W-LAN+Bluetooth Combo Module Data Sheet

Cypress Chipset
for 802.11a/b/g/n/ac + Bluetooth 5.0

Tentative P/N : LBEH5UL1CX-TEMP

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

The revision history of the product specification

Revised No.	Revised Date	Note
-	2014.04.18	Initial Release
A	2014.04.23	P5 6.1Dimensions Thickness 1.0 →1.05max
B	2014.04.30	P5 6.1 Dimensions P30 11.Land Pattern Because of changing the module size

C	2014.05.20	Revised Tentative P/N
		    Removed FM function
		P3 Revised "2.KEY FEATURE"
		    Revised "2.1. Block Diagram"
		    Revised "2.2. Ordering Information"
		P6 Revised "6.2 Pin Layout"
		P7-8 Revised "6.3 Module PIN Descriptions"
		P12-19 Revised "9. INTERFACE TIMING AND CHARACTERISTICS"
		P30 11.LAND PATTERN
		    Added the annotation

D	2014.06.30	P9 REFERENCE PERIPHERAL CIRCUIT Added the circuit
E	2015.5.12	P19 10.4 DC/RF Characteristics for IEEE802.11a - 5GHz Changed 11a power 14dBm→13dBm
F	2016.7.29	P5 Revised "6.1. Dimensions" Added marking P16 Revised "10. ELECTORICAL CHARACTERISTICS" P27 Added "12. TAPE AND REEL PACKING"
G	2017.2.28	Changed IC Part Number
H	2017.4.12	P4 4.Operation Condition Adding 3.3V VIO support.
J	2018.12.27	P3,25,26. Changed BT version from 4.1 to 5.0 P3. KEY FEATURE : Uploaded Module weight P4. Corrected "External LPO Signal Requirement" P9. Revised "Reference circuit" P32. Revised "Soldering Conditions/Cleaning"
K	2019.04.24	P3. Added QDID P32. Updated 15. PRECONDITION TO USE OUT PRODUCTS

Preliminary

< Specification may be changed by Murata without notice >

Murata Manufacturing Co., Ltd.

TABLE OF CONTENTS

Please be aware that an important notice concerning availability, standard warranty and use in critical applications of Murata products and disclaimers thereto appears at the end of this specification sheet.

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

1. SCOPE

This specification is applied to the IEEE802.11a/b/g/n/ac W-LAN 2x2 MIMO (Multi Input Multi Output) + Bluetooth 5.0.

2. KEY FEATURE
- Cypress CYW4356 inside
- Support MCS0-9(up to 256QAM) in 20MHz/40MHz/80MHz channels for data rates up to 866.7Mbps
- Compliant with IEEE802.11a/b/g/n/ac
- Compliant with Bluetooth specification 5.0
- PCIe interface for W-LAN
- Interface support for Bluetooth is Host Controller Interface (HCI)
- Surface mount type 11.5 x 8.8 mm (Typical), H = 1.05 mm (Max)
- Weight : 0.244g
- MSL : 3

2.1. Block Diagram
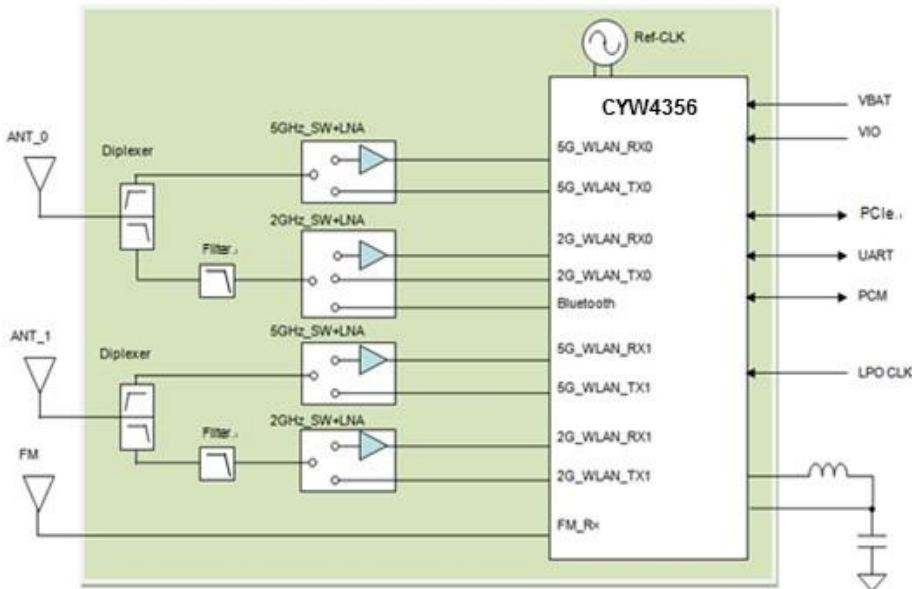
2.2. Ordering Information

Ordering Part Number	Description
LBEH5UL1CX-TEMP	In case of sample order
LBEH5UL1CX-TEMP-D	EVK

2.3. RoHS Compliance
This module is compliant with the RoHS directive.

3. Certification Information

3.1. Bluetooth® Qualification
QDID: 119620

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

4. ABSOLUTE MAXIMUM RATINGS

Parameter		min.	max.	Unit
Storage Temperature		-40	85	deg.C
Supply Voltage	VBAT	0	5.0	V
	VIO	0	3.9	V

* Stresses in excess of the absolute ratings may cause permanent damage. Functional operation is not implied under these conditions. Exposure to absolute ratings for extended periods of time may adversely affect reliability. No damage assuming only one parameter is set at limit at a time with all other parameters which are set within operating condition.

5. OPERATING CONDITION

Parameter		min.	typ.	max.	unit
Operating Temperature[*1]		-20	25	+75	deg.C
Supply Voltage	VBAT	3.35	-	4.2	V
	VIO	1.71 3.14	1.8 3.3	1.89 3.46	V

*1. Functionality is guaranteed but specifications require derating at extreme temperatures.

6. External LPO Signal Requirement

Parameter	External LPO Clock	Unit
Nominal input frequency	32.768	kHz
Frequency accuracy	+/-200	ppm
Duty cycle	30-70	%
Input signal amplitude	200 - 3300	mVp-p
Signal type	Square-wave or sine-wave	-
Input impedance[*a]	> 100k < 5	ohm pF
Clock jitter (during initial start-up)	<10,000	ppm

a) When power is applied or switch off.

