	SU	8.0 ±2.0		
					484 tone (Full tone)	8.0 ±2.0
					26 tone	8.0 ±2.0
					52 tone	8.0 ±2.0
					106 tone	8.0 ±2.0
					242 tone	6.0 ±2.0

2.1.1.2 RF Power Setting for BT (BR/EDR) / BLE

Table 9 describes the RF power settings for BT (BR/EDR), BLE.

Table 9: BT / BLE RF Power Setting - FCC

Mode	Channel	Maximum Tune Up Tolerance (dBm)
BR	NA	3.0 ± 3.0
EDR	NA	0.0 ± 3.0
LE	NA	3.0 ± 3.0
LE 2 Mbps	NA	3.0 ± 3.0

2.1.1.3 RF Power Setting for 5 GHz WLAN

Table 10 describes the RF power settings for 5 GHz 802.11a WLAN.

Table 10: WLAN RF Power Setting - 5 GHz 802.11a (FCC)

Mode	Rate	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11a	All Rate	W52/W53	36, 64	13.0 ± 2.0
	All Rate	W52/W53	40 ~ 48	15.0 ± 2.0
	All Rate	W52/W53	52, 56	16.0 ± 2.0
	6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps	W52/W53	60	17.0 ± 2.0
	48 Mbps, 54 Mbps	W52/W53	60	16.0 ± 2.0
	All Rate	W56	100 ~ 136	14.0 ± 2.0
	All Rate	W56	140	13.0 ± 2.0
	All Rate	W56	144	16.0 ± 2.0
	6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps	W58	149 ~ 161	17.0 ± 2.0
	48 Mbps, 54 Mbps	W58	149 ~ 161	16.0 ± 2.0
	All Rate	W58	165	12.0 ± 2.0

Table 11 and **Table 12** describe the RF power settings for 5 GHz 802.11n WLAN.

Table 11: WLAN RF Power Setting - 5 GHz 802.11n (HT20) (FCC)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11n (HT20)	All MCS Index	W52/W53	36	12.0 ± 2.0
	All MCS Index	W52/W53	40	15.0 ± 2.0
	All MCS Index	W52/W53	44~60	16.0 ± 2.0
	All MCS Index	W52/W53	64	13.0 ± 2.0
	All MCS Index	W56	100~136	14.0 ± 2.0
	All MCS Index	W56	140	12.0 ± 2.0
	All MCS Index	W58	149~161	16.0 ± 2.0
	All MCS Index	W58	165	12.0 ± 2.0

Table 12: WLAN RF Power Setting - 5 GHz 802.11n (HT40) (FCC)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11n (HT40)	All MCS index	W52/W53	38,62	11.0 ± 2.0
	All MCS Index	W52/W53	46	16.0 ± 2.0
	All MCS Index	W52/W53	54	14.0 ± 2.0
	All MCS Index	W56	102	12.0 ± 2.0

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
	All MCS Index	W56	110	13.0 ± 2.0
	All MCS Index	W56	118~134	14.0 ± 2.0
	All MCS Index	W56	142	16.0 ± 2.0
	All MCS Index	W58	151	16.0 ± 2.0
	All MCS index	W58	159	12.0 ± 2.0

Table 13, **Table 14**, and **Table 15** describe the RF power settings for 5 GHz 802.11ac WLAN.

Table 13: WLAN RF Power Setting - 5 GHz 802.11ac (VHT20) (FCC)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ac (VHT20)	All MCS index	W52/W53	36	12.0 ± 2.0
	All MCS index	W52/W53	40	15.0 ± 2.0
	MCS0 ~ MCS7	W52/W53	44~60	16.0 ± 2.0
	MCS8	W52/W53	40~60	15.0 ± 2.0
	All MCS index	W52/W53	64	13.0 ± 2.0
	All MCS index	W56	100~136	14.0 ± 2.0
	All MCS index	W56	140	12.0 ± 2.0
	MCS0 ~ MCS7	W56	144	16.0 ± 2.0
	MCS8	W56	144	15.0 ± 2.0
	MCS0 ~ MCS7	W58	149~161	16.0 ± 2.0
	MCS8	W58	149~161	15.0 ± 2.0
	All MCS index	W58	165	12.0 ± 2.0

Table 14: WLAN RF Power Setting - 5 GHz 802.11ac (VHT40) (FCC)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ac (VHT40)	All MCS index	W52/W53	38,62	11.0 ± 2.0
	All MCS index	W52/W53	46	16.0 ± 2.0
	MCS0 ~ MCS7	W52/W53	46	15.0 ± 2.0
	MCS8, MCS9	W52/W53	54	14.0 ± 2.0
	All MCS index	W56	102	12.0 ± 2.0
	All MCS index	W56	110	13.0 ± 2.0
	All MCS index	W56	118~134	14.0 ± 2.0
	MCS0 ~ MCS7	W56	142	16.0 ± 2.0
	MCS8, MCS9	W56	142	15.0 ± 2.0
	MCS0 ~ MCS7	W58	151	16.0 ± 2.0
	MCS8, MCS9	W58	151	15.0 ± 2.0
	All MCS index	W58	159	12.0 ± 2.0

Table 15: WLAN RF Power Setting - 5 GHz 802.11ac (VHT80) (FCC)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ac (VHT80)	All MCS index	W52/W53	42,58	9.0 ± 2.0
	All MCS index	W56	106	9.0 ± 2.0
	MCS0 ~ MCS7	W56	122,138	15.0 ± 2.0
	MCS8, MCS9	W56	122,138	14.0 ± 2.0
	MCS0 ~ MCS7	W58	155	15.0 ± 2.0
	MCS8, MCS9	W58	155	14.0 ± 2.0

Table 16, **Table 17**, and **Table 18** describe the RF power settings for 5 GHz 802.11ax WLAN.

Table 16: WLAN RF Power Setting - 5 GHz 802.11ax (HE20) (FCC)

Mode	MCS Index	Band	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE20)	All MCS index	W52/W53	36	SU	12.0 ± 2.0		
						242 tone (Full tone)	12.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	12.0 ± 2.0
	MCS0 ~ MCS9	W52/W53	40	SU	15.0 ± 2.0		
						242 tone (Full tone)	15.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
	MCS10 ~ MCS11	W52/W53	40	SU	14.0 ± 2.0		
						242 tone (Full tone)	14.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
	MCS0 ~ MCS7	W52/W53	44 ~ 60	SU	16.0 ± 2.0		
						242 tone (Full tone)	16.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
	MCS8 ~ MCS9	W52/W53	44 ~ 60	SU	15.0 ± 2.0		
						242 tone (Full tone)	15.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
	MCS10 ~ MCS11	W52/W53	44 ~ 60	SU	14.0 ± 2.0		
						242 tone (Full tone)	14.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
	All MCS index	W52/W53	64	SU	13.0 ± 2.0		
						242 tone (Full tone)	13.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
	All MCS index	W56	100 ~ 136	SU	14.0 ± 2.0		
						242 tone (Full tone)	14.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0

Mode	MCS Index	Band	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
	All MCS index	W56	140	SU	12.0 ± 2.0		
						242 tone (Full tone)	12.0 ± 2.0
						26 tone	5.0 ± 2.0
						52 tone	9.0 ± 2.0
						106 tone	10.0 ± 2.0
	MCS0 ~ MCS7	W56	144	SU	16.0 ± 2.0		
						242 tone (Full tone)	16.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
	MCS8, MCS9	W56	144	SU	15.0 ± 2.0		
						242 tone (Full tone)	15.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
	MCS10, MCS11	W56	144	SU	14.0 ± 2.0		
						242 tone (Full tone)	14.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
	MCS0 ~ MCS7	W58	149 ~ 161	SU	16.0 ± 2.0		
						242 tone (Full tone)	16.0 ± 2.0
						26 tone	16.0 ± 2.0
						52 tone	16.0 ± 2.0
						106 tone	16.0 ± 2.0
	MCS8 ~ MCS9	W58	149 ~ 161	SU	15.0 ± 2.0		
						242 tone (Full tone)	15.0 ± 2.0
						26 tone	15.0 ± 2.0
						52 tone	15.0 ± 2.0
						106 tone	15.0 ± 2.0
	MCS10 ~ MCS11	W58	149 ~ 161	SU	14.0 ± 2.0		
						242 tone (Full tone)	14.0 ± 2.0
						26 tone	14.0 ± 2.0
						52 tone	14.0 ± 2.0
						106 tone	14.0 ± 2.0
	All MCS index	W58	165	SU	12.0 ± 2.0		
						242 tone (Full tone)	12.0 ± 2.0
						26 tone	12.0 ± 2.0
						52 tone	12.0 ± 2.0
						106 tone	12.0 ± 2.0

Table 17: WLAN RF Power Setting - 5 GHz 802.11ax (HE40) (FCC)

Mode	MCS Index	Band	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE40)	All MCS index	W52/W53	38	SU	11.0 ± 2.0		
						484 tone (Full tone)	11.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	11.0 ± 2.0
						242 tone	10.0 ± 2.0
	MCS0 ~ MCS7	W52/W53	46	SU	16.0 ± 2.0		
						484 tone (Full tone)	16.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
						242 tone	14.0 ± 2.0
	MCS8 ~ MCS9	W52/W53	46	SU	15.0 ± 2.0		
						484 tone (Full tone)	15.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
						242 tone	14.0 ± 2.0
	MCS10 ~ MCS11	W52/W53	46	SU	14.0 ± 2.0		
						484 tone (Full tone)	14.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
						242 tone	14.0 ± 2.0
	All MCS index	W52/W53	54	SU	14.0 ± 2.0		
						484 tone (Full tone)	14.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
						242 tone	14.0 ± 2.0
	All MCS index	W52/W53	62	SU	11.0 ± 2.0		
						484 tone (Full tone)	11.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	11.0 ± 2.0
						242 tone	10.0 ± 2.0
	All MCS index	W56	102	SU	12.0 ± 2.0		
						484 tone (Full tone)	12.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0

