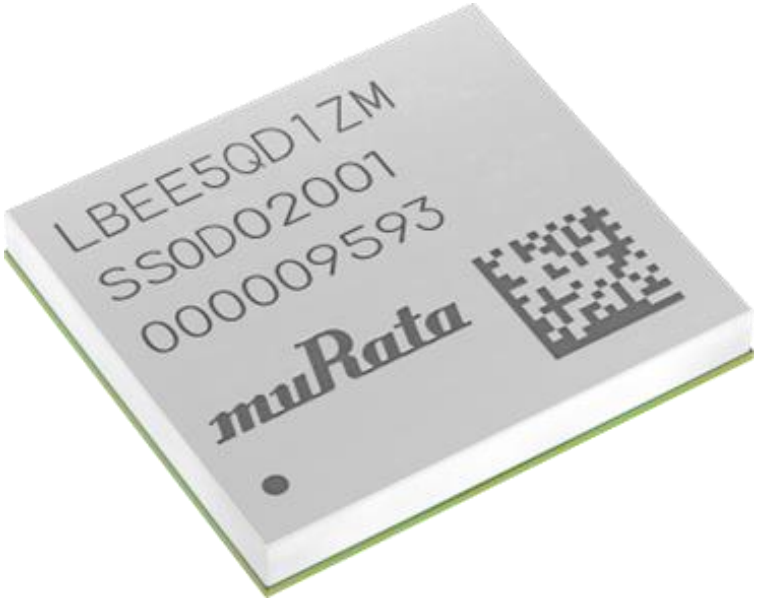
Application Note

Type 1ZM Wi-Fi™ + Bluetooth® Module

NXP 88W8987 Chipset for 802.11a/b/g/n/ac + Bluetooth 5.1
Radio Law Certification Application Note - Rev. 2.0

- Design Name: Type 1ZM
- P/N: LBEE5QD1ZM



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About This Document

Murata's Type 1ZM is a small and high-performance module based on NXP 88W8987 combo chipset, supporting IEEE 802.11a/b/g/n/ac + Bluetooth 5.1 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 1ZM 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

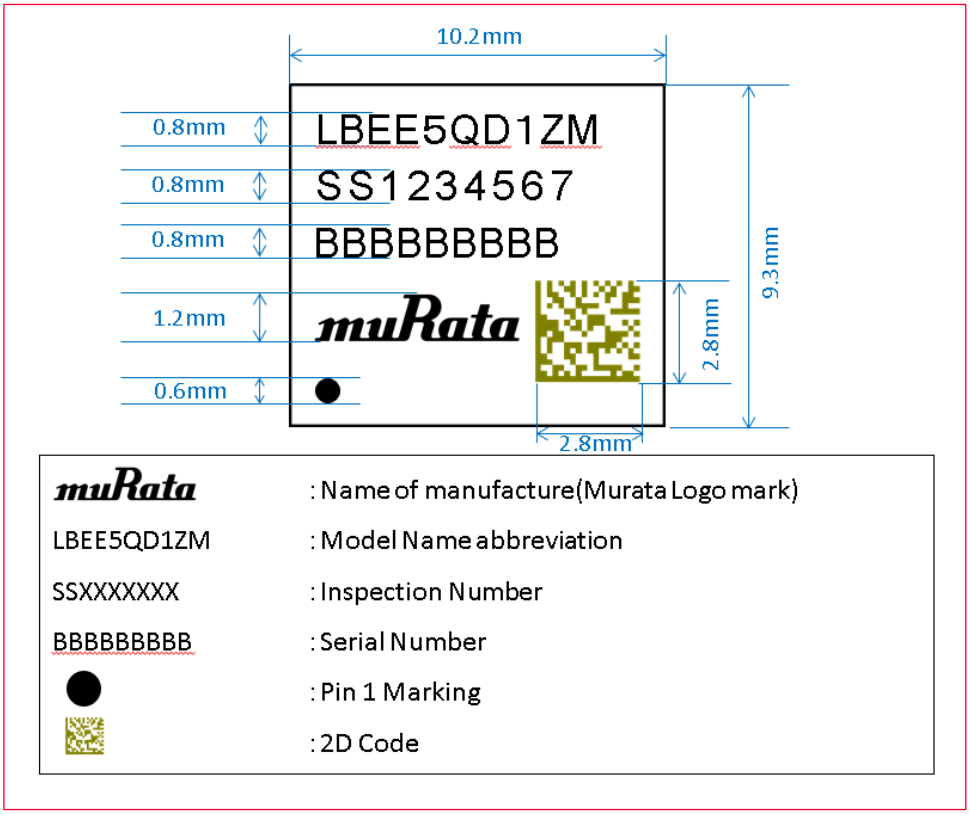
1.1 Application Model Part Number

Application model part number: **LBEE5QD1ZM**

1.2 Markings / Dimensions

Figure 1 shows the module labels.

Figure 1: Labels



Since there is no space to describe the notational requirements of each country, we are applying for the notational requirements to be posted in the manual and package.

1.3 Pin Layout

Figure 2 shows the pin layout.

Figure 2: Pin Layout

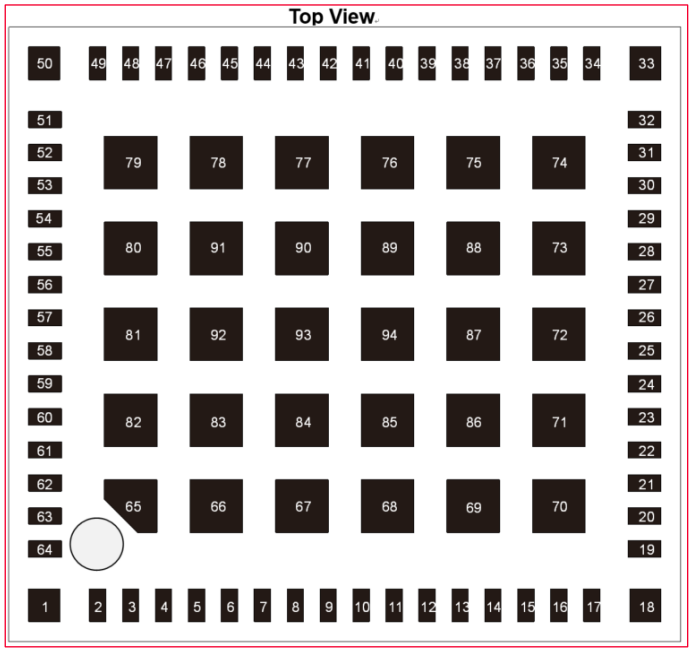


Table 2 describes the pin number.