7. DIMENSIONS, MARKING AND TERMINAL CONFIGURATIONS
7.1. Dimensions

<TOP VIEW>

<BOTTOM VIEW>

SS1234567

1CX

Conformal shield

<SIDE VIEW>
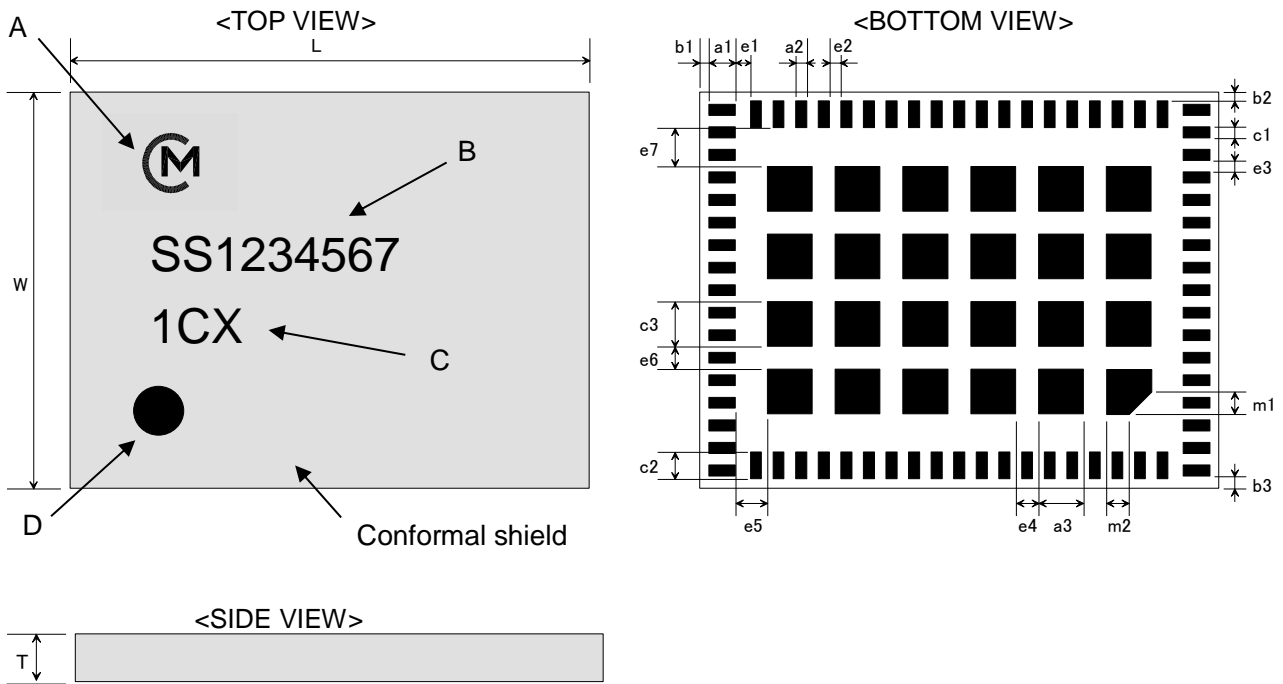
(Unit: mm)

Mark	Dimensions	Mark	Dimensions	Mark	Dimensions
L	11.5 +/- 0.2	W	8.8 +/- 0.2	T	1.05 max.
a1	0.6 +/- 0.1	a2	0.25 +/- 0.1	a3	1.0 +/- 0.1
b1	0.2 +/- 0.2	b2	0.2 +/- 0.2	b3	0.275 +/- 0.2
c1	0.25 +/- 0.1	c2	0.6 +/- 0.1	c3	1.0 +/- 0.1
e1	0.325 +/- 0.1	e2	0.25 +/- 0.1	e3	0.25 +/- 0.1
e4	0.5 +/- 0.1	e5	0.7 +/- 0.1	e6	0.5 +/- 0.1
e7	0.85 +/- 0.1	m1	0.5 +/- 0.1	m2	0.5 +/- 0.1

Marking	Meaning
A	Murata Logo
B	Inspection Number
C	Module Type
D	Pin 1 Marking

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

7.2. Pin Layout

Top View
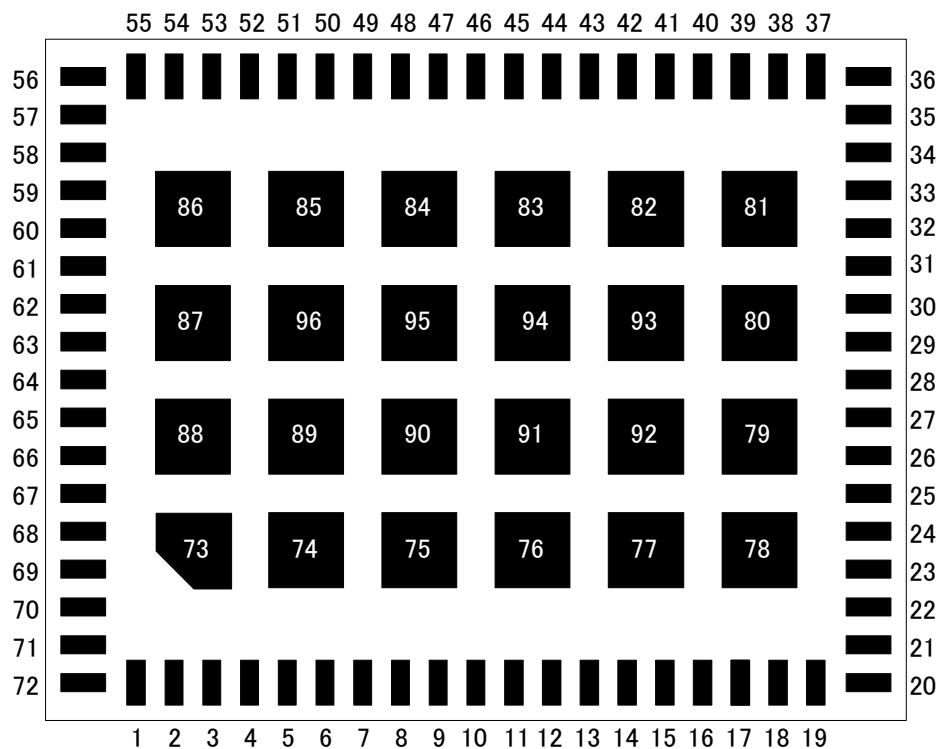
Pin No.	Description	Pin No.	Description	Pin No.	Description	Pin No.	Description
1	GND	25	LPO	49	GND	73	GND
2	GPIO_3	26	GND	50	GND	74	GND
3	GPIO_5	27	PCIE_REFCLKP	51	NC	75	GND
4	GPIO_4	28	PCIE_REFCLKN	52	GND	76	GND
5	GPIO_6	29	GND	53	BT_DEV_WAKE	77	GND
6	GPIO_2	30	PCIE_TDN	54	BT_HOST_WAKE	78	GND
7	JTAG_SEL	31	PCIE_TDP	55	GND	79	GND
8	GPIO_0	32	GND	56	GND	80	GND
9	GND	33	PCIE_RDN	57	ANT_CORE0	81	GND
10	BT_REG_ON	34	PCIE_RDP	58	GND	82	GND
11	NC	35	GND	59	GND	83	GND
12	NC	36	GND	60	BT_UART_RTS	84	GND
13	NC	37	VIO	61	BT_UART_CTS	85	GND
14	GND	38	GND	62	BT_UART_RXD	86	GND
15	VBAT_LDO	39	PCIE_CLKREQ_L	63	BT_UART_TXD	87	GND
16	VBAT_LDO	40	PCIE_PME_L	64	GND	88	GND
17	VBAT_SR	41	PERST_L	65	NC	89	GND
18	GND	42	BT_PCM_IN	66	NC	90	GND
19	VDD_CBUCK_1P5	43	BT_PCM_SYNC	67	NC	91	GND
20	SR_PVSS	44	BT_PCM_OUT	68	GND	92	GND
21	SR_PVSS	45	BT_PCM_CLK	69	GND	93	GND
22	SR_VLx	46	GND	70	GND	94	GND
23	WL_REG_ON	47	NC	71	ANT_CORE1	95	GND
24	GND	48	NC	72	GND	96	GND