Mode	MCS Index	Band	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
						106 tone	12.0 ± 2.0
						242 tone	6.0 ± 2.0
	All MCS index	W56	110	SU	13.0 ± 2.0		
						484 tone (Full tone)	13.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	13.0 ± 2.0
	All MCS index	W56	118 ~ 126	SU	14.0 ± 2.0		
						484 tone (Full tone)	14.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	14.0 ± 2.0
	All MCS index	W56	134	SU	14.0 ± 2.0		
						484 tone (Full tone)	14.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	9.0 ± 2.0
	MCS0 ~ MCS7	W56	142	SU	16.0 ± 2.0		
						484 tone (Full tone)	16.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	14.0 ± 2.0
	MCS8, MCS9	W56	142	SU	15.0 ± 2.0		
						484 tone (Full tone)	15.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	14.0 ± 2.0
	MCS10, MCS11	W56	142	SU	14.0 ± 2.0		
						484 tone (Full tone)	14.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	14.0 ± 2.0
	MCS0 ~ MCS7	W58	151	SU	16.0 ± 2.0		
						484 tone (Full tone)	16.0 ± 2.0
						26 tone	16.0 ± 2.0
						52 tone	16.0 ± 2.0
						106 tone	16.0 ± 2.0

Mode	MCS Index	Band	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
						242 tone	16.0 ± 2.0
	MCS8, MCS9	W58	151	SU	15.0 ± 2.0		
						484 tone (Full tone)	15.0 ± 2.0
						26 tone	15.0 ± 2.0
						52 tone	15.0 ± 2.0
						106 tone	15.0 ± 2.0
						242 tone	15.0 ± 2.0
	MCS10, MCS11	W58	151	SU	14.0 ± 2.0		
						484 tone (Full tone)	14.0 ± 2.0
						26 tone	14.0 ± 2.0
						52 tone	14.0 ± 2.0
						106 tone	14.0 ± 2.0
						242 tone	14.0 ± 2.0
	All MCS index	W58	159	SU	12.0 ± 2.0		
						484 tone (Full tone)	12.0 ± 2.0
						26 tone	12.0 ± 2.0
						52 tone	12.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	12.0 ± 2.0

Table 18: WLAN RF Power Setting - 5 GHz 802.11ax (HE80) (FCC)

Mode	MCS Index	Band	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE80)	All MCS index	W52/W53	42	SU	9.0 ± 2.0		
						996 tone (Full tone)	9.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	9.0 ± 2.0
						106 tone	9.0 ± 2.0
						242 tone	9.0 ± 2.0
						484 tone	8.0 ± 2.0
	All MCS index	W52/W53	58	SU	9.0 ± 2.0		
						996 tone (Full tone)	9.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	9.0 ± 2.0
						106 tone	9.0 ± 2.0
						242 tone	9.0 ± 2.0
						484 tone	8.0 ± 2.0
	All MCS index	W56	106	SU	9.0 ± 2.0		
						996 tone (Full tone)	9.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	9.0 ± 2.0
						106 tone	9.0 ± 2.0

Mode	MCS Index	Band	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
						242 tone	6.0 ± 2.0
						484 tone	9.0 ± 2.0
	MCS0 ~ MCS7	W56	122	SU	15.0 ± 2.0		
						996 tone (Full tone)	15.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	14.0 ± 2.0
						484 tone	15.0 ± 2.0
	MCS8 ~ MCS11	W56	122	SU	14.0 ± 2.0		
						996 tone (Full tone)	14.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	14.0 ± 2.0
						484 tone	14.0 ± 2.0
	MCS0 ~ MCS7	W56	138	SU	15.0 ± 2.0		
						996 tone (Full tone)	15.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	14.0 ± 2.0
						484 tone	15.0 ± 2.0
	MCS8 ~ MCS11	W56	138	SU	14.0 ± 2.0		
						996 tone (Full tone)	14.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	14.0 ± 2.0
						484 tone	14.0 ± 2.0
	MCS0 ~ MCS7	W58	155	SU	15.0 ± 2.0		
						996 tone (Full tone)	15.0 ± 2.0
						26 tone	15.0 ± 2.0
						52 tone	15.0 ± 2.0
						106 tone	15.0 ± 2.0
						242 tone	12.0 ± 2.0
						484 tone	14.0 ± 2.0
	MCS8 ~ MCS11	W58	155	SU	14.0 ± 2.0		
						996 tone (Full tone)	14.0 ± 2.0
						26 tone	14.0 ± 2.0
						52 tone	14.0 ± 2.0
						106 tone	14.0 ± 2.0
						242 tone	12.0 ± 2.0
						484 tone	14.0 ± 2.0

2.1.2 Theory of Operation

Table 19 describes the theory of operation for FCC.

Table 19: Theory of Operation - FCC

Frequency of Operation			Scan	Ad hoc Mode	Indoor/Outdoor
2.4 GHz	11b/g/n/ac/ax (BW20)	2412-2462 MHz	Active	Yes	Both
	11n/ac/ax (BW40)	2422-2452 MHz	Active	Yes	Both
	BT	2402-2480 MHz	N/A	N/A	Both
	BLE	2402-2480 MHz	N/A	N/A	Both
W52	11a/n/ac/ax (BW20)	5180-5240 MHz	Active	Yes	Both
	11n/ac/ax (BW40)	5190-5230 MHz	Active	Yes	Both
	11ac/ax (BW80)	5210 MHz	Active	Yes	Both
W53[1]	11a/n/ac/ax (BW20)	5260-5320 MHz	Passive	No	Both
	11n/ac/ax (BW40)	5270-5310 MHz	Passive	No	Both
	11ac/ax (BW80)	5290 MHz	Passive	No	Both
W56[1]	11a/n/ac/ax (BW20)	5500-5720 MHz	Passive	No	Both
	11n/ac/ax (BW40)	5510-5710 MHz	Passive	No	Both
	11ac/ax (BW80)	5530-5690 MHz	Passive	No	Both
W58	11a/n/ac/ax (BW20)	5745-5825 MHz	Active	Yes	Both
	11n/ac/ax (BW40)	5755-5795 MHz	Active	Yes	Both
	11ac/ax (BW80)	5775 MHz	Active	Yes	Both

2.1.3 Integration Instructions

This manual is based on KDB 996369. It is designed to ensure that module manufacturers correctly communicate the necessary information to host manufacturers that incorporate their modules.

2.1.3.1 General: Applicable

Section 2.1.3.2 through Section 2.1.3.10 describe the items that must be provided in the integration instructions for host product manufacturers (e.g., OEM instruction manual) to use when integrating a module in a host product. This modular transmitter applicant (muRata) should include information in their instructions for all these items indicating clearly when they are not applicable.

2.1.3.2 List of Applicable FCC Rules: Applicable

This device complies with below part 15 of FCC Rules.
- Part 15 Subpart C
- Part 15 Subpart E

2.1.3.3 Summarize the specific operational use conditions: Applicable

This module is designed for mounting inside of the end product by us professionally. Therefore, it complies with the antenna and transmission system requirements of §15.203.

2.1.3.4 Limited Module Procedures: Applicable

This module does not supply a regulated voltage, it can only be used in a host that supplies regulated voltage.

[1] DFS MASTER function not available.
DFS client function available.
There is a TPC function.

2.1.3.5 RF Exposure Considerations: Applicable

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines. This equipment should be installed and operated keeping the radiator at least 20 centimeters or more away from person's body.

It is necessary to take a SAR test with your set mounting this module (except to use only Bluetooth). Class II permissive change application is necessary using the SAR report. Please contact Murata. And an application for a Class II permissive change from a Mobile equipment to a Portable equipment is also required.

- **Portable equipment:** Equipment for which the spaces between human body and antenna are used within 20 centimeter.
- **Mobile equipment:** Equipment used at position in which the spaces between human body and antenna exceeded 20 centimeter.

2.1.3.6 Antennas: Applicable

Table 20 lists the antenna for FCC.

Table 20: Antenna - FCC

No.	Part number	Vendor	Peak Gain [dBi]		Type	Connector
			2.4 GHz	5 GHz		
1	146153	Molex	3.2	4.25	Dipole	u.FL

2.1.3.7 Label and Compliance Information: Applicable

The following statements must be described on the user manual of the host device of this module:

Contains Transmitter Module FCC ID: VPYLBEE5ZZ1XL OR Contains FCC ID: VPYLBEE5ZZ1XL

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

If it is difficult to describe this statement on the host product due to the size, please describe in the User's manual.

FCC CAUTION

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Compliance with FCC requirement 15.407(c)

Data transmission is always initiated by software, which is passed down through the MAC, through the digital and analog baseband, and finally to the RF chip. Several special packets are initiated by the MAC. These are the only ways the digital baseband portion will turn on the RF transmitter, which then turns off at the end of the packet. Therefore, the transmitter will be on only while one of the aforementioned packets is being transmitted. In other words, this device automatically discontinue transmission in case of either absence of information to transmit or operational failure.