Table 2: Terminal Configurations

No	Pin name	No	Pin name	No	Pin name	No	Pin name
1	GND	18	GND	35	VBAT	52	GND
2	GND	19	GND	36	GND	53	SD_DAT2
3	GPIO19	20	RF	37	GND	54	SD_DAT3
4	GPIO18	21	GND	38	GPIO15	55	SD_DAT1
5	GPIO17	22	GND	39	GPIO14	56	SD_DAT0
6	GPIO16	23	CONFIG_AUTO_REF_DET	40	GPIO13	57	SD_CMD
7	GPIO7	24	GND	41	GPIO12	58	GND
8	GPIO0	25	GND	42	PMIC_EN	59	SD_CLK
9	GPIO6	26	GND	43	GND	60	GND
10	GPIO5	27	GPIO1	44	NC(PDn)	61	SLP_CLK_IN
11	GPIO4	28	GPIO2	45	GND	62	GND
12	CONFIG_HOST[0]	29	GPIO3	46	GPIO11	63	VIO
13	CONFIG_HOST[1]	30	GPIO20	47	GPIO10	64	GND
14	AVDD18	31	GND	48	GPIO9	65 ~ 94	GND
15	GND	32	GND	49	GPIO8		
16	GND	33	GND	50	GND		
17	GND	34	VBAT	51	GND		

1.4 Operating Conditions

Table 3 describes the operating conditions.

Table 3: Operating Conditions

Parameter		Minimum	Typical	Maximum	Unit
Operating Temperature		-40	25	85	°C
Supply Voltage	VBAT	2.7	3.3	5.5	V
	VIO	1.62	1.8	1.98	V

VBAT: Only this power supply affects the RF characteristics.

1.5 Package Label

Figure 3 shows the package and **Figure 4** shows an example of the package label.

Figure 3: Package (Humidity-proof Packaging)

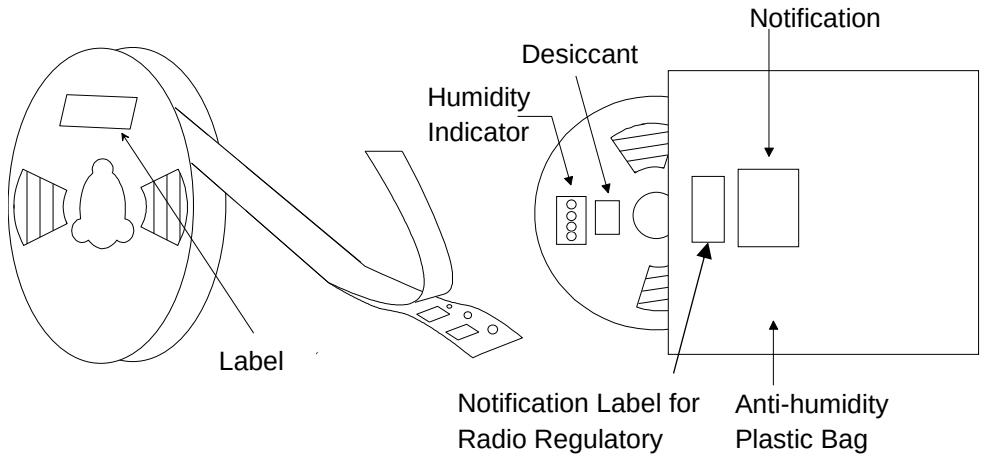
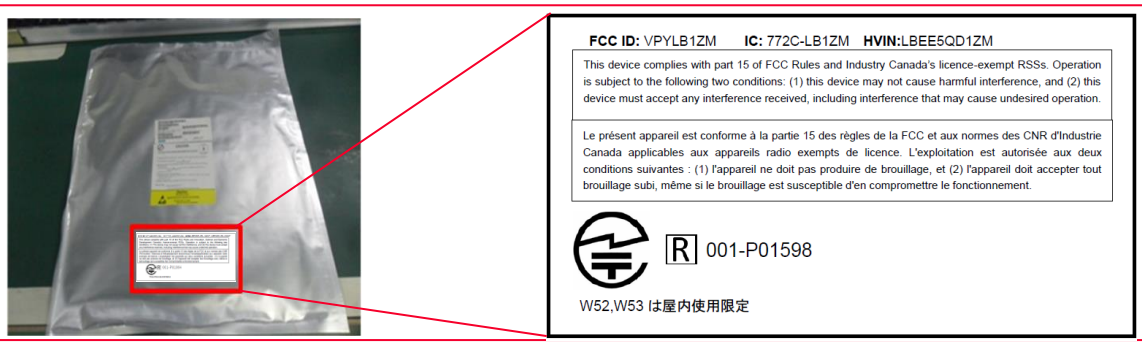


Figure 4: Package Label Display Example



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
- NCC (Taiwan)

2.1 FCC

Model Name: LBEE5QD1ZM

FCC ID: VPYLB1ZM

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).

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.

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

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.

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

Since there is no space which indicates FCC ID on this module, FCC ID is indicated in a manual.
If the FCC ID is not visible when the module is installed inside another device,
then the module is installed must also display a label referring to the enclosed module.

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

RF Power Settings for 2.4 GHz WLAN are described in **Table 4**.

Table 4: WLAN RF Power Setting - 2.4 GHz 802.11 b/g/n (HT20)/ac (VHT20) (FCC)

Mode	Rate/MCS index	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11b	All Rate	1 ~ 11	17.0 ± 2.0
IEEE 802.11g	All Rate	1 ~ 3, 9 ~ 11	14.0 ± 2.0
	6Mbps, 9Mbps, 12Mbps, 18Mbps	4 ~ 8	17.0 ± 2.0
	24Mbps, 36Mbps, 48Mbps, 54Mbps	4 ~ 8	16.0 ± 2.0
IEEE 802.11n (HT20)	All MCS index	1 ~ 3, 9 ~ 11	13.0 ± 2.0
	MCS0 ~ MCS2	4 ~ 8	16.0 ± 2.0
	MCS3 ~ MCS7	4 ~ 8	15.0 ± 2.0
IEEE 802.11ac (VHT20)	All MCS index	1 ~ 3, 9 ~ 11	13.0 ± 2.0
	MCS0 ~ MCS2	4 ~ 8	16.0 ± 2.0
	MCS3 ~ MCS7	4 ~ 8	15.0 ± 2.0
	MCS8	4 ~ 8	14.0 ± 2.0

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

RF power settings for BT (BR/EDR), BLE are described in **Table 5**.