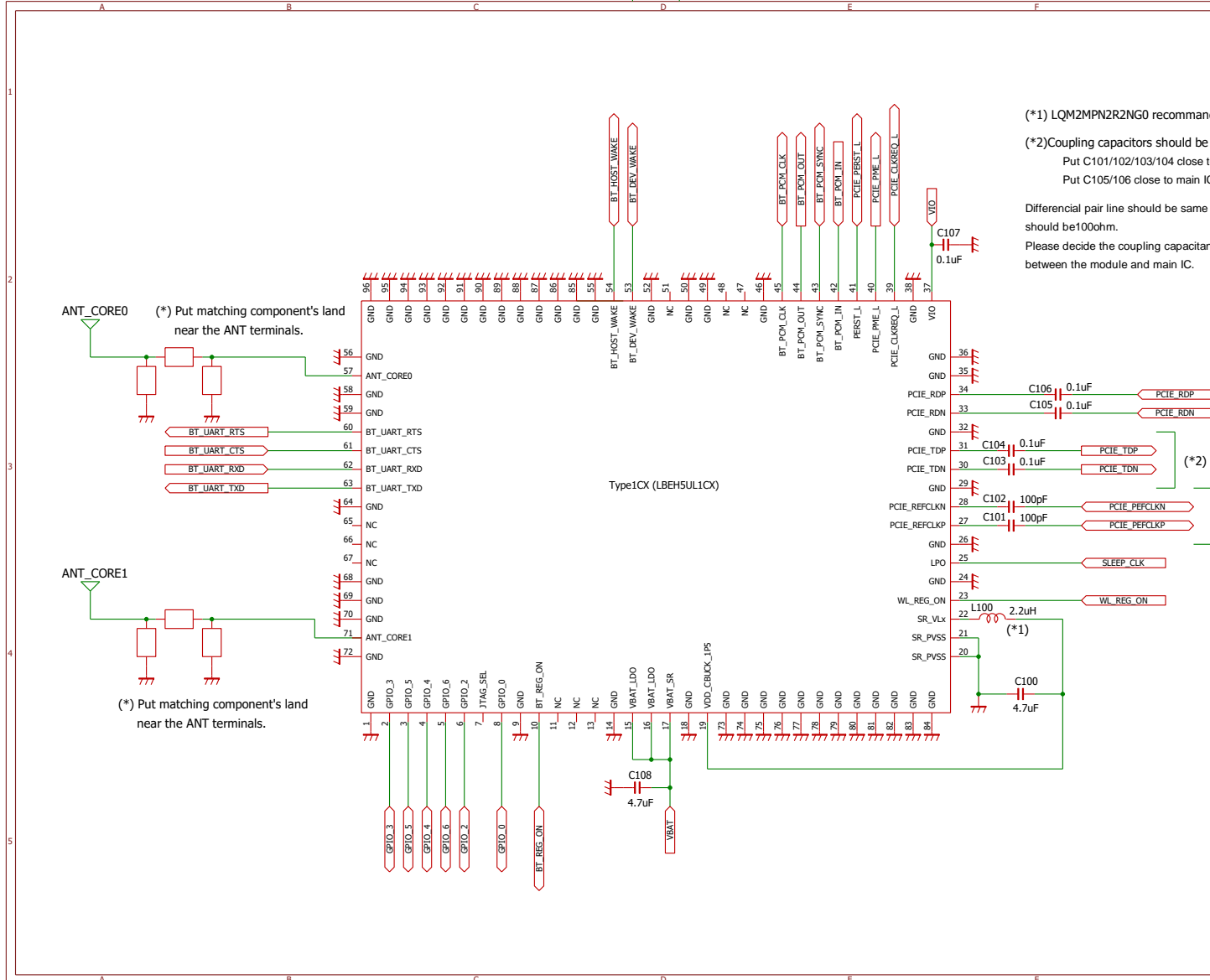Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