Frequency Tolerance: ±20 ppm

This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

When installing it in mobile equipment, please describe the following warning to the manual.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines. This equipment should be installed and operated keeping the radiator at least 20cm or more away from person's body.

This module is only approved as mobile equipment. Therefore, do not install it on portable equipment.

If you wish to use it as a portable equipment, please contact Murata in advance as Class II application accompanied by SAR testing using the final product are required.

2.1.3.8 Information On Test Modes and Additional Testing Requirements: Applicable

Please check the installation manual first. Please contact Murata if you have any questions when conducting the RF certification test on the host. We (Murata) are ready to present the control manual and others for the RF certification test.

2.1.3.9 Additional Testing, Part 15 Subpart B Disclaimer: Applicable

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

If the final product with this module is FCC Class A digital device, include the following in the manual of the final product:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

If the final product with this module is FCC Class B digital device, include the following in the manual of the final product:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: -Reorient or relocate the receiving antenna. -Increase the separation between the equipment and receiver. -Connect the equipment into an outlet on a circuit different from that to which the receiver is connected. -Consult the dealer or an experienced radio/TV technician for help.

2.1.3.10 Note on EMI Considerations: Applicable

Note that a host manufacture is recommended to use KDB 996369 D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear

interactions generate additional non-compliant limits due to module placement to host components or properties.

For standalone mode, reference the guidance in D04 Module Integration Guide and for simultaneous mode7; see D02 Module Q&A Question 12, which permits the host manufacturer to confirm compliance.

2.1.3.11 How to Make Changes: Applicable

When changing from the conditions of approval, please present technical documentation that it is equivalent to a Class I change. For example, when adding or changing an antenna, the following technical documents are required.

1. The document indicating the same type as the original antenna.
2. Technical document showing that the gain is the same or lower than the gain at the time of the original approval.
3. Technical document showing that the spurious is no more than 3 dB worse than when it was originally certified.

2.1.4 About Power Supply (Limited Condition)

This module (LBEE5ZZ1XL and LBEE5ZZ2XS) has been approved as Limited Modular Approval. These modules do not have a voltage stabilizing circuit in the power path to the internal RF circuitry. Therefore, the Limited Condition must provide a stable power supply for the supply voltage to the module. Please supply a stable power supply so that the voltage shown in **Table 21** is applied.

Table 21: Power Supply Voltages - FCC

Parameter		Minimum	Typical	Maximum	Unit
Supply Voltage	VDD33	3.14	3.3	3.46	V
	VDD18	1.71	1.8	1.89	V
	VIO	1.71 3.14	1.8 3.3	1.89 3.46	V
	VIO_SD	1.71 3.14	1.8 3.3	1.89 3.46	V

2.1.5 Feed Line

This section describes the trace antenna and feed line.

2.1.5.1 Signal Line Between an Antenna and a Module

About the signal line between an antenna and a module
It is a 50-ohm line design.
Fine tuning of return loss etc. can be performed using a matching network.
However, it is required to check "Class1 change" and "Class2 change"
which the authorities define then.
The concrete contents of a check as follows.

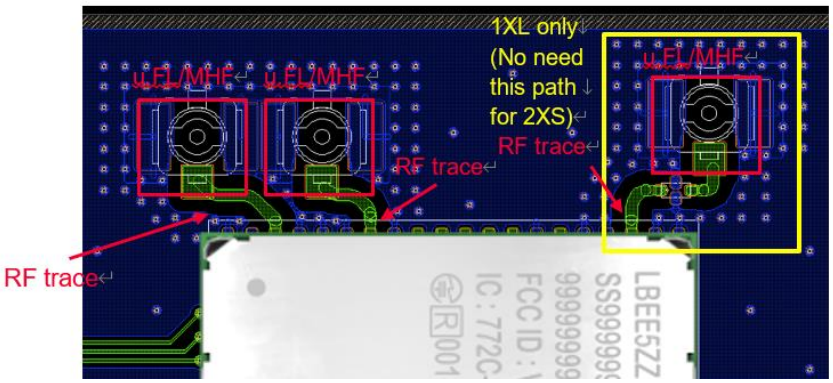
1）Different length and shapes affect radiated emissions, must confirm the same specification is used as **Figure 6** and **Figure 7**.

2）The emission level is not getting worse.

The following is the design of the EVB used for the test.

Figure 6 shows the pattern used in the certification test.

Figure 6: EVB Design Used for Testing - FCC

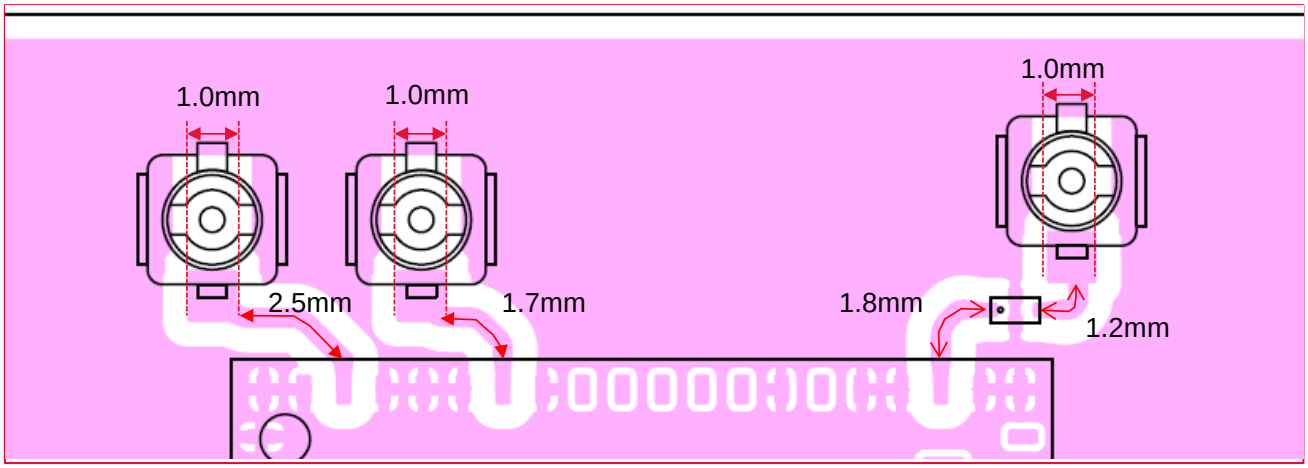


The 50Ω microstrip line needs to be copied when module is installed in the End product.

Murata provides set makers (type1xl-2xs-u-fl.dxf) with Gerber data or something similar.

Figure 7 shows the feed line of the jig where the certification test was conducted.

Figure 7: 50Ω Microstrip Line - FCC



Substrate type name of certification test jig: P2ML9917
feed line width : 0.4mm
Substrate thin : 0.8 ± 0.1 mm
Substrate material: FR -4
Substrate thickness between GND layer and surface layer: 0.408mm

2.2 ISED

PMN: LBEE5ZZ1XL	**HVIN:** LBEE5ZZ1XL LBEE5ZZ2XS	**IC:** 772C-LBEE5ZZ1XL

Since this module is not sold to general end users directly, there is no user manual of module.
For the details about this module, please refer to the specification sheet of module.
This module should be installed in the host device according to the interface specification (installation procedure).

The following information must be indicated on the host device of this module.

Contains IC: 772C-LBEE5ZZ1XL

If the final product use the following frequency, please note that there is a limit.

for indoor use only(5150-5250MHz band and channel 52, 54, 58)
Pour usage intérieur seulement (5150-5250MHz band and channel 52, 54, 58)

The following statements must be described on the user manual of the host device of this module:

English Version This device complies with Industry Canada's applicable licence-exempt RSSs. Operation is subject to the following two conditions: 1. This device may not cause interference; and 2. This device must accept any interference, including interference that may cause undesired operation of the device.
French Version Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : 1. l'appareil ne doit pas produire de brouillage; 2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

If the antenna of the end product is removed, please describe the follow warning on the manual of the end product which contains this module.

English Version This radio transmitter (772C-LBEE5ZZ1XL) has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device. : Dipole Antenna Gain: 3.2 dBi@2.4GHz/4.25 dBi@5GHz
French Version Le présent émetteur radio (772C-LBEE5ZZ1XL) a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué pour tout type figurant sur la liste, sont strictement interdits pour l'exploitation de l'émetteur. : Dipole Antenna Gain: 3.2 dBi@2.4GHz/4.25 dBi@5GHz

The following statements must be described on the user manual of the host device of this module;

English Version Data transmission is always initiated by software, which is the passed down through the MAC, through the digital and analog baseband, and finally to the RF chip. Several special packets are initiated by the MAC. These are the only ways the digital baseband portion will turn on the RF transmitter, which it then turns off at the end of the packet. Therefore, the transmitter will be on only while one of the aforementioned packets is being transmitted. In other words, this device automatically discontinue transmission in case of either absence of information to transmit or operational failure.
French Version La transmission des données est toujours initiée par le logiciel, puis les données sont transmises par l'intermédiaire du MAC, par la bande de base numérique et analogique et, enfin, à la puce RF. Plusieurs paquets spéciaux sont initiés par le MAC. Ce sont les seuls moyens pour qu'une partie de la bande de base numérique active l'émetteur RF, puis désactive celui-ci à la fin du paquet. En conséquence, l'émetteur reste uniquement activé lors de la transmission d'un des paquets susmentionnés. En d'autres termes, ce dispositif interrompt automatiquement toute transmission en cas d'absence d'information à transmettre ou de défaillance.