Table 5: BT / BLE RF Power Setting (FCC)

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

2.1.1.3 RF Power Setting for 5 GHz WLAN

RF power settings for 5 GHz WLAN are described in **Table 6** through **Table 11**.

Table 6: 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	14.0 ± 2.0
		W52/W53	40 ~ 60	15.0 ± 2.0
		W56	100	14.0 ± 2.0
		W56	104 ~ 144	15.0 ± 2.0

Mode	Rate	Band	Channel	Maximum Tune Up Tolerance (dBm)
		W58	149 ~ 165	15.0 ± 2.0

Table 7: 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, 64	13.0 ± 2.0
		W52/W53	40 ~ 60	14.0 ± 2.0
		W56	100	13.0 ± 2.0
		W56	104 ~ 144	14.0 ± 2.0
		W58	149 ~ 165	14.0 ± 2.0

Table 8: 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	12.0 ± 2.0
		W52/W53	46, 54	14.0 ± 2.0
		W56	102	12.0 ± 2.0
		W56	110 ~ 142	14.0 ± 2.0
		W58	151, 159	14.0 ± 2.0

Table 9: 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, 64	13.0 ± 2.0
		W52/W53	40 ~ 60	14.0 ± 2.0
		W56	100	13.0 ± 2.0
		W56	104 ~ 144	14.0 ± 2.0
		W58	149 ~ 165	14.0 ± 2.0

Table 10: 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	12.0 ± 2.0
	MCS0 ~ MCS7	W52/W53	46, 54	14.0 ± 2.0
	MCS8, MCS9	W52/W53	46, 54	13.0 ± 2.0
	All MCS index	W56	102	12.0 ± 2.0
	MCS0 ~ MCS7	W56	110 ~ 142	14.0 ± 2.0
	MCS8, MCS9	W56	110 ~ 142	13.0 ± 2.0
	MCS0 ~ MCS7	W58	151, 159	14.0 ± 2.0
	MCS8, MCS9	W58	151, 159	13.0 ± 2.0

Table 11: 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	10.0 ± 2.0
	All MCS index	W56	106	10.0 ± 2.0
	MCS0 ~ MCS2	W56	122, 138	14.0 ± 2.0
	MCS3 ~ MCS9	W56	122, 138	13.0 ± 2.0
	MCS0 ~ MCS2	W58	155	14.0 ± 2.0
	MCS3 ~ MCS9	W58	155	13.0 ± 2.0

2.1.2 Theory of Operation

Table 12 describes the theory of operation.

Table 12: Theory of Operation - FCC

Frequency of Operation			Scan	Ad hoc Mode
2.4 GHz	11b/g/n/ac ((V)HT20)	2412-2462 MHz	Active	Yes
	BT	2402-2480 MHz	N/A	N/A
	BLE	2402-2480 MHz	N/A	N/A
W52	11a/n/ac ((V)HT20)	5180-5240 MHz	Active	Yes
	11n/ac ((V)HT40)	5190-5230 MHz	Active	Yes
	11ac (VHT80)	5210 MHz	Active	Yes
W53	11a/n/ac ((V)HT20)	5260-5320 MHz	Passive	No
	11n/ac ((V)HT40)	5270-5310 MHz	Passive	No
	11ac (VHT80)	5290 MHz	Passive	No
W56	11a/n/ac ((V)HT20)	5500-5720 MHz	Passive	No
	11n/ac ((V)HT40)	5510-5710 MHz	Passive	No
	11ac (VHT80)	5530-5690 MHz	Passive	No
W58	11a/n/ac ((V)HT20)	5745-5825 MHz	Active	Yes
	11n/ac ((V)HT40)	5755-5795 MHz	Active	Yes
	11ac (VHT80)	5775 MHz	Active	Yes

2.1.3 Antenna

Table 13 describes the FCC antenna.

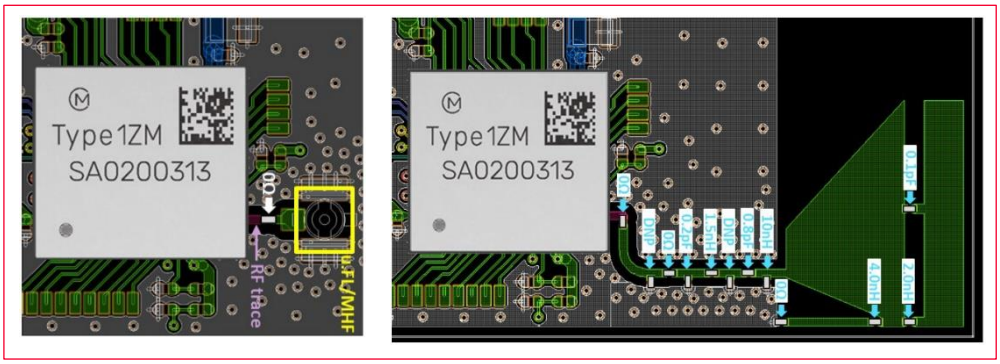
Table 13: Antenna - FCC

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	146187	Molex	3.0	4.25	Dipole	u.FL
3	LBEE5QD1ZM_Antenna	Murata	3.6	4.6	Monopole	Trace

50Ω line (microstrip line pattern)
Certification tests are conducted in the following patterns.

Figure 5 shows the pattern used in the certification test for FCC.

Figure 5: 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 with Gerber data or something similar.

2.1.4 Integration Instructions

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

Contains Transmitter Module FCC ID: VPYLB1ZM	OR	Contains FCC ID: VPYLB1ZM

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.

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.

Frequency Tolerance: ±20 ppm

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

Compliance with FCC requirement 15.407(c)
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. Frequency Tolerance: ±20 ppm.

When installing it in a 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.