7.3. Module PIN Descriptions

No.	Pin name	Type	System	Connection to IC pin name	Description
1	GND	-	-	-	-
2	GPIO_3	I/O	WL	GPIO_3	Programmable GPIO Pin
3	GPIO_5	I/O	WL	GPIO_5	Programmable GPIO Pin
4	GPIO_4	I/O	WL	GPIO_4	Programmable GPIO Pin
5	GPIO_6	I/O	WL	GPIO_6	Programmable GPIO Pin
6	GPIO_2	I/O	WL	GPIO_2	Programmable GPIO Pin
7	JTAG_SEL	I	-	JTAG_SEL	JTAG select. The JTAG interface (multiplexed on the GPIO pins) is enabled when this pin is asserted high.
8	GPIO_0	I/O	WL	GPIO_0	Programmable GPIO Pin
9	GND	-	-	-	-
10	BT_REG_ON	I	BT	BT_REG_ON	Used by PMU to power up or power down the internal CYW4356 regulators used by the BT/FM section. Also, when deasserted, this pin holds the BT/FM section in reset. This pin has an internal 200k ohm pull-down resistor that is enabled by default. It can be disabled through programming.
11	NC	–	–	–	–
12	NC	–	–	–	–
13	NC	–	–	–	–
14	GND	-	-	-	-
15 16	VBAT_LDO	I	BT/FM	LDO_VDDBAT5V	Power supply
17	VBAT_SR	I	-	SR_VDDBAT	Power supply
18	GND	-	-	-	-
19	VDD_CBUCK_1P5	I	-	LDO_VDD1P5	LDO input. Also voltage feedback input for CBUCK.(1.35V default)
20 21	SR_PVSS	-	-	-	Connect to GND
22	SR_VLx	O	-	SR_VLX	CBuck switching regulator output.
23	WL_REG_ON	I	WL	WL_REG_ON	Used by PMU to power up or power down the internal CYW4356 regulators used by the WLAN section. Also, when deasserted, this pin holds the WLAN section in reset. This pin has an internal 200k ohm pull-down resistor that is enabled by default. It can be disabled through programming.
24	GND	-	-	-	-
25	LPO	I	-	LPO_IN	External Sleep clock input(32.768kHz)
26	GND	-	-	-	-
27	PCIE_REFCLKP	I	WL	PCIE_REFCLKP	PCIE Differential Clock inputs (negative and positive). 100MHz differential.
28	PCIE_REFCLKN	I	WL	PCIE_REFCLKN	
29	GND	-	-	-	-
30	PCIE_TDN	O	WL	PCIE_TDN0	Transmitter differential pair (x1 lane)
31	PCIE_TDP	O	WL	PCIE_TDP0	
32	GND	-	-	-	-
33	PCIE_RDN	I	WL	PCIE_RDN0	Receiver differential pair (x1 lane)
34	PCIE_RDP	I	WL	PCIE_RDP0	
35	GND	-	-	-	-
36	GND	-	-	-	-

No.	Pin name	Type	System	Connection to IC pin name	Description
37	VIO	I		VDDIO_PMU, VDDIO, VDDIO_SD, BT_VDDO	Supply for PMU, BT, WLAN, SDIO.
38	GND	-	-	-	-
39	PCIE_CLKREQ_L	OD	WL	PCIE_CLKREQ_L	PCIe clock request signal which indicates when the REFCLK to the PCIe interface can be gated. 1=the clock can be gated 0=the clock is required
40	PCIE_PME_L	OD	WL	PCI_PME_L	PCI power management event output. Used to request a change in the device or system power state. The assertion and deassertion of this signal is asynchronous to the PCIe reference clock. This signal has an open-drain output structure, as per the PCI Bus Local Bus Specification, revision2.3.
41	PERST_L	I(PU)	WL	PCIE_PERST_L	PCIe System Preset. This input is the PCIe reset as defined in the PCIe base specification version 1.1.
42	BT_PCM_IN	I	BT	BT_PCM_IN	PCM data input
43	BT_PCM_SYNC	I/O	BT	BT_PCM_SYNC	PCM sync; can be master(output) or slave(input).
44	BT_PCM_OUT	O	BT	BT_PCM_OUT	PCM data output
45	BT_PCM_CLK	I/O	BT	BT_PCM_CLK	PCM clock; can be master(output) or slave(input).
46	GND	-	-	-	-
47	NC	–	–	–	–
48	NC	–	–	–	–
49	GND	-	-	-	-
50	GND	-	-	-	-
51	NC	–	–	–	–
52	GND	-	-	-	-
53	BT_DEV_WAKE	I/O	BT	BT_DEV_WAKE	Bluetooth DEV_WAKE
54	BT_HOST_WAKE	I/O	BT	BT_HOST_WAKE	Bluetooth HOST_WAKE
55	GND	-	-	-	-
56	GND	-	-	-	-
57	ANT_CORE0	I/O	-	-	-
58	GND	-	-	-	-
59	GND	-	-	-	-
60	BT_UART_RTS	O	BT/FM	BT_ UART_RTS_L	UART request – to - send. Active - low request - to-send signal for the HCI UART interface.
61	BT_UART_CTS	I	BT/FM	BT_ UART_CTS_L	UART clear – to - send. Active - low clear – to - send signal for the HCI UART interface.
62	BT_UART_RXD	I	BT/FM	BT_ UART_RXD	UART serial input. Serial data input for the HCI UART interface.
63	BT_UART_TXD	O	BT/FM	BT_ UART_TXD	UART serial output. Serial data output for the HCI UART interface.
64	GND	-	-	-	-
65	NC	–	–	–	–
66	NC	–	–	–	–
67	NC	–	–	–	–
68	GND	-	-	-	-
69	GND	-	-	-	-
70	GND	-	-	-	-
71	ANT_CORE1	I/O	-	-	-
72-96	GND	-	-	-	-

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

8. REFERENCE PERIPHERAL CIRCUIT

(*1) LQM2MPN2R2NG0 recomman

(*2)Coupling capacitors should be
Put C101/102/103/104 close t
Put C105/106 close to main IC

Differencial pair line should be same
should be100ohm.
Please decide the coupling capacitan
between the module and main IC.

C107
0.1uF

ANT_CORE0   (*) Put matching component's land
             near the ANT terminals.

56 GND
57 ANT_CORE0
58 GND
59 GND
60 BT_UART_RTS
61 BT_UART_CTS
62 BT_UART_RXD
63 BT_UART_TXD
64 GND
65 NC
66 NC
67 NC
68 GND
69 GND
70 GND
71 ANT_CORE1
72 GND

Type1CX (LBEH5UL1CX)

ANT_CORE1

(*) Put matching component's land
    near the ANT terminals.