When installing it in a mobile equipment.

English Version This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment and meets RSS-102 of the IC radio frequency (RF) Exposure rules. This equipment should be installed and operated keeping the radiator at least 20cm or more away from person's body.
French Version Cet équipement est conforme aux limites d'exposition aux rayonnements énoncées pour un environnement non contrôlé et respecte les règles d'exposition aux fréquences radioélectriques (RF) CNR-102 de l'IC. Cet équipement doit être installé et utilisé en gardant une distance de 20 cm ou plus entre le radiateur et le corps humain.

When installing it in a portable equipment. Please describe the following warning to the manual.

- It is necessary to take a SAR test with your set mounting this module.
- Class 4 permissive change application is necessary using the SAR report.
- Please contact Murata.

- **Portable equipment:** Equipment for which the spaces between human body and antenna are used within 20 cm.
- **Mobile equipment:** Equipment used at position in which the spaces between human body and antenna exceeded 20 cm.

If it is difficult to describe this statement on the host product due to the size, please describe in the User's manual.

2.2.1 Setting RF Power

This section describes the RF power settings.

2.2.1.1 RF Power Setting for 2.4 GHz WLAN

Table 22, **Table 23**, and **Table 24** describes the RF Power Settings for 2.4 GHz WLAN.

Table 22: WLAN RF Power Setting - 2.4 GHz 802.11 b/g/n (HT20/40)/ac (VHT20/40) (ISED)

Mode	Rate/MCS index	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11b	All Rate	1, 11	14.0 ± 2.0
		2 ~ 10	18.0 ± 2.0
IEEE 802.11g	All rate	1, 11	10.0 ± 2.0
	6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps	2 ~ 10	17.0 ± 2.0
	48 Mbps, 54 Mbps	2 ~ 10	16.0 ± 2.0
IEEE 802.11n (HT20)	All MCS index	1	8.0 ± 2.0
	MCS0 ~ MCS2	2 ~ 10	16.0 ± 2.0
	MCS3 ~ MCS7	2 ~ 10	15.0 ± 2.0
	All MCS index	11	10.0 ± 2.0
IEEE 802.11n (HT40)	All MCS index	3	9.0 ± 2.0
		4 ~ 8	14.0 ± 2.0
		9	8.0 ± 2.0
IEEE 802.11ac (VHT20)	All MCS index	1	8.0 ± 2.0
	MCS0 ~ MCS2	2 ~ 10	16.0 ± 2.0
	MCS3 ~ MCS7	2 ~ 10	15.0 ± 2.0
	MCS8	2 ~ 10	14.0 ± 2.0
	All MCS index	11	10.0 ± 2.0
IEEE 802.11ac (VHT40)	All MCS index	3	9.0 ± 2.0
		4 ~ 8	14.0 ± 2.0
		9	8.0 ± 2.0

Table 23: WLAN RF Power Setting - 2.4 GHz 802.11ax (HE20) (FCC)

Mode	Rate / MCS index	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE20)	All MCS index	1	SU	8.0 ±2.0		
					242 tone (Full tone)	8.0 ±2.0
					26 tone	8.0 ±2.0
					52 tone	8.0 ±2.0
					106 tone	8.0 ±2.0
	MCS0 ~ MCS2	2 ~ 10	SU	16.0 ±2.0		
					242 tone (Full tone)	16.0 ±2.0
					26 tone	16.0 ±2.0
					52 tone	16.0 ±2.0
					106 tone	16.0 ±2.0
	MCS3 ~ MCS7	2 ~ 10	SU	15.0 ±2.0		
					242 tone (Full tone)	15.0 ±2.0
					26 tone	15.0 ±2.0
					52 tone	15.0 ±2.0
					106 tone	15.0 ±2.0
	MCS8, MCS9	2 ~ 10	SU	14.0 ±2.0		
					242 tone (Full tone)	14.0 ±2.0
					26 tone	14.0 ±2.0
					52 tone	14.0 ±2.0
					106 tone	14.0 ±2.0
	MCS10, MCS11	2 ~ 10	SU	13.0 ±2.0		

Mode	Rate / MCS index	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
					242 tone (Full tone)	13.0 ±2.0
					26 tone	13.0 ±2.0
					52 tone	13.0 ±2.0
					106 tone	13.0 ±2.0
	All MCS index	11	SU	10.0 ±2.0		
					242 tone (Full tone)	10.0 ±2.0
					26 tone	10.0 ±2.0
					52 tone	10.0 ±2.0
					106 tone	10.0 ±2.0

Table 24: WLAN RF Power Setting - 2.4 GHz 802.11ax (HE40) (FCC)

Mode	Rate / MCS index	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE40)	All MCS index	3	SU	9.0 ±2.0		
					484 tone (Full tone)	9.0 ±2.0
					26 tone	8.0 ±2.0
					52 tone	8.0 ±2.0
					106 tone	8.0 ±2.0
					242 tone	9.0 ±2.0
	MCS0 ~ MCS9	4 ~ 8	SU	14.0 ±2.0		
					484 tone (Full tone)	14.0 ±2.0
					26 tone	14.0 ±2.0
					52 tone	14.0 ±2.0
					106 tone	14.0 ±2.0
					242 tone	14.0 ±2.0
	MCS10, MCS11	4 ~ 8	SU	13.0 ±2.0		
					484 tone (Full tone)	13.0 ±2.0
					26 tone	13.0 ±2.0
					52 tone	13.0 ±2.0
					106 tone	13.0 ±2.0
					242 tone	13.0 ±2.0
	All MCS index	9	SU	8.0 ±2.0		
					484 tone (Full tone)	8.0 ±2.0
					26 tone	8.0 ±2.0
					52 tone	8.0 ±2.0
					106 tone	8.0 ±2.0
					242 tone	6.0 ±2.0

2.2.1.2 RF Power Setting for BT (BR/EDR) / BLE

Table 9 describes the RF power settings for BT (BR/EDR), BLE.

Table 25: BT / BLE RF Power Setting (ISED)

Mode	Channel	Maximum Tune Up Tolerance (dBm)
BR	NA	3.0 ± 3.0
EDR	NA	0.0 ± 3.0
LE	NA	3.0 ± 3.0
LE 2 Mbps	NA	3.0 ± 3.0

2.2.1.3 RF Power Setting for 5 GHz WLAN

Table 26 describes the RF power settings for 5 GHz 802.11a WLAN.

Table 26: WLAN RF Power Setting - 5 GHz 802.11a (ISED)

Mode	Rate	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11a	All Rate	W52/W53	36 ~ 44	8.0 ± 2.0
	All Rate	W52/W53	48	9.0 ± 2.0
	All Rate	W52/W53	52, 56	16.0 ± 2.0
	6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps	W52/W53	60	17.0 ± 2.0
	48 Mbps, 54 Mbps	W52/W53	60	16.0 ± 2.0
	All Rate	W52/W53	64	13.0 ± 2.0
	All Rate	W56	100 ~ 116, 132 ~ 136	14.0 ± 2.0
	All Rate	W56	140	13.0 ± 2.0
	All Rate	W56	144	16.0 ± 2.0
	6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps	W58	149 ~ 161	17.0 ± 2.0
	48 Mbps, 54 Mbps	W58	149 ~ 161	16.0 ± 2.0
	All Rate	W58	165	12.0 ± 2.0

Table 27 and **Table 28** Table 12describe the RF power settings for 5 GHz 802.11n WLAN.

Table 27: WLAN RF Power Setting - 5 GHz 802.11n (HT20) (ISED)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11n (HT20)	All MCS Index	W52/W53	36 ~ 44	8.0 ± 2.0
	All MCS Index	W52/W53	48	9.0 ± 2.0
	All MCS Index	W52/W53	52~60	16.0 ± 2.0
	All MCS Index	W52/W53	64	13.0 ± 2.0
	All MCS Index	W56	100 ~ 116, 132 ~ 136	14.0 ± 2.0
	All MCS Index	W56	140	12.0 ± 2.0
	All MCS Index	W58	149~161	16.0 ± 2.0
	All MCS Index	W58	165	12.0 ± 2.0

Table 28: WLAN RF Power Setting - 5 GHz 802.11n (HT40) (ISED)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11n (HT40)	All MCS index	W52/W53	38,46	10.0 ± 2.0
	All MCS Index	W52/W53	54	14.0 ± 2.0
	All MCS Index	W52/W53	62	11.0 ± 2.0
	All MCS Index	W56	102	12.0 ± 2.0
	All MCS Index	W56	110	13.0 ± 2.0

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
	All MCS Index	W56	134	14.0 ± 2.0
	All MCS Index	W56	142	16.0 ± 2.0
	All MCS Index	W58	151	16.0 ± 2.0
	All MCS index	W58	159	12.0 ± 2.0

Table 29, **Table 30**Table 14, and **Table 31** describe the RF power settings for 5 GHz 802.11ac WLAN.