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

The available scientific evidence does not show that any health problems are associated with using low power wireless devices. There is no proof, however, that these low power wireless devices are absolutely safe. Low power Wireless devices emit low levels of radio frequency energy (RF) in the microwave range while being used. Whereas high levels of RF can produce health effects (by heating tissue), exposure of low-level RF that does not produce heating effects causes no known adverse health effects. Many studies of low-level RF exposures have not found any biological effects. Some studies have suggested that some biological effects might occur, but such findings have not been

confirmed by additional research. LBEE5QD1ZM has been tested and found to comply with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines.

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.

- **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.

2.2 ISED

PMN: LBEE5QD1ZM	**HVIN:** LBEE5QD1ZM	**IC:** 772C-LB1ZM

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-LB1ZM

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

In case of the final product which can be carried around to outdoor.

The following indication is necessary to the final product.
When the AP function is used in W52;
At the time of a channel setting of W52, please indicate "for indoor use only".
During connecting, please show the channel number which connects.
And please indicate that the end user may find out "for indoor use only channel".
When the STA function is used in channel 52, 54, 58, at the time of the channel 52 or 54 or 58 setting, please indicate "for indoor use only channel".
During connecting, please show the channel number which connects.

And please indicate that the end user may find out "for indoor use only channel".

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 (IC Number : 772C-LB1ZM) identify the device by certification number or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device. : 146153 Dual Dipole antenna Gain: +3.2dBi@2.4GHz +4.25dBi@5GHz : 146187 Dual Dipole antenna Gain: +3.0dBi@2.4GHz +4.25dBi@5GHz : LBEE5QD1ZM-Antenna monopole antenna Gain: +3.6dBi@2.4GHz +4.6dBi@5GHz
French Version Le présent émetteur radio (IC Number : 772C-LB1ZM) a été approuvé par Industrie 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, sont strictement interdits pour l'exploitation de l'émetteur. Type d'antenne : 146153 Dual Dipole antenna Gain: +3.2dBi@2.4GHz +4.25dBi@5GHz : 146187 Dual Dipole antenna Gain: +3.0dBi@2.4GHz +4.25dBi@5GHz : LBEE5QD1ZM-Antenna monopole antenna Gain: +3.6dBi@2.4GHz +4.6dBi@5GHz

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

English Version For indoor use only (5150-5250 MHz band and channel 52, 54, 58).
French Version Pour usage intérieur seulement (5150-5250 MHz 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 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.

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

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

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.

English Version The available scientific evidence does not show that any health problems are associated with using low power wireless devices. There is no proof, however, that these low power wireless devices are absolutely safe. Low power Wireless devices emit low levels of radio frequency energy (RF) in the microwave range while being used. Whereas high levels of RF can produce health effects (by heating tissue), exposure of low-level RF that does not produce heating effects causes no known adverse health effects. Many studies of low-level RF exposures have not found any biological effects. Some studies have suggested that some biological effects might occur, but such findings have not been confirmed by additional research. LBEE5QD1ZM has been tested and found to comply with IC radiation exposure limits set forth for an uncontrolled environment and meets RSS-102 of the IC radio frequency (RF) Exposure rules.
French Version Les connaissances scientifiques dont nous disposons n'ont mis en évidence aucun problème de santé associé à l'usage des appareils sans fil à faible puissance. Nous ne sommes cependant pas en mesure de prouver que ces appareils sans fil à faible puissance sont entièrement sans danger. Les appareils sans fil à faible puissance émettent une énergie fréquence radioélectrique (RF) très faible dans le spectre des micro-ondes lorsqu'ils sont utilisés. Alors qu'une dose élevée de RF peut avoir des effets sur la santé (en chauffant les tissus), l'exposition à de faibles RF qui ne produisent pas de chaleur n'a pas de mauvais effets connus sur la santé. De nombreuses études ont été menées sur les expositions aux RF faibles et n'ont découvert aucun effet biologique. Certaines études ont suggéré qu'il pouvait y avoir certains effets biologiques, mais ces résultats n'ont pas été confirmés par des recherches supplémentaires. LBEE5QD1ZM a été testé et jugé conforme aux limites d'exposition aux rayonnements IC énoncées pour un environnement non contrôlé et respecte les règles d'exposition aux fréquences radioélectriques (RF) CNR-102 de l'IC.

- **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.

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

RF Power Settings for 2.4 GHz WLAN are described in **Table 14**.

Table 14: WLAN RF Power Setting - 2.4 GHz 802.11 b/g/n (HT20)/ac (VHT20) (ISED)

Mode	Rate/MCS index	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11b	All Rate	1 ~ 11	17.0 ± 2.0
IEEE 802.11g	All Rate	1 ~ 3, 9 ~ 11	14.0 ± 2.0
	6Mbps, 9Mbps, 12Mbps, 18Mbps	4 ~ 8	17.0 ± 2.0
	24Mbps, 36Mbps, 48Mbps, 54Mbps	4 ~ 8	16.0 ± 2.0
IEEE 802.11n (HT20)	All MCS index	1 ~ 3, 9 ~ 11	13.0 ± 2.0
	MCS0 ~ MCS2	4 ~ 8	16.0 ± 2.0
	MCS3 ~ MCS7	4 ~ 8	15.0 ± 2.0
IEEE 802.11ac (VHT20)	All MCS index	1 ~ 3, 9 ~ 11	13.0 ± 2.0
	MCS0 ~ MCS2	4 ~ 8	16.0 ± 2.0
	MCS3 ~ MCS7	4 ~ 8	15.0 ± 2.0
	MCS8	4 ~ 8	14.0 ± 2.0

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

RF power settings for BT (BR/EDR), BLE are described in **Table 15**.

Table 15: BT / BLE RF Power Setting - ISED

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

2.2.1.3 RF Power Setting for 5 GHz WLAN

RF power settings for 5 GHz WLAN are described Table 16 through **Table 21**.