36 GND
35 GND
34 PCIE_RDP   C106 0.1uF   PCIE_RDP
33 PCIE_RDN   C105 0.1uF   PCIE_RDN
32 GND
31 PCIE_TDP   C104 0.1uF   PCIE_TDP
30 PCIE_TDN   C103 0.1uF   PCIE_TDN   (*2)
29 GND
28 PCIE_REFCLKN C102 100pF   PCIE_PEFCLKN
27 PCIE_REFCLKP C101 100pF   PCIE_PEFCLKP
26 GND
25 LPO   SLEEP_CLK
24 GND
23 WL_REG_ON   WL_REG_ON
22 SR_VLx   L100 2.2uH
21 SR_PVSS   (*1)
20 SR_PVSS
             C100
             4.7uF

C108
4.7uF

VBAT

9. POWER ON SEQUENCE
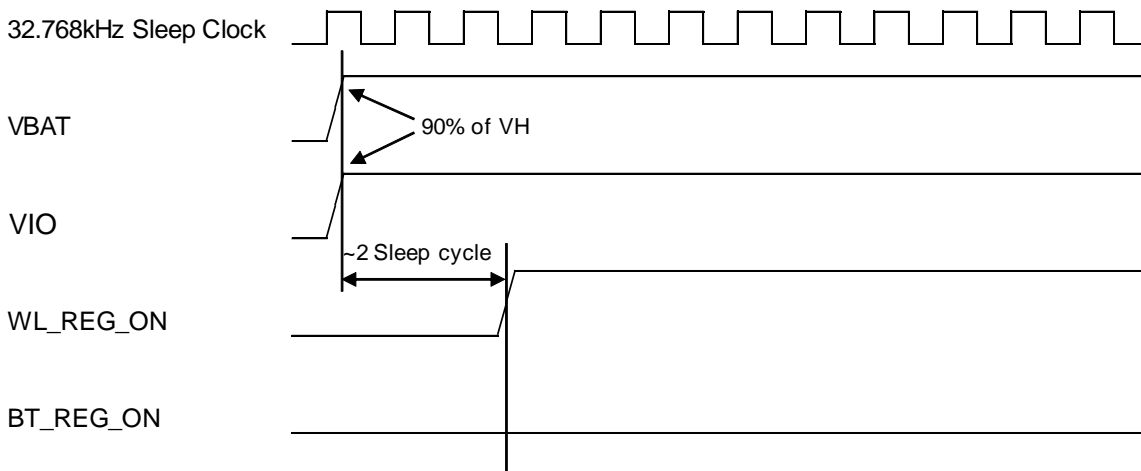
-VBAT should not rise 10%-90%faster than 40 microsecond.
-VBAT should be up before or at the same time as VIO. VIO should NOT be present first or be held high before VBAT is high.

9.1. Power On Sequence for WLAN ON and BT ON

9.2. Power On Sequence for WLAN ON and BT Off

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.
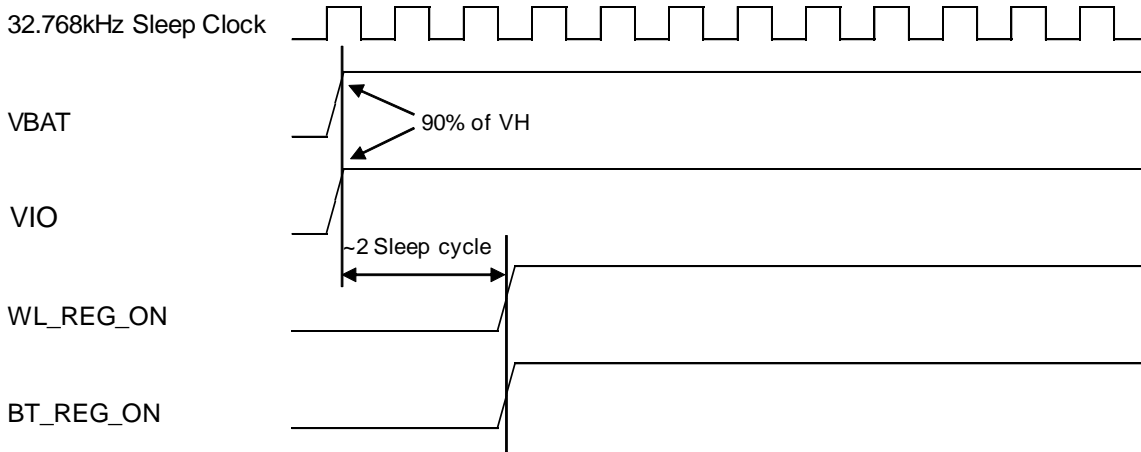
9.3. Power On Sequence for WLAN OFF and BT ON