Table 29: WLAN RF Power Setting - 5 GHz 802.11ac (VHT20) (ISED)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ac (VHT20)	All MCS index	W52/W53	36 ~ 44	8.0 ± 2.0
	All MCS index	W52/W53	48	9.0 ± 2.0
	MCS0 ~ MCS7	W52/W53	52~60	16.0 ± 2.0
	MCS8	W52/W53	52~60	15.0 ± 2.0
	All MCS index	W52/W53	64	13.0 ± 2.0
	All MCS index	W56	100 ~ 116, 132 ~ 136	14.0 ± 2.0
	All MCS index	W56	140	12.0 ± 2.0
	MCS0 ~ MCS7	W56	144	16.0 ± 2.0
	MCS8	W56	144	15.0 ± 2.0
	MCS0 ~ MCS7	W58	149~161	16.0 ± 2.0
	MCS8	W58	149~161	15.0 ± 2.0
	All MCS index	W58	165	12.0 ± 2.0

Table 30: WLAN RF Power Setting - 5 GHz 802.11ac (VHT40) (ISED)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ac (VHT40)	All MCS index	W52/W53	38,46	10.0 ± 2.0
	All MCS index	W52/W53	54	14.0 ± 2.0
	MCS0 ~ MCS7	W52/W53	62	11.0 ± 2.0
	All MCS index	W56	102	12.0 ± 2.0
	All MCS index	W56	110	13.0 ± 2.0
	All MCS index	W56	134	14.0 ± 2.0
	MCS0 ~ MCS7	W56	142	16.0 ± 2.0
	MCS8, MCS9	W56	142	15.0 ± 2.0
	MCS0 ~ MCS7	W58	151	16.0 ± 2.0
	MCS8, MCS9	W58	151	15.0 ± 2.0
	All MCS index	W58	159	12.0 ± 2.0

Table 31: WLAN RF Power Setting - 5 GHz 802.11ac (VHT80) (ISED)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ac (VHT80)	All MCS index	W52/W53	42,58	9.0 ± 2.0
	All MCS index	W56	106	9.0 ± 2.0
	MCS0 ~ MCS7	W56	138	15.0 ± 2.0
	MCS8, MCS9	W56	138	14.0 ± 2.0
	MCS0 ~ MCS7	W58	155	15.0 ± 2.0
	MCS8, MCS9	W58	155	14.0 ± 2.0

Table 32Table 16, **Table 33**, and

Table 34 describe the RF power settings for 5 GHz 802.11ax WLAN.

Table 32: WLAN RF Power Setting - 5 GHz 802.11ax (HE20) (ISED)

Mode	MCS Index	Band	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE20)	All MCS index	W52/W53	36 ~ 44	SU	8.0 ± 2.0		
						242 tone (Full tone)	8.0 ± 2.0
						26 tone	2.0 ± 2.0
						52 tone	3.0 ± 2.0
						106 tone	7.0 ± 2.0
	All MCS index	W52/W53	48	SU	9.0 ± 2.0		
						242 tone (Full tone)	9.0 ± 2.0
						26 tone	2.0 ± 2.0
						52 tone	3.0 ± 2.0
						106 tone	7.0 ± 2.0
	MCS0 ~ MCS7	W52/W53	52 ~ 60	SU	16.0 ± 2.0		
						242 tone (Full tone)	16.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
	MCS8 ~ MCS9	W52/W53	52 ~ 60	SU	15.0 ± 2.0		
						242 tone (Full tone)	15.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
	MCS10 ~ MCS11	W52/W53	52 ~ 60	SU	14.0 ± 2.0		
						242 tone (Full tone)	14.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
	All MCS index	W52/W53	64	SU	13.0 ± 2.0		
						242 tone (Full tone)	13.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
	All MCS index	W56	100 ~ 116, 132 ~ 136	SU	14.0 ± 2.0		
						242 tone (Full tone)	14.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
	All MCS index	W56	140	SU	12.0 ± 2.0		

Mode	MCS Index	Band	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
						242 tone (Full tone)	12.0 ± 2.0
						26 tone	5.0 ± 2.0
						52 tone	9.0 ± 2.0
						106 tone	10.0 ± 2.0
	MCS0 ~ MCS7	W56	144	SU	16.0 ± 2.0		
						242 tone (Full tone)	16.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
	MCS8, MCS9	W56	144	SU	15.0 ± 2.0		
						242 tone (Full tone)	15.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
	MCS10, MCS11	W56	144	SU	14.0 ± 2.0		
						242 tone (Full tone)	14.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
	MCS0 ~ MCS7	W58	149 ~ 161	SU	16.0 ± 2.0		
						242 tone (Full tone)	16.0 ± 2.0
						26 tone	16.0 ± 2.0
						52 tone	16.0 ± 2.0
						106 tone	16.0 ± 2.0
	MCS8 ~ MCS9	W58	149 ~ 161	SU	15.0 ± 2.0		
						242 tone (Full tone)	15.0 ± 2.0
						26 tone	15.0 ± 2.0
						52 tone	15.0 ± 2.0
						106 tone	15.0 ± 2.0
	MCS10 ~ MCS11	W58	149 ~ 161	SU	14.0 ± 2.0		
						242 tone (Full tone)	14.0 ± 2.0
						26 tone	14.0 ± 2.0
						52 tone	14.0 ± 2.0
						106 tone	14.0 ± 2.0
	All MCS index	W58	165	SU	12.0 ± 2.0		
						242 tone (Full tone)	12.0 ± 2.0
						26 tone	12.0 ± 2.0
						52 tone	12.0 ± 2.0
						106 tone	12.0 ± 2.0

Table 33: WLAN RF Power Setting - 5 GHz 802.11ax (HE40) (FCC)

Mode	MCS Index	Band	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE40)	All MCS index	W52/W53	38, 46	SU	10.0 ± 2.0		
						484 tone (Full tone)	10.0 ± 2.0
						26 tone	2.0 ± 2.0
						52 tone	3.0 ± 2.0
						106 tone	7.0 ± 2.0
						242 tone	9.0 ± 2.0
	All MCS index	W52/W53	54	SU	14.0 ± 2.0		
						484 tone (Full tone)	14.0 ± 2.0
						26 tone	9.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	13.0 ± 2.0
						242 tone	14.0 ± 2.0
	All MCS index	W52/W53	62	SU	11.0 ± 2.0		
						484 tone (Full tone)	11.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	10.0 ± 2.0
						106 tone	11.0 ± 2.0
						242 tone	10.0 ± 2.0
	All MCS index	W56	102	SU	12.0 ± 2.0		
						484 tone (Full tone)	12.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	6.0 ± 2.0
	All MCS index	W56	110	SU	13.0 ± 2.0		
						484 tone (Full tone)	13.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	13.0 ± 2.0
	All MCS index	W56	134	SU	14.0 ± 2.0		
						484 tone (Full tone)	14.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	9.0 ± 2.0
	MCS0 ~ MCS7	W56	142	SU	16.0 ± 2.0		
						484 tone (Full tone)	16.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0

Mode	MCS Index	Band	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
						242 tone	14.0 ± 2.0
	MCS8, MCS9	W56	142	SU	15.0 ± 2.0		
						484 tone (Full tone)	15.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	14.0 ± 2.0
	MCS10, MCS11	W56	142	SU	14.0 ± 2.0		
						484 tone (Full tone)	14.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	14.0 ± 2.0
	MCS0 ~ MCS7	W58	151	SU	16.0 ± 2.0		
						484 tone (Full tone)	16.0 ± 2.0
						26 tone	16.0 ± 2.0
						52 tone	16.0 ± 2.0
						106 tone	16.0 ± 2.0
						242 tone	16.0 ± 2.0
	MCS8, MCS9	W58	151	SU	15.0 ± 2.0		
						484 tone (Full tone)	15.0 ± 2.0
						26 tone	15.0 ± 2.0
						52 tone	15.0 ± 2.0
						106 tone	15.0 ± 2.0
						242 tone	15.0 ± 2.0
	MCS10, MCS11	W58	151	SU	14.0 ± 2.0		
						484 tone (Full tone)	14.0 ± 2.0
						26 tone	14.0 ± 2.0
						52 tone	14.0 ± 2.0
						106 tone	14.0 ± 2.0
						242 tone	14.0 ± 2.0
	All MCS index	W58	159	SU	12.0 ± 2.0		
						484 tone (Full tone)	12.0 ± 2.0
						26 tone	12.0 ± 2.0
						52 tone	12.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	12.0 ± 2.0

Table 34: WLAN RF Power Setting - 5 GHz 802.11ax (HE80) (FCC)

Mode	MCS Index	Band	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE80)	All MCS index	W52/W53	42	SU	9.0 ± 2.0		
						996 tone (Full tone)	9.0 ± 2.0
						26 tone	2.0 ± 2.0
						52 tone	3.0 ± 2.0
						106 tone	7.0 ± 2.0
						242 tone	9.0 ± 2.0
						484 tone	8.0 ± 2.0
	All MCS index	W52/W53	58	SU	9.0 ± 2.0		
						996 tone (Full tone)	9.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	9.0 ± 2.0
						106 tone	9.0 ± 2.0
						242 tone	9.0 ± 2.0
						484 tone	8.0 ± 2.0
	All MCS index	W56	106	SU	9.0 ± 2.0		
						996 tone (Full tone)	9.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	9.0 ± 2.0
						106 tone	9.0 ± 2.0
						242 tone	6.0 ± 2.0
						484 tone	9.0 ± 2.0
	MCS0 ~ MCS7	W56	138	SU	15.0 ± 2.0		
						996 tone (Full tone)	15.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	14.0 ± 2.0
						484 tone	15.0 ± 2.0
	MCS8 ~ MCS11	W56	138	SU	14.0 ± 2.0		
						996 tone (Full tone)	14.0 ± 2.0
						26 tone	8.0 ± 2.0
						52 tone	11.0 ± 2.0
						106 tone	12.0 ± 2.0
						242 tone	14.0 ± 2.0
						484 tone	14.0 ± 2.0
	MCS0 ~ MCS7	W58	155	SU	15.0 ± 2.0		
						996 tone (Full tone)	15.0 ± 2.0
						26 tone	15.0 ± 2.0
						52 tone	15.0 ± 2.0
						106 tone	15.0 ± 2.0
						242 tone	12.0 ± 2.0
						484 tone	14.0 ± 2.0
	MCS8 ~ MCS11	W58	155	SU	14.0 ± 2.0		

Mode	MCS Index	Band	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
						996 tone (Full tone)	14.0 ± 2.0
						26 tone	14.0 ± 2.0
						52 tone	14.0 ± 2.0
						106 tone	14.0 ± 2.0
						242 tone	12.0 ± 2.0
						484 tone	14.0 ± 2.0

2.2.2 Theory of Operation

Table 35 describes the theory of operation for ISED.