Table 16: 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, 64	14.0 ± 2.0
		W52/W53	40 ~ 60	15.0 ± 2.0
		W56	100	14.0 ± 2.0
		W56	104 ~ 116 132 ~ 144	15.0 ± 2.0
		W58	149 ~ 165	15.0 ± 2.0

Table 17: 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, 64	13.0 ± 2.0
		W52/W53	40 ~ 60	14.0 ± 2.0
		W56	100	13.0 ± 2.0
		W56	104 ~ 116 132 ~ 144	14.0 ± 2.0
		W58	149 ~ 165	14.0 ± 2.0

Table 18: 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, 62	12.0 ± 2.0
		W52/W53	46, 54	14.0 ± 2.0
		W56	102	12.0 ± 2.0
		W56	110, 134, 142	14.0 ± 2.0
		W58	151, 159	14.0 ± 2.0

Table 19: 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, 64	13.0 ± 2.0
		W52/W53	40 ~ 60	14.0 ± 2.0
		W56	100	13.0 ± 2.0
		W56	104 ~ 116 132 ~ 144	14.0 ± 2.0
		W58	149 ~ 165	14.0 ± 2.0

Table 20: 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, 62	12.0 ± 2.0
	MCS0 ~ MCS7	W52/W53	46, 54	14.0 ± 2.0
	MCS8, MCS9	W52/W53	46, 54	13.0 ± 2.0
	All MCS index	W56	102	12.0 ± 2.0
	MCS0 ~ MCS7	W56	110, 134, 142	14.0 ± 2.0
	MCS8, MCS9	W56	110, 134, 142	13.0 ± 2.0
	MCS0 ~ MCS7	W58	151, 159	14.0 ± 2.0
	MCS8, MCS9	W58	151, 159	13.0 ± 2.0

Table 21: 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	10.0 ± 2.0
	All MCS index	W56	106	10.0 ± 2.0
	MCS0 ~ MCS2	W56	138	14.0 ± 2.0
	MCS3 ~ MCS9	W56	138	13.0 ± 2.0
	MCS0 ~ MCS2	W58	155	14.0 ± 2.0
	MCS3 ~ MCS9	W58	155	13.0 ± 2.0

2.2.2 Theory of Operation

Table 22 describes the theory of operation.

Table 22: Theory of Operation - ISED

Frequency of Operation			Scan	Ad hoc Mode
2.4 GHz	11b/g/n/ac ((V)HT20)	2412-2462 MHz	Active	Yes
	BT	2402-2480 MHz	N/A	N/A
	BLE	2402-2480 MHz	N/A	N/A
W52	11a/n/ac ((V)HT20)	5180-5240 MHz	Active	Yes
	11n/ac ((V)HT40)	5190-5230 MHz	Active	Yes
	11ac (VHT80)	5210 MHz	Active	Yes
W53	11a/n/ac ((V)HT20)	5260-5320 MHz	Passive	No
	11n/ac ((V)HT40)	5270-5310 MHz	Passive	No
	11ac (VHT80)	5290 MHz	Passive	No
W56	11a/n/ac ((V)HT20)	5500-5720 MHz (*ISED:5600-5650 MHz disable)	Passive	No
	11n/ac ((V)HT40)	5510-5710 MHz (*ISED:5600-5650 MHz disable)	Passive	No
	11ac (VHT80)	5530-5690 MHz (*ISED:5600-5650 MHz disable)	Passive	No
W58	11a/n/ac ((V)HT20)	5745-5825 MHz	Active	Yes
	11n/ac ((V)HT40)	5755-5795 MHz	Active	Yes
	11ac (VHT80)	5775 MHz	Active	Yes

2.2.3 Antenna

The antenna models for ISED are described in **Table 23**.

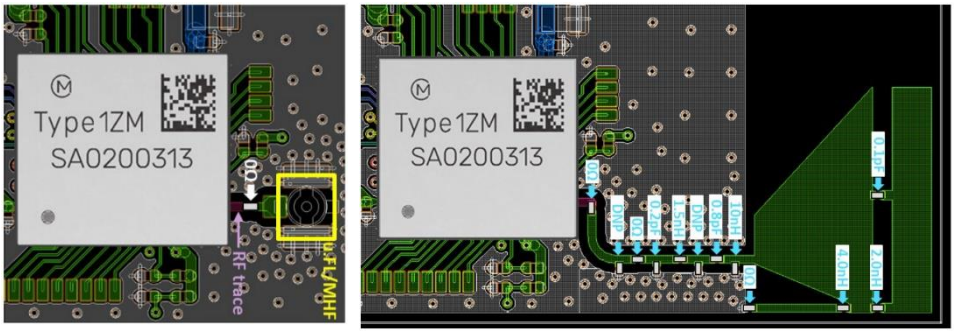
Table 23: Antenna - ISED

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	146187	Molex	3.0	4.25	Dipole	u.FL
3	LBEE5QD1ZM_Antenna	Murata	3.6	4.6	Monopole	Trace

50Ω line (microstrip line pattern)
Certification tests are conducted in the following patterns.

Figure 6 shows the pattern used in the certification test for ISED.

Figure 6: 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 with Gerber data or something similar.

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.: T201215W01-RT1

EN 301 893 v2.1.1:2017

Report No.: T200915W04-RT3

EN 300 440 v2.1.1:2017

Report No.: T200915W04-RT5

Product name: Communication Module

Model: LBEE5QD1ZM

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

RF power settings for 2.4 GHz WLAN are described in **Table 24**.

Table 24: WLAN RF Power Setting - 2.4 GHz (EU)

Mode	Rate/MCS index	Channel	Output Power in dBm (typical)
IEEE 802.11b	All Rate	1 ~ 13	14.0
IEEE 802.11g	All Rate	1 ~ 13	14.0
IEEE 802.11n (HT20)	All MCS index	1 ~ 13	14.0
IEEE 802.11ac (VHT20)	All MCS index	1 ~ 13	14.0

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

RF power settings for BT (BR/EDR), BLE are described in **Table 25**.

Table 25: BT / BLE RF Power Setting - EU

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

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

RF power settings for 5 GHz WLAN (W52/W53/W56) are described in **Table 26**.

Table 26: WLAN RF Power Setting - 5 GHz 802.11a/n/ac for Channels 36 ~ 140 (EU)

Mode	Rate/MCS Index	Channel	Output Power in dBm (typical)
IEEE 802.11a	All Rate	36 ~ 140	15.0
IEEE 802.11n (HT20)	All MCS index	36 ~ 140	14.0
IEEE 802.11n (HT40)	All MCS index	38 ~ 134	14.0
IEEE 802.11ac (VHT20)	All MCS index	36 ~ 140	14.0
IEEE 802.11ac (VHT40)	MCS0 ~ MCS7	38 ~ 134	14.0
	MCS8 ~ MCS9	38 ~ 134	13.0
IEEE 802.11ac (VHT80)	MCS0 ~ MCS2	42 ~ 122	14.0
	MCS3 ~ MCS9	42 ~ 122	13.0

2.3.1.4 RF Power Setting for 5 GHz WLAN (W58)

RF power settings for 5 GHz WLAN (W58) are described in **Table 27**.