9.4. Power On Sequence for WLAN OFF and BT OFF

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.
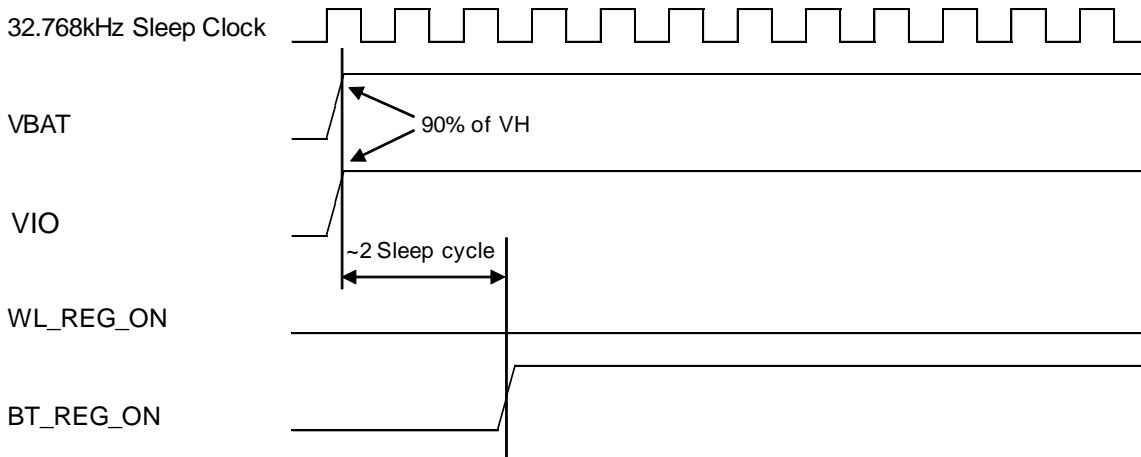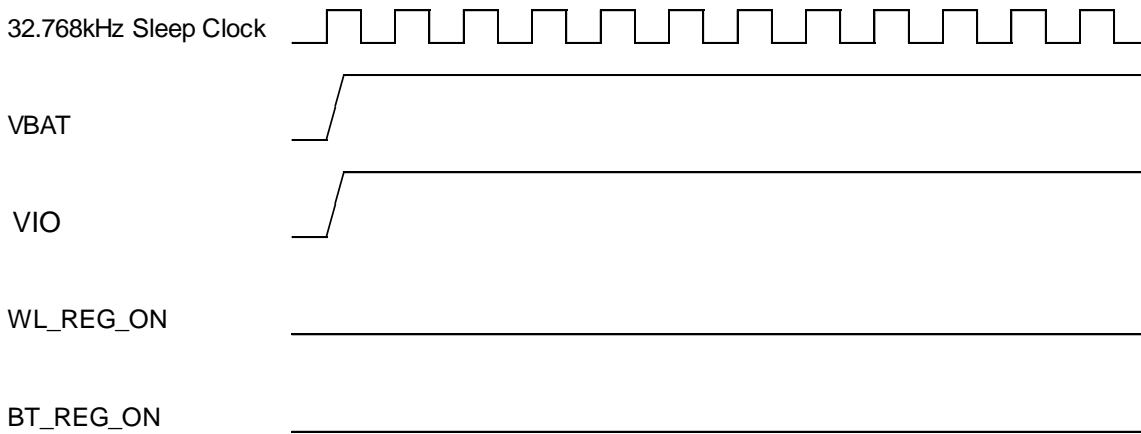
10. INTERFACE TIMING AND AC CHARACTERISTICS

10.1. Bluetooth UART Timing
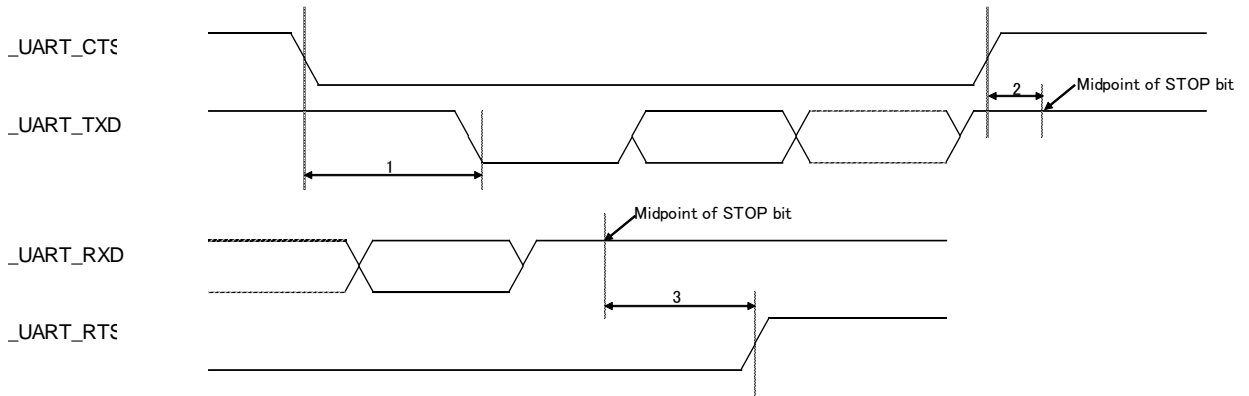
Reference	Description	Min	Typ	Max	Unit
1	Delay time, UART_CTS low to UART_TXD valid	-	-	1.5	Bit periods
2	Setup time, UART_CTS high before midpoint of stop bit	-	-	0.5	Bit periods
3	Delay time, midpoint of stop bit to UART_RTS high	-	-	0.5	Bit periods

10.2. PCM Interface Timing

10.2.1. Short Frame Sync, Master Mode

Reference	Description	Min	Typ	Max	Unit
1	PCM bit clock frequency	-	-	12	MHz
2	PCM bit clock Low	41	-	-	ns
3	PCM bit clock High	41	-	-	ns
4	PCM_SYN delay	0	-	25	ns
5	PCM_OUT delay	0	-	25	ns
6	PCM_IN setup	8	-	-	ns
7	PCM_IN hold	8	-	-	ns
8	Delay from rising edge of PCM_BCLK during last bit period to PCM_OUT becoming high impedance	0	-	25	ns

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

10.2.2. Short Frame Sync, Slave Mode

Reference	Description	Min	Typ	Max	Unit
1	PCM bit clock frequency	-	-	12	MHz
2	PCM bit clock Low	41	-	-	ns
3	PCM bit clock High	41	-	-	ns
4	PCM_SYNC setup	8	-	-	ns
5	PCM_SYNC hold	8	-	-	ns
6	PCM_OUT delay	0	-	25	ns
7	PCM_IN setup	8	-	-	ns
8	PCM_IN hold	8	-	-	ns
9	Delay from rising edge of PCM_BCLK during last bit period to PCM_OUT becoming high impedance	0	-	25	ns

10.2.3. Long Frame Sync, Master Mode

Reference	Description	Min	Typ	Max	Unit
1	PCM bit clock frequency	-	-	12	MHz
2	PCM bit clock Low	41	-	-	ns
3	PCM bit clock High	41	-	-	ns
4	PCM_SYNC delay	0	-	25	ns
5	PCM_OUT delay	0	-	25	ns
6	PCM_IN setup	8	-	-	ns
7	PCM_IN hold	8	-	-	ns
8	Delay from rising edge of PCM_BCLK during last bit period to PCM_OUT becoming high impedance	0	-	25	ns