Table 35: Theory of Operation - ISED

Frequency of Operation			Scan	Ad hoc Mode
2.4 GHz	11b/g/n/ac/ax (BW20)	2412-2462 MHz	Active	Yes
	11n/ac/ax (BW40)	2422-2452 MHz	Active	Yes
	BT	2402-2480 MHz	N/A	N/A
	BLE	2402-2480 MHz	N/A	N/A
W52	11a/n/ac/ax (BW20)	5180-5240 MHz	Active	Yes
	11n/ac/ax (BW40)	5190-5230 MHz	Active	Yes
	11ac/ax (BW80)	5210 MHz	Active	Yes
W53[2]	11a/n/ac/ax (BW20)	5260-5320 MHz	Passive	No
	11n/ac/ax (BW40)	5270-5310 MHz	Passive	No
	11ac/ax (BW80)	5290 MHz	Passive	No
W56[3]	11a/n/ac/ax (BW20)	5500-5720 MHz	Passive	No
	11n/ac/ax (BW40)	5510-5710 MHz	Passive	No
	11ac/ax (BW80)	5530-5690 MHz	Passive	No
W58	11a/n/ac/ax (BW20)	5745-5825 MHz	Active	Yes
	11n/ac/ax (BW40)	5755-5795 MHz	Active	Yes
	11ac/ax (BW80)	5775 MHz	Active	Yes

2.2.3 Antenna

The antenna models for ISED are described in **Table 36**.

Table 36: Antenna – ISED

No.	Part number	Vendor	Peak Gain [dBi]		Type	Connector
			2.4 GHz	5 GHz		
1	146153	Molex	3.2	4.25	Dipole	u.FL

[2] DFS MASTER function not available.
DFS client function available.
There is a TPC function.
[3] The frequency band 5600MHz-5640MHz (11a/n 20M band), 5590MHz-5630MHz (11n/ac/ax 40M band) and 5610MHz(11ac/ax 80M band) is restricted in ISED.

2.2.3.1 Signal Line Between an Antenna and a Module

About the signal line between an antenna and a module
It is a 50-ohm line design.
Fine tuning of return loss etc. can be performed using a matching network.
However, it is required to check "Class1 change" and "Class2 change"
which the authorities define then.
The concrete contents of a check as follows.

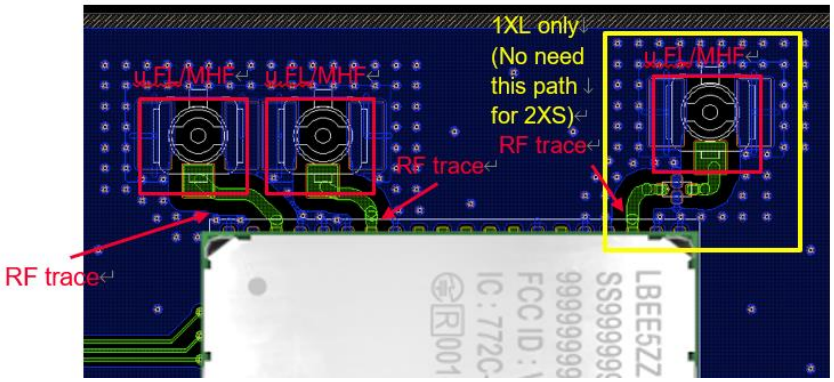
1）Different length and shapes affect radiated emissions, must confirm the same specification is used as **Figure 8**Figure 6 and **Figure 9**Figure 7.

2）The emission level is not getting worse.

The following is the design of the EVB used for the test.

Figure 8 shows the pattern used in the certification test.

Figure 8: EVB Design Used for Testing – ISED

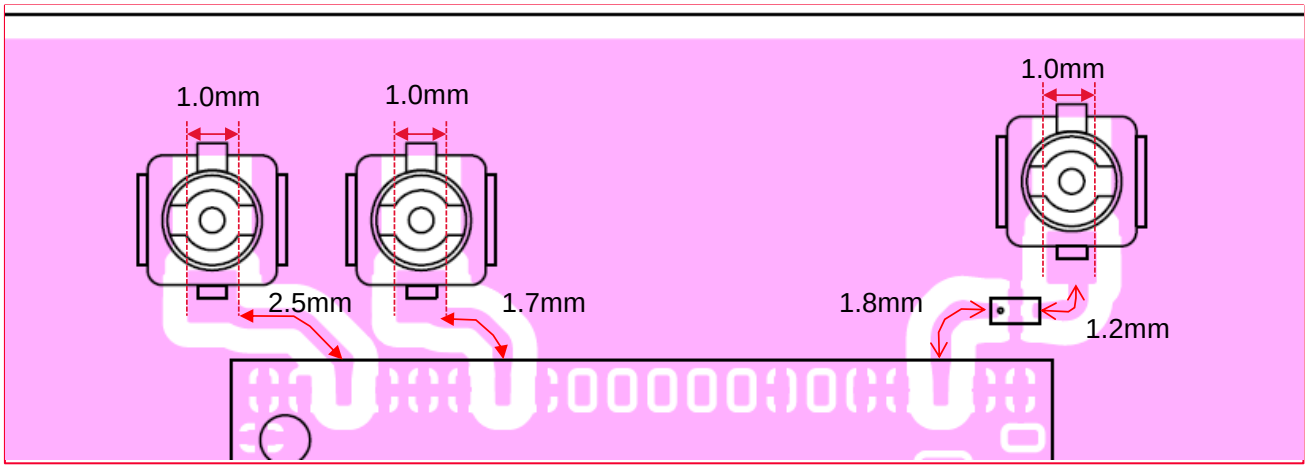


The 50Ω microstrip line needs to be copied when module is installed in the End product.

Murata provides set makers (type1xl-2xs-u-fl.dxf) with Gerber data or something similar.

Figure 9 Figure 7 shows the feed line of the jig where the certification test was conducted.

Figure 9: 50Ω Microstrip Line - ISED



Substrate type name of certification test jig: P2ML9917
feed line width : 0.4mm
Substrate thin : 0.8 ± 0.1 mm
Substrate material: FR -4
Substrate thickness between GND layer and surface layer: 0.408mm

2.3 EU

The following report is issued:

Only the Antenna Terminated Conducted test section of each report is available for TCF of the final product.

The radiation characteristic data should be acquired by you in the final product.

Radio Equipment Directive (RED) 2014/53/EU Article 3.2

Conforms to: EN 300 328 v2.2.2:2019

Report No.: E2-2022-10030

Report No.: E2-2022-10031

Report No.: E2-2022-10032

EN 301 893 v2.1.1:2017

Report No.: E2-2022-10033

Report No.: E2-2022-10034

EN 300 440 v2.1.1:2017

Report No.: E2-2022-10035

Product name: Communication Module

Model: LBEE5ZZ1XL, LBEE5ZZ2XS

Manufacture: Murata manufacturing Co., Ltd.

When shipping final products with this module to Europe, make a self-declaration that the product complies with European regulations and apply the CE mark.

2.3.1 Setting RF Power

This section describes the RF power settings.

2.3.1.1 RF Power Setting for 2.4 GHz WLAN

Table 37, **Table 38**, and **Table 39** describe the RF Power Settings for 2.4 GHz WLAN.

Table 37: WLAN RF Power Setting - 2.4 GHz 802.11 b/g/n (HT20/40)/ac (VHT20/40) (EU)

Mode	Rate/MCS index	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11b	All Rate	1 ~ 13	11.0 ± 2.0
IEEE 802.11g	All Rate	1 ~ 13	11.0 ± 2.0
IEEE 802.11n (HT20)	All MCS index	1 ~ 13	11.0 ± 2.0
IEEE 802.11n (HT40)	All MCS index	3 ~ 11	11.0 ± 2.0
IEEE 802.11ac (VHT20)	All MCS index	1 ~ 13	11.0 ± 2.0
IEEE 802.11ac (VHT40)	All MCS index	3 ~ 11	11.0 ± 2.0

Table 38: WLAN RF Power Setting - 2.4 GHz 802.11ax (HE20) (EU)

Mode	Rate / MCS index	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE20)	All MCS index	1 ~ 13	SU	11.0 ± 2.0		
					242 tone (Full tone)	11.0 ± 2.0
					26 tone	6.0 ± 2.0
					52 tone	8.0 ± 2.0
					106 tone	11.0 ± 2.0

Table 39: WLAN RF Power Setting - 2.4 GHz 802.11ax (HE40) (EU)

Mode	Rate / MCS index	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE40)	All MCS index	3 ~ 11	SU	11.0 ± 2.0		
					484 tone (Full tone)	11.0 ± 2.0
					26 tone	6.0 ± 2.0
					52 tone	8.0 ± 2.0
					106 tone	11.0 ± 2.0
					242 tone	11.0 ± 2.0

2.3.1.2 RF Power Setting for BT (BR/EDR) / BLE

Table 40 describes the RF power settings for BT (BR/EDR), BLE.