Table 27: WLAN RF Power Setting - 5 GHz 802.11 a/n/ac for Channels 149 ~ 165 (EU)

Mode	Rate/MCS Index	Channel	Output Power in dBm (typical)
IEEE 802.11a	All Rate	149 ~ 165	7.0
IEEE 802.11n (HT20)	All MCS index	149 ~ 165	7.0
IEEE 802.11n (HT40)	All MCS index	151, 159	7.0
IEEE 802.11ac (VHT20)	All MCS index	149 ~ 165	7.0
IEEE 802.11ac (VHT40)	All MCS index	151, 159	7.0
IEEE 802.11ac (VHT80)	All MCS index	155	7.0

2.3.2 Theory of Operation

Table 28 describes the theory of operation.

Table 28: Theory of Operation - EU

Frequency of Operation			Scan	Ad hoc Mode
2.4 GHz	11b/g/n/ac ((V)HT20)	2412-2472 MHz	Active	Yes
	BT	2402-2480 MHz	N/A	N/A
	BLE	2402-2480 MHz	N/A	N/A
W52	11a/n/ac ((V)HT20)	5180-5240 MHz	Active	Yes
	11n/ac ((V)HT40)	5190-5230 MHz	Active	Yes

Frequency of Operation			Scan	Ad hoc Mode
	11ac (VHT80)	5210 MHz	Active	Yes
W53	11a/n/ac ((V)HT20)	5260-5320 MHz	Passive	No
	11n/ac ((V)HT40)	5270-5310 MHz	Passive	No
	11ac (VHT80)	5290 MHz	Passive	No
W56	11a/n/ac ((V)HT20)	5500-5700 MHz	Passive	No
	11n/ac ((V)HT20)	5510-5670 MHz	Passive	No
	11ac (VHT80)	5530-5610 MHz	Passive	No
W58	11a/n/ac ((V)HT20)	5745-5825 MHz	Active	Yes
	11n/ac ((V)HT40)	5755-5795 MHz	Active	Yes
	11ac (VHT80)	5775 MHz	Active	Yes

2.4 Japan

- **Manufacturer Name:** Murata Manufacturing Co., Ltd.
- **Model or Product Name:** LBEE5QD1ZM

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 5.2GHz 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: 5.2GHz/5.3GHz/5.6GHz(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-P01598
W52/53 は屋内使用限定

2.4GHz と 5GHz(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 + Bluetooth BR/EDR/LE combo module.

- **Product Size:** 10.2 x 9.3 mm (Typical), H = 1.3 mm (Maximum)
- **Wireless-IC:** NXP 88W8987 inside
- **Reference Clock**: 38.4 MHz X′tal
- **Weight:** 0.318 g

2.4.2 Feature

- **Product Name:** Communication Module
- **Model Name:** LBEE5QD1ZM
- **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 MHz)/11ac (20MHz)
  5 GHz 11a (20 MHz)/11n (20/40 MHz)/11ac (20/40/80 MHz)
  (BT) Hopping off 1 MHz / Hopping on 79 MHz
  (BLE) 1 MHz / 2 MHz
- **Input Voltage to RF parts:** VBAT Typical 3.3V

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

RF power settings for 2.4 GHz WLAN are described in **Table 29**.

Table 29: WLAN RF Power Setting - 2.4 GHz (Japan)

Mode	Rate/MCS index	Channel	Output Power in dBm (typical)
IEEE 802.11b	All Rate	1 ~ 13	16.0
IEEE 802.11g	6Mbps, 9Mbps, 12Mbps, 18Mbps	1 ~ 13	17.0
	24Mbps, 36Mbps, 48Mbps, 54Mbps	1 ~ 13	16.0
IEEE 802.11n (HT20)	MCS0 ~ MCS2	1 ~ 13	16.0
	MCS3 ~ MCS7	1 ~ 13	15.0
IEEE 802.11ac (VHT20)	MCS0 ~ MCS2	1 ~ 13	16.0
	MCS3 ~ MCS7	1 ~ 13	15.0
	MCS8	1 ~ 13	14.0

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

RF power settings for BT (BR/EDR), BLE are described in **Table 30**.

Table 30: 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 (W52/W53/W56)

RF power settings for 5 GHz WLAN (W52/W53/W56) are described in **Table 31**.

Table 31: WLAN RF Power Setting - 5 GHz 802.11a/n/ac for Channels 36 ~ 144 (Japan)

Mode	Rate/MCS Index	Channel	Output Power in dBm (typical)
IEEE 802.11a	All Rate	36 ~ 144	15.0
IEEE 802.11n (HT20)	All MCS index	36 ~ 144	14.0
IEEE 802.11n (HT40)	All MCS index	38 ~ 142	14.0
IEEE 802.11ac (VHT20)	All MCS index	36 ~ 144	14.0
IEEE 802.11ac (VHT40)	MCS0 ~ MCS7	38 ~ 142	14.0
	MCS8 ~ MCS9	38 ~ 142	13.0
IEEE 802.11ac (VHT80)	MCS0 ~ MCS2	42 ~ 138	14.0
	MCS3 ~ MCS9	42 ~ 138	13.0

2.4.4 Types of Radio Emissions

Table 32 describes the types of radio emissions.

Table 32: 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	MCS0	BPSK	G1D
	MCS1, MCS2	QPSK	G1D
	MCS3, MCS4	16 QAM	D1D
	MCS5, MCS6, MCS7	64 QAM	D1D
IEEE 802.11ac	MCS8, MCS9	256 QAM	D1D

2.4.5 Theory of Operation

Table 33 describes the theory of operation.

Table 33: Theory of Operation - Japan

Frequency of Operation			Scan	Ad hoc Mode
2.4 GHz	11b/g/n/ac ((V)HT20)	2412-2472 MHz	Active	Yes
	BT	2402-2480 MHz	N/A	N/A
	BLE	2402-2480 MHz	N/A	N/A
W52	11a/n/ac ((V)HT20)	5180-5240 MHz	Active	Yes
	11n/ac ((V)HT40)	5190-5230 MHz	Active	Yes
	11ac (VHT80)	5210 MHz	Active	Yes

Frequency of Operation			Scan	Ad hoc Mode
W53	11a/n/ac ((V)HT20)	5260-5320 MHz	Passive	No
	11n/ac ((V)HT40)	5270-5310 MHz	Passive	No
	11ac (VHT80)	5290 MHz	Passive	No
W56	11a/n/ac ((V)HT20)	5500-5720 MHz	Passive	No
	11n/ac ((V)HT40)	5510-5710 MHz	Passive	No
	11ac (VHT80)	5530-5690 MHz	Passive	No

2.4.6 Antenna

The antenna registered under the Radio Act Certification of Japan are described in **Table 34**.