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

10.2.4. Long Frame Sync, Slave Mode

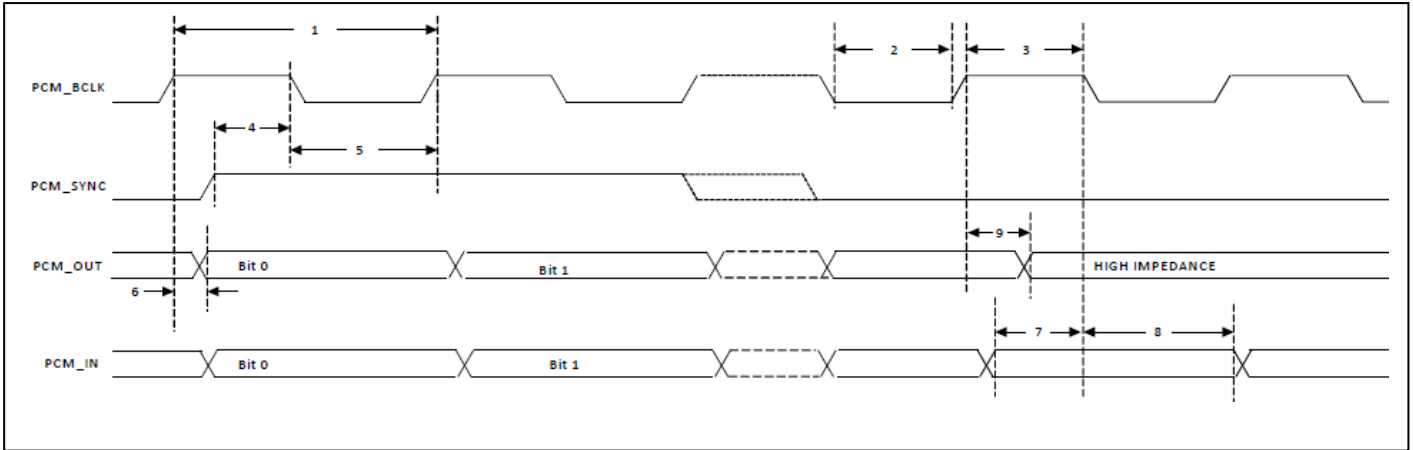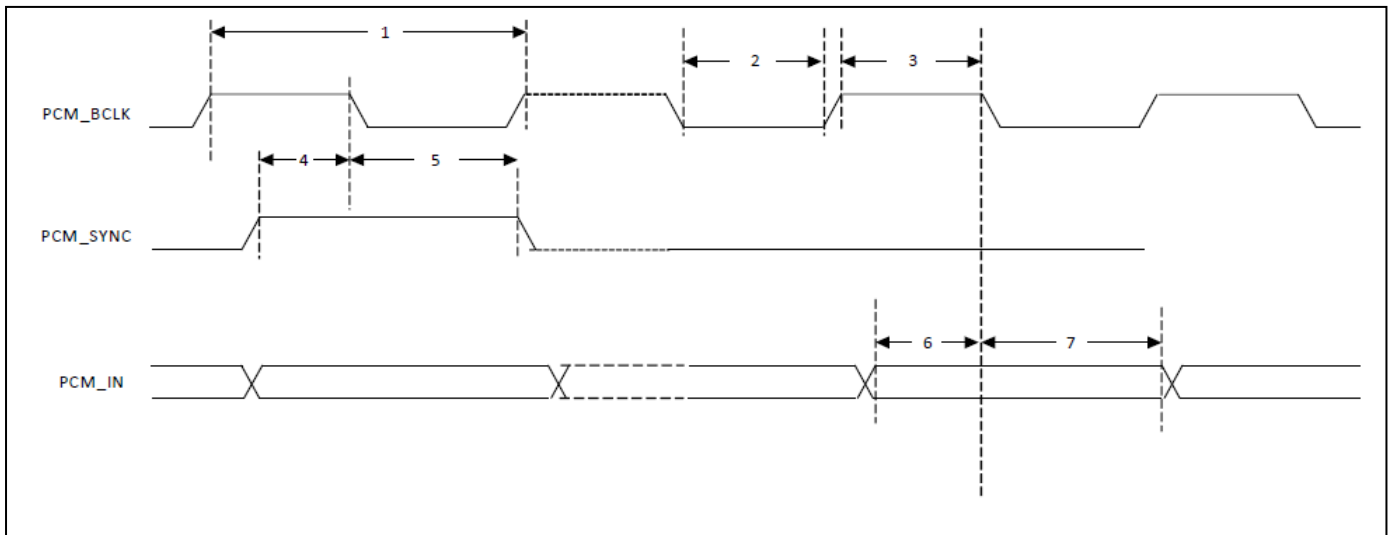| Reference	Description	Min	Typ	Max	Unit
1	PCM bit clock frequency	-	-	12	MHz
2	PCM bit clock Low	41	-	-	ns
3	PCM bit clock High	41	-	-	ns
4	PCM_SYNC setup	8	-	-	ns
5	PCM_SYNC hold	8	-	-	ns
6	PCM_OUT delay	0	-	25	ns
7	PCM_IN setup	8	-	-	ns
8	PCM_IN hold	8	-	-	ns
9	Delay from rising edge of PCM_BCLK during last bit period to PCM_OUT becoming high impedance	0	-	25	ns

10.2.5. Short Frame Sync, Burst Mode

Reference	Description	Min	Typ	Max	Unit
1	PCM bit clock frequency	-	-	24	MHz
2	PCM bit clock Low	20.8	-	-	ns
3	PCM bit clock High	20.8	-	-	ns
4	PCM_SYNC setup	8	-	-	ns
5	PCM_SYNC hold	8	-	-	ns
6	PCM_IN setup	8	-	-	ns
7	PCM_IN hold	8	-	-	ns