Table 40: BT / BLE RF Power Setting - EU

Mode	Channel	Maximum Tune Up Tolerance (dBm)
BR	NA	3.0 ± 3.0
EDR	NA	0.0 ± 3.0
LE	NA	3.0 ± 3.0
LE 2 Mbps	NA	3.0 ± 3.0

2.3.1.3 RF Power Setting for 5 GHz WLAN (W52/W53/W56)

Table 41 and **Table 42** describe the RF power settings for 5 GHz WLAN (W52/W53/W56).

Table 41: WLAN RF Power Setting - 5 GHz 802.11a/n/ac for Channels 36 ~ 140 (EU)

Mode	Rate/MCS Index	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11a	All Rate	36 ~ 140	13.0 ± 2.0
IEEE 802.11n (HT20)	All MCS index	36 ~ 140	13.0 ± 2.0
IEEE 802.11n (HT40)	All MCS index	38 ~ 134	13.0 ± 2.0
IEEE 802.11ac (VHT20)	All MCS index	36 ~ 140	13.0 ± 2.0
IEEE 802.11ac (VHT40)	All MCS index	38 ~ 134	13.0 ± 2.0
IEEE 802.11ac (VHT80)	All MCS index	42 ~ 122	13.0± 2.0

Table 42: WLAN RF Power Setting - 5 GHz 802.11ax for Channels 36 ~ 140 (EU)

Mode	MCS Index	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE20)	All MCS index	36 ~ 140	SU	13.0 ± 2.0		
					242 tone (Full tone)	13.0 ± 2.0
					26 tone	6.0 ± 2.0
					52 tone	8.0 ± 2.0
					106 tone	11.0 ± 2.0
IEEE 802.11ax (HE40)	All MCS index	38 ~ 134	SU	13.0 ± 2.0		
					484 tone (Full tone)	13.0 ± 2.0
					26 tone	6.0 ± 2.0
					52 tone	8.0 ± 2.0
					106 tone	11.0 ± 2.0
					242 tone	13.0 ± 2.0
IEEE 802.11ax (HE80)	All MCS index	42~122	SU	14.0 ± 2.0		
					996 tone (Full tone)	14.0 ± 2.0
					26 tone	7.0 ± 2.0
					52 tone	9.0 ± 2.0
					106 tone	12.0 ± 2.0
					242 tone	14.0 ± 2.0
					484 tone	14.0 ± 2.0

2.3.1.4 RF Power Setting for 5 GHz WLAN (W58)

Table 43 and **Table 44** describe the RF power settings for 5 GHz WLAN (W58).

Table 43: WLAN RF Power Setting - 5 GHz 802.11 a/n/ac for Channels 149 ~ 165 (EU)

Mode	Rate/MCS Index	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11a	All Rate	149 ~ 165	4.0 ± 2.0
IEEE 802.11n (HT20)	All MCS index	149 ~ 165	4.0 ± 2.0
IEEE 802.11n (HT40)	All MCS index	149 ~ 165	4.0 ± 2.0
IEEE 802.11ac (VHT20)	All MCS index	149 ~ 165	4.0 ± 2.0
IEEE 802.11ac (VHT40)	All MCS index	151 ~ 159	4.0 ± 2.0
IEEE 802.11ac (VHT80)	All MCS index	155	4.0 ± 2.0

Table 44: WLAN RF Power Setting - 5 GHz 802.11ax for Channels 149 ~ 165 (EU)

Mode	MCS Index	Channel	SU	Maximum Tune Up Tolerance (dBm)	RU	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ax (HE20)	All MCS index	149 ~ 165	SU	4.0 ± 2.0		
					242 tone (Full tone)	4.0 ± 2.0
					26 tone	4.0 ± 2.0
					52 tone	4.0 ± 2.0
					106 tone	4.0 ± 2.0
IEEE 802.11ax (HE40)	All MCS index	151 ~ 159	SU	4.0 ± 2.0		
					484 tone (Full tone)	4.0 ± 2.0
					26 tone	4.0 ± 2.0
					52 tone	4.0 ± 2.0
					106 tone	4.0 ± 2.0
					242 tone	4.0 ± 2.0
IEEE 802.11ax (HE80)	All MCS index	155	SU	4.0 ± 2.0		
					996 tone (Full tone)	4.0 ± 2.0
					26 tone	4.0 ± 2.0
					52 tone	4.0 ± 2.0
					106 tone	4.0 ± 2.0
					242 tone	4.0 ± 2.0
					484 tone	4.0 ± 2.0

2.3.2 Theory of Operation

Table 45 describes the theory of operation for EU.

Table 45: Theory of Operation - EU

Frequency of Operation			Scan	Ad hoc Mode
2.4 GHz	11b/g/n/ac/ax (BW20)	2412-2472 MHz	Active	Yes
	11n/ac/ax (BW40)	2422-2462 MHz	Active	Yes
	BT	2402-2480 MHz	N/A	N/A
	BLE	2402-2480 MHz	N/A	N/A
W52	11a/n/ac/ax (BW20)	5180-5240 MHz	Active	Yes
	11n/ac/ax (BW40)	5190-5230 MHz	Active	Yes
	11ac/ax (BW80)	5210 MHz	Active	Yes
W53[4]	11a/n/ac/ax (BW20)	5260-5320 MHz	Passive	No
	11n/ac/ax (BW40)	5270-5310 MHz	Passive	No
	11ac/ax (BW80)	5290 MHz	Passive	No
W56[4]	11a/n/ac/ax (BW20)	5500-5700 MHz	Passive	No
	11n/ac/ax (BW40)	5510-5670 MHz	Passive	No
	11ac/ax (BW80)	5530-5610 MHz	Passive	No
W58	11a/n/ac/ax (BW20)	5745-5825 MHz	Active	Yes
	11n/ac/ax (BW40)	5755-5795 MHz	Active	Yes
	11ac/ax (BW80)	5775 MHz	Active	Yes

[4] DFS MASTER function not available.
DFS client function available.
There is a TPC function.

2.4 Japan

- **Manufacturer Name:** Murata Manufacturing Co., Ltd.
- **Model or Product Name:** LBEE5ZZ1XL and LBEE5ZZ2XS

This module has received “CERTIFICATION for TYPE CERTIFICATION" under the Japanese Radio Act.

電波法の要求に基づく警告
（警告）5 GHz の周波数帯においては、5.2 GHz/5.3GHz/5.6GHz 帯 (W52/W53/W56)の 3 種類の帯域を使用することができます。5.2 GHz/5.3 GHz 帯無線 LAN (W52/W53)の屋外使用は 5.2 GHz 帯高出力データ通信システムの基地局又は陸上移動中継局と通信する場合を除き電波法で禁止されています

English Translation
Warning based on the requirements of Japanese Radio Act.
(Warning) In the 5GHz frequency band, you can use 3 bands: 5.2 GHz/5.3 GHz/5.6 GHz(W52/W53/W56).
Outdoor use of 5.2 GHz/5.3 GHz band wireless LANs(W52/W53) is prohibited by the Radio Act except when communicating with 5.2 GHz band high-power data communication system base stations or land mobile relay stations.

R 001-P01770
W52/53 は屋内使用限定

2.4 GHz と 5 GHz (W52, W53, W56)で使用するモジュールです。
W53/W56 は子局としてのみ動作させてください。

English Translation
This is a module for use at 2.4 GHz and 5 GHz (W52, W53, W56).
Operate the W53/W56 only as a client mode.

2.4.1 Product Outline

This specification characterizes the IEEE 802.11 a/b/g/n/ac/ax + Bluetooth BR/EDR/LE combo module.

- **Product Size:** 19.1 x 16.5 millimeter (Typical), H = 2.1 millimeter (Maximum)
- **Wireless-IC:** NXP 88W9098 inside
- **Reference Clock**: 40 MHz X′tal
- **Weight:** 1.355 g

2.4.2 Feature

- **Product Name:** Communication Module
- **Model Name:** LBEE5ZZ1XL, LBEE5ZZ2XS
- **Purpose of the equipment:** Telecommunication
- **Equipment Type:** Transceiver
- **Frequency band:** 2412-2472 MHz/ 2402-2480 MHz/ 2405-2480 MHz/ 5180-5320 MHz/ 5500-5720 MHz

- **Channel:** (WLAN)1 ~ 13 ch/ 36 ~ 64 ch/ 100 ~ 144 ch
  (BT)1 ~ 79 ch (BLE) 1 ~ 40 ch
- **Bandwidth:** (WLAN) 2.4 GHz 11b (20 MHz)/11g (20 MHz)/11n (20/40 MHz)/
  11ac(20/40MHz)/11ax(20/40MHz)
  5 GHz 11a (20 MHz)/11n (20/40 MHz)/11ac (20/40/80 MHz)/11ax (20/40/80 MHz)
  (BT) Hopping off 1 MHz / Hopping on 79 MHz
  (BLE) 1 MHz / 2 MHz
- **Input Voltage to RF parts:** VDD33 Typical 3.3V
  VDD18 Typical 1.8V

2.4.3 Setting RF Power

This section describes the RF power settings.