Table 34: 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	146187	Molex	3.0	4.25	Dipole	u.FL
3	206994	Molex	3.6	3.6	Monopole	u.FL
4	LBEE5QD1ZM_Antenna	Murata	3.6	4.6	Monopole	Trace
5	219611	Molex	2.67	3.67	Dipole	u.FL
6	WT32D1-KX	Unictron	3.0	4.0	Dipole	MHF I
7	AA258	Unictron	0.9	3.8	Dipole	MHF I
8	TA-38B-A-W01	Unictron	2.61	3.07	Dipole	RSMA
9	TA-6B-A-WE01	Unictron	2.23	4.59	Dipole	RSMA
10	FXP830.07.0100C	Taoglas	2.5	4.7	Dipole	MHF I
11	GW.48.A151	Taoglas	1.82	3.28	Dipole	RSMA
12	GW.40.2153	Taoglas	3.15	4.39	Dipole	RSMA
13	GW.52.A153	Taoglas	2.93	4.53	Dipole	RSMA
14	SRF2W012	Antenova	3.0	4.0	Dipole	MHF I
15	STDANTEMD-013	Sansei	1.9	2.8	Dipole	MHF I
16	EMF2471A3S	Laird	2.4	4.4	Dipole	MHF I
17	1001932FT	KAVX	2.5	4.4	Dipole	MHF I
18	1001932PT	KAVX	2.03	4.45	Dipole	MHF I
19	W24P-U	Inventek	3.58	NA	Dipole	u.FL

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.

(1)

本製品は、電波法に基づく工事設計認証(認証番号:001-P01598)を受けた特定無線設備を内蔵しています。

(2)

R 001-P01598

5.2GHz/5.3GHz 帯無線 LAN(W52/W53)の屋外使用は 5.2GHz 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)
(1)

This product incorporates specified radio equipment that has received CERTIFICATION for TYPE CERTIFICATION (certification number: 001-P01598) based on the Japan Radio Act.

(2)

R 001-P01598

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

2.5 NCC

Model Name: LBEE5QD1ZM	Brand Name: muRata	CCAM24Y10030T8

2.5.1 NCC Warning Statement

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

取得審驗證明之低功率射頻器材，非經核准，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。低功率射頻器材之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。前述合法通信，指依電信管理法規定作業之無線電通信。
低功率射頻器材須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾

English Translation
Without permission granted by the NCC, any company, enterprise, or user is not allowed to change frequency, enhance transmitting power or alter original characteristic as well as performance to an approved low power radio-frequency device. The low power radio-frequency devices shall not influence aircraft security and interfere legal communications; If found, the user shall cease operating immediately until no interference is achieved. The said legal communications means radio communications is operated in compliance with the Telecommunications Management
The low power radio-frequency devices must be susceptible with the interference from legal communications or ISM radio wave radiated devices.

應避免影響附近雷達系統之操作

English Translation
The operation of nearby radar system must be avoided.

The products have an external antenna port must be described this wording.

高增益指向性天線只得應用於固定式點對點系統

English Translation
The high gain directional antenna can only be used in fixed point-to-point system.

The following information must be indicated on the host device of this module or on the user manual:

內含發射器模組: CCAM24Y10030T8

2.5.2 Product Outline

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

- **Product Size:** 10.2 x 9.3 mm (Typical), H = 1.3 mm (Maximum)
- **Wireless-IC:** 88W8987 inside
- **Reference Clock**: 38.4 MHz X′tal

2.5.3 Feature

- **Product Name:** Communication Module
- **Model Name:** LBEE5QD1ZM
- **Purpose of the equipment:** Telecommunication
- **Equipment Type:** Transceiver
- **Frequency band:** BTBLE 2400 ~ 2483.5 MHz
  WLAN 2.4GHz 2400 ~ 2483.5 MHz
  WLAN 5GHz 5150 ~ 5250 MHz/5250 ~ 5350 MHz
  5470 ~ 5725 MHz/5725 ~ 5895 MHz
- **Frequency of Operation:** BTBLE 2402 ~ 2480 MHz
  WLAN 2.4GHz 2412 ~ 2462 MHz
  WLAN 5GHz 5180 ~ 5240 MHz/5260 ~ 5320 MHz
  5500 ~ 5700 MHz/5745 ~ 5825 MHz
- **Type of Modulation**: BR/EDR FHSS
  Bluetooth LE GFSK
  WLAN DBPSK/DQPSK/CCK/BPSK/QPSK/16QAM/64QAM
- **Bandwidth:** BT Hopping off 1MHz / Hopping on 79 MHz
  Bluetooth LE 2 MHz
  WLAN 2.4 GHz 11b/g/n: 20 MHz
  WLAN 5 GHz 11a:20 MHz 11n:20/40 MHz 11ac:20/40/80 MHz
- **Input Voltage to RF parts:** VBAT Typical 3.3V

2.5.4 Setting RF Power

This section describes the RF power settings.

2.5.4.1 RF Power Setting for 2.4 GHz WLAN

RF power settings for 2.4 GHz WLAN are described in **Table 35**.

Table 35: WLAN RF Power Setting - 2.4 GHz 802.11 b/g/n (HT20)/ac (VHT20) (NCC)

Mode	Rate/MCS index	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11b	All Rate	1 ~ 11	17.0 ± 2.0
IEEE 802.11g	All Rate	1 ~ 3, 9 ~ 11	14.0 ± 2.0
	6Mbps, 9Mbps, 12Mbps, 18Mbps	4 ~ 8	17.0 ± 2.0
	24Mbps, 36Mbps, 48Mbps, 54Mbps	4 ~ 8	16.0 ± 2.0
IEEE 802.11n (HT20)	All MCS index	1 ~ 3, 9 ~ 11	13.0 ± 2.0
	MCS0 ~ MCS2	4 ~ 8	16.0 ± 2.0
	MCS3 ~ MCS7	4 ~ 8	15.0 ± 2.0
IEEE 802.11ac (VHT20)	All MCS index	1 ~ 3, 9 ~ 11	13.0 ± 2.0
	MCS0 ~ MCS2	4 ~ 8	16.0 ± 2.0
	MCS3 ~ MCS7	4 ~ 8	15.0 ± 2.0
	MCS8	4 ~ 8	14.0 ± 2.0

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

RF power settings for BT (BR/EDR), BLE are described in **Table 36**.