2.4.3.1 RF Power Setting for 2.4 GHz WLAN

Table 46 describes the RF power settings for 2.4 GHz WLAN.

Table 46: WLAN RF Power Setting - 2.4 GHz 802.11 b/g/n (HT20/40)/ac (VHT20/40)/ax (HE20/40) (Japan)

Mode	Rate/MCS index	Channel	Output Power in dBm (typical)
IEEE 802.11b	All Rate	1 ~ 13	11.0
IEEE 802.11g	All Rate	1 ~ 13	13.0
IEEE 802.11n (HT20)	All MCS index	1 ~ 13	13.0
IEEE 802.11n (HT20)	All MCS index	3 ~ 11	13.0
IEEE 802.11ac (VHT20)	All MCS index	1 ~ 13	13.0
IEEE 802.11ac (VHT40)	All MCS index	3 ~ 11	13.0
IEEE 802.11ax (HE20)	All MCS index	1 ~ 13	13.0
IEEE 802.11ax (HE40)	All MCS index	3 ~ 11	13.0

2.4.3.2 RF Power Setting BT (BR/EDR) / BLE

RF power settings for BT (BR/EDR), BLE are described in the following tables.

Table 47 shows BT (BR/EDR) and BLE power setting.

Table 47: BT / BLE RF Power Setting - Japan

Mode	Output Power in dBm (typical)
BR	3.0
EDR	0.0
LE	3.0
LE 2 Mbps	3.0

2.4.3.3 RF Power Setting for 5 GHz WLAN

Table 48 describes the RF power settings for 5 GHz WLAN.

Table 48: WLAN RF Power Setting - 5 GHz 802.11a/n/ac/ax (Japan)

Mode	Rate/MCS Index	Band	Channel	Output Power in dBm (typical)
IEEE 802.11a	All Rate	W52/W53	36 ~ 64	10.0
	6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps	W56	100 ~ 144	17.0
	48 Mbps, 54 Mbps	W56	100 ~ 144	16.0
IEEE 802.11n (HT20)	All MCS index	W52/W53	36 ~ 64	10.0
	All MCS index	W56	100 ~ 144	16.0
IEEE 802.11n (HT40)	All MCS index	W52/W53	38 ~ 62	10.0
	All MCS index	W56	102 ~ 142	16.0
IEEE 802.11ac (VHT20)	All MCS index	W52/W53	36 ~ 64	10.0
	MCS0 ~ MCS7	W56	100 ~ 144	16.0
	MCS8	W56	100 ~ 144	15.0
IEEE 802.11ac (VHT40)	All MCS index	W52/W53	38 ~ 62	10.0
	MCS0 ~ MCS7	W56	102 ~ 142	16.0
	MCS8 ~ MCS9	W56	102 ~ 142	15.0
IEEE 802.11ac (VHT80)	All MCS index	W52/W53	42, 58	10.0
	MCS0 ~ MCS7	W56	106 ~ 138	15.0
	MCS8 ~ MCS9	W56	106 ~ 138	14.0
IEEE 802.11ax (HE20)	All MCS index	W52/W53	36 ~ 64	10.0
	MCS0 ~ MCS7	W56	100 ~ 144	16.0
	MCS8 ~ MCS9	W56	100 ~ 144	15.0
	MCS10 ~ MCS11	W56	100 ~ 144	14.0
IEEE 802.11ax (HE40)	All MCS index	W52/W53	38 ~ 62	10.0
	MCS0 ~ MCS7	W56	102 ~ 142	16.0
	MCS8 ~ MCS9	W56	102 ~ 142	15.0
	MCS10 ~ MCS11	W56	102 ~ 142	14.0
IEEE 802.11ax (HE80)	All MCS index	W52/W53	42, 58	10.0
	MCS0 ~ MCS7	W56	106 ~ 138	15.0
	MCS8 ~ MCS11	W56	106 ~ 138	14.0

2.4.4 Types of Radio Emissions

Table 49 describes the types of radio emissions.

Table 49: Types of Radio Emissions

Mode	Rate/MCS Index	Modulation System	Types of Radio Emissions
Bluetooth	BR	GFSK	F1D
	EDR 2Mbps	π/4DQPSK	G1D
	EDR 3Mbps	8DPSK	G1D
	LE 1 Mbps, LE 2 Mbps	GFSK	F1D
IEEE 802.11b	1 Mbps	DBPSK	G1D
	2 Mbps	DQPSK	G1D
	5.5 Mbps, 11 Mbps	CCK	G1D
IEEE 802.11g IEEE 802.11a	6Mbps, 9 Mbps	BPSK	G1D
	12Mbps, 18 Mbps	QPSK	G1D
	24Mbps, 36 Mbps	16 QAM	D1D
	48Mbps, 54 Mbps	64 QAM	D1D
IEEE 802.11n IEEE 802.11ac IEEE 802.11ax	MCS0	BPSK	G1D
	MCS1, MCS2	QPSK	G1D
	MCS3, MCS4	16 QAM	D1D
	MCS5, MCS6, MCS7	64 QAM	D1D

Mode	Rate/MCS Index	Modulation System	Types of Radio Emissions
IEEE 802.11ac IEEE 802.11ax	MCS8, MCS9	256 QAM	D1D
IEEE 802.11ax	MCS10, MCS11	1024QAM	D1D

2.4.5 Theory of Operation

Table 50 describes the theory of operation for Japan.

Table 50: Theory of Operation - Japan

Frequency of Operation			Scan	Ad hoc Mode
2.4 GHz	11b/g/n/ac/ax(BW20)	2412-2472 MHz	Active	Yes
	11n/ac/ax(BW40)	2422-2462 MHz	Active	Yes
	BT	2402-2480 MHz	N/A	N/A
	BLE	2402-2480 MHz	N/A	N/A
W52	11a/n/ac/ax (BW20)	5180-5240 MHz	Active	Yes
	11n/ac/ax (BW40)	5190-5230 MHz	Active	Yes
	11ac/ax (BW80)	5210 MHz	Active	Yes
W53[5]	11a/n/ac/ax (BW20)	5260-5320 MHz	Passive	No
	11n/ac/ax (BW40)	5270-5310 MHz	Passive	No
	11ac/ax (BW80)	5290 MHz	Passive	No
W56[5]	11a/n/ac/ax (BW20)	5500-5720 MHz	Passive	No
	11n/ac/ax (BW40)	5510-5710 MHz	Passive	No
	11ac/ax (BW80)	5530-5690 MHz	Passive	No

2.4.6 Antenna

The antenna registered under the Radio Act Certification of Japan are described in **Table 51**.

Table 51: Antenna - Japan

No.	Part number	Vendor	Peak Gain [dBi]		Type	Connector
			2.4 GHz	5 GHz		
1	146153	Molex	3.2	4.25	Dipole	u.FL
2	219611	Molex	2.67	3.67	Dipole	u.FL
3	146187	Molex	3.2	4.25	Dipole	u.FL
4	WT32D1-KX	Unictron	3.0	4.0	Dipole	MHF I
5	AA258	Unictron	0.9	3.8	Dipole	MHF I
6	TA-38B-A-W01	Unictron	2.61	3.07	Dipole	RSMA
7	GW.48.A151	Taoglas	1.82	3.28	Dipole	RSMA
8	SRF2W012	Antenova	3.0	4.0	Dipole	MHF I
9	STDANTEMD-013(dipole)	Sansei	1.9	2.8	Dipole	MHF I

[5] DFS MASTER function not available.
DFS client function available.
There is a TPC function.

2.4.7 Notification

It is recommended that the indication of (1) or (2) below is described on the product incorporating this module in Japanese. If there is any problem with the indication of (1) or (2) on the product, we recommend indicating (1) or (2) in the user manual or on the package of the product incorporating this module, or electronic display on the product. In the case of the electronic display, it is necessary to describe "using the electronic display" + "how to reach to below indication" in the user manual of the product.

Japan Version

(1)

本製品は、電波法に基づく工事設計認証(認証番号:001-P01770)を受けた特定無線設備を内蔵しています。

(2)

R001-P01770

5.2 GHz/5.3 GHz 帯無線 LAN(W52/W53)の屋外使用は 5.2 GHz 帯高出力データ通信システムの基地局又は陸上移動中継局と通信する場合を除き電波法で禁止されています。

English Version

(1)

This product incorporates specified radio equipment that has received CERTIFICATION for TYPE CERTIFICATION (certification number: 001-P01770) based on the Japan Radio Act.

(2)

R001-P01770

Outdoor use of 5.2 GHz/5.3 GHz band wireless LANs (W52/W53) is prohibited by the Radio Act except when communicating with 5.2 GHz band high-power data communication system base stations or land mobile relay stations.

Revision History

Revision	Date	Changed Item	Comment
1.0	Mar 27, 2025	Issued as Application Note.	Initial Release
2.0	Dec 02, 2025	2.3 EU 2.3.1.4 RF Power Setting for 5 GHz WLAN (W58) 2.3.2 Theory of Operation	Removed EN62311 Removed channel 169

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