Table 36: BT / BLE RF Power Setting - NCC

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

2.5.4.3 RF Power Setting for 5 GHz WLAN

RF power settings for 5 GHz WLAN are described in **Table 37** through **Table 42**.

Table 37: WLAN RF Power Setting - 5 GHz 802.11a (NCC)

Mode	Rate	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11a	All Rate	W52/W53	36, 64	14.0 ± 2.0
		W52/W53	40 ~ 60	15.0 ± 2.0
		W56	100	14.0 ± 2.0
		W56	104 ~ 144	15.0 ± 2.0
		W58	149 ~ 165	15.0 ± 2.0

Table 38: WLAN RF Power Setting - 5 GHz 802.11n (HT20) (NCC)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11n (HT20)	All MCS Index	W52/W53	36, 64	13.0 ± 2.0
		W52/W53	40 ~ 60	14.0 ± 2.0
		W56	100	13.0 ± 2.0
		W56	104 ~ 144	14.0 ± 2.0
		W58	149 ~ 165	14.0 ± 2.0

Table 39: WLAN RF Power Setting - 5 GHz 802.11n (HT40) (NCC)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11n (HT40)	All MCS index	W52/W53	38, 62	12.0 ± 2.0
		W52/W53	46, 54	14.0 ± 2.0
		W56	102	12.0 ± 2.0
		W56	110 ~ 142	14.0 ± 2.0
		W58	151, 159	14.0 ± 2.0

Table 40: WLAN RF Power Setting - 5 GHz 802.11ac (VHT20) (NCC)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ac (VHT20)	All MCS index	W52/W53	36, 64	13.0 ± 2.0
		W52/W53	40 ~ 60	14.0 ± 2.0
		W56	100	13.0 ± 2.0
		W56	104 ~ 144	14.0 ± 2.0
		W58	149 ~ 165	14.0 ± 2.0

Table 41: WLAN RF Power Setting - 5 GHz 802.11ac (VHT40) (NCC)

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

Table 42: WLAN RF Power Setting – 5 GHz 802.11ac (VHT80) (NCC)

Mode	MCS Index	Band	Channel	Maximum Tune Up Tolerance (dBm)
IEEE 802.11ac (VHT80)	All MCS index	W52/W53	42, 58	10.0 ± 2.0
	All MCS index	W56	106	10.0 ± 2.0
	MCS0 ~ MCS2	W56	122, 138	14.0 ± 2.0
	MCS3 ~ MCS9	W56	122, 138	13.0 ± 2.0
	MCS0 ~ MCS2	W58	155	14.0 ± 2.0
	MCS3 ~ MCS9	W58	155	13.0 ± 2.0

2.5.5 Theory of Operation

Table 43 describes the theory of operation.

Table 43: Theory of Operation - NCC

Frequency of Operation			Scan	Ad hoc Mode
2.4 GHz	11b/g/n/ac ((V)HT20)	2412-2462 MHz	Active	Yes
	BT	2402-2480 MHz	N/A	N/A
	BLE	2402-2480 MHz	N/A	N/A
W52	11a/n/ac ((V)HT20)	5180-5240 MHz	Active	Yes
	11n/ac ((V)HT40)	5190-5230 MHz	Active	Yes
	11ac (VHT80)	5210 MHz	Active	Yes
W53	11a/n/ac ((V)HT20)	5260-5320 MHz	Passive	No
	11n/ac ((V)HT40)	5270-5310 MHz	Passive	No
	11ac (VHT80)	5290 MHz	Passive	No
W56	11a/n/ac ((V)HT20)	5500-5720 MHz	Passive	No
	11n/ac ((V)HT40)	5510-5710 MHz	Passive	No
	11ac (VHT80)	5530-5690 MHz	Passive	No
W58	11a/n/ac ((V)HT20)	5745-5825 MHz	Active	Yes
	11n/ac ((V)HT40)	5755-5795 MHz	Active	Yes
	11ac (VHT80)	5775 MHz	Active	Yes

2.5.6 Antenna

Table 44 describes the NCC antenna.

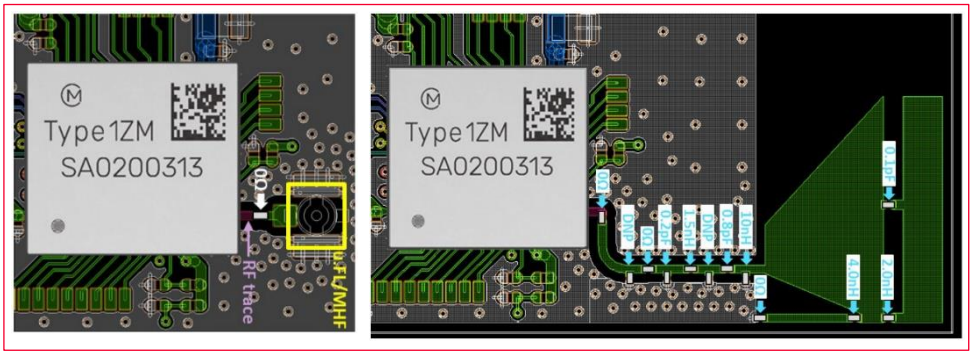
Table 44: Antenna - NCC

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	146187	Molex	3.0	4.25	Dipole	u.FL
3	WT32D1-KX	Unictron	3.0	4.0	Dipole	MHF I
4	LBEE5QD1ZM_Antenna	Murata	3.6	4.6	Monopole	Trace

50Ω line (microstrip line pattern)
Certification tests are conducted in the following patterns.

Figure 7 shows the pattern used in the certification test for NCC.

Figure 7: EVB Design Used for Testing - NCC



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

Murata provides set makers with Gerber data or something similar.

Revision History

Revision	Date	Changed Item	Comment
1.0	Mar 04, 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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