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

10.2.6. <u>Long Frame Sync, Burst Mode</u>
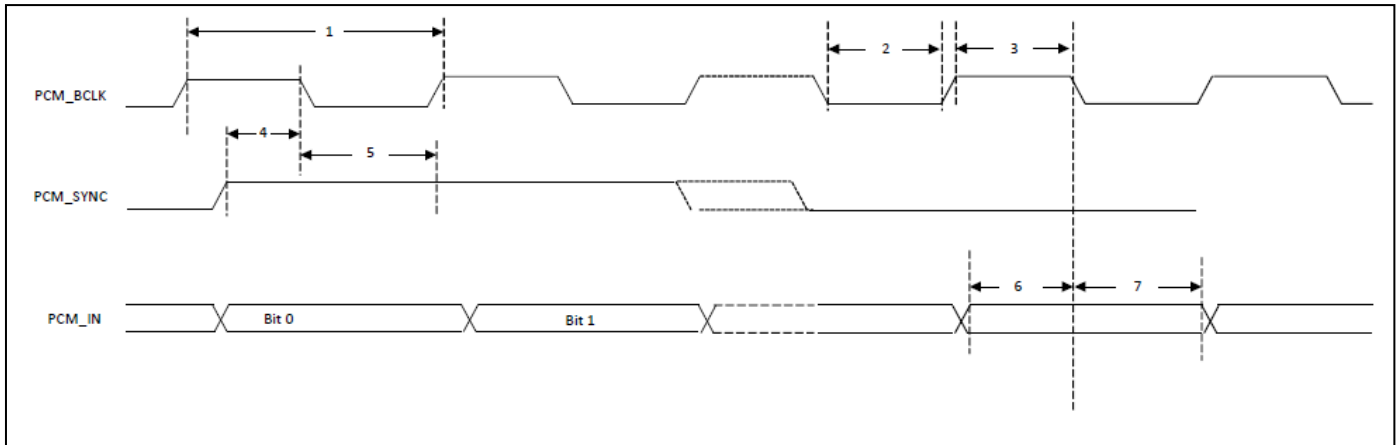
Reference	Description	Min	Typ	Max	Unit
1	PCM bit clock frequency	-	-	24	MHz
2	PCM bit clock Low	20.8	-	-	ns
3	PCM bit clock High	20.8	-	-	ns
4	PCM_SYNC setup	8	-	-	ns
5	PCM_SYNC hold	8	-	-	ns
6	PCM_IN setup	8	-	-	ns
7	PCM_IN hold	8	-	-	ns

11. ELECTORICAL CHARACTERISTICS (ANT CORE0/1)

11.1. DC/RF Characteristics for IEEE802.11b - 2.4GHz

Normal Condition : 25deg.C, VBAT=3.6V, VIO=1.8V. **11Mbps** mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11b-2.4GHz			
Mode	DSSS / CCK			
Channel frequency (spacing)	2412 to 2472 MHz (5MHz)			
Power setting (txpwr1-quarter, decimal)	18			
Current Consumption	**Min.**	**Typ.**	**Max.**	**unit**
(a) Tx mode	-	-	450	mA
(b) Rx mode	-	-	150	mA
Transmitter	**Min.**	**Typ.**	**Max.**	**Unit**
Power Levels	16	18	20	dBm
Spectrum Mask				
(a) 1st side lobes	-	-	-30	dBr
(b) 2nd side lobes	-	-	-50	dBr
Power-on/off ramp	-	-	2.0	Usec
RF Carrier Suppression	15	-	-	dB
Modulation Accuracy	-	-	-9.1	dB
Spurious Emissions (BW=100kHz)				
(a) 30-1000MHz	-	-	-36	dBm
(b) 1000-12750MHz	-	-	-30	dBm
(c) 1800-1900MHz	-	-	-47	dBm
(d) 5150-5300MHz	-	-	-47	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (FER$\leq$ 8%)	-	-	-86.5	dBm
Maximum Input Level (FER $\leq$ 8%)	-10	-	-	dBm

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

11.2. DC/RF Characteristics for IEEE802.11g - 2.4GHz

Normal Condition : 25deg.C, VBAT =3.6V, VIO=1.8V. **54Mbps** mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11g-2.4GHz			
Mode	OFDM			
Channel frequency (spacing)	2412 to 2472 MHz (5MHz)			
Power setting (txpwr1-quarter, decimal)	15.5			
Current Consumption	**Min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode		-	370	mA
(b) Rx mode		-	150	mA
Transmitter	**Min.**	**Typ.**	**Max.**	**Unit**
Power Levels	13.5	15.5	17.5	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-23	dBr
(b) at fc +/- 20MHz	-	-	-33	dBr
(c) at fc $\geq$ +/-30MHz	-	-	-43	dBr
Constellation Error	-	-	-27	dB
Spurious Emissions (BW=100kHz)				
(a) 30-1000MHz	-	-	-36	dBm
(b) 1000-12750MHz	-	-	-30	dBm
(c) 1800-1900MHz	-	-	-47	dBm
(d) 5150-5300MHz	-	-	-47	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER $\leq$ 10%)	-	-	-72.5	dBm
Maximum Input Level (PER $\leq$ 10%)	-20	-	-	dBm

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

11.3. DC/RF Characteristics for IEEE802.11n - 2.4GHz

Normal Condition : 25deg.C, VBAT =3.6V, VIO=1.8V. **MCS7** mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11n-2.4GHz			
Mode	OFDM			
Channel frequency (spacing)	2412 to 2472 MHz (5MHz)			
Power setting (txpwr1-quarter, decimal)	14.5			
Current Consumption	**Min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode		-	320	mA
(b) Rx mode		-	150	mA
Transmitter	**Min.**	**Typ.**	**Max.**	**Unit**
Power Levels	12.5	14.5	16.5	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-23	dBr
(b) at fc +/- 20MHz	-	-	-31	dBr
(c) at fc $\geq$ +/-30MHz	-	-	-48	dBr
Constellation Error	-	-	-30	dB
Spurious Emissions (BW=100kHz)				
(a) 30-1000MHz	-	-	-36	dBm
(b) 1000-12750MHz	-	-	-30	dBm
(c) 1800-1900MHz	-	-	-47	dBm
(d) 5150-5300MHz	-	-	-47	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER $\leq$ 10%)	-	-	-69	dBm
Maximum Input Level (PER < 10%)	-20	-	-	dBm

11.4. DC/RF Characteristics for IEEE802.11ac - 2.4GHz

Normal Condition : 25deg.C, VBAT=3.6V, VIO=1.8V. **MCS8** mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11n-2.4GHz			
Mode	OFDM			
Channel frequency (spacing)	2412 to 2472 MHz (5MHz)			
Power setting (txpwr1-quarter, decimal)	13			
Current Consumption	**Min.**	**Typ.**	**Max.**	**unit**
(a) Tx mode	-	-	320	mA
(b) Rx mode	-	-	150	mA
Transmitter	**Min.**	**Typ.**	**Max.**	**Unit**
Power Levels	11	13	15	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-23	dBr
(b) at fc +/- 20MHz	-	-	-31	dBr
(c) at fc $\geq$ +/-30MHz	-	-	-48	dBr
Constellation Error	-	-	-32	dB
Spurious Emissions (BW=100kHz)				
(a) 30-1000MHz	-	-	-36	dBm
(b) 1000-12750MHz	-	-	-30	dBm
(c) 1800-1900MHz	-	-	-47	dBm
(d) 5150-5300MHz	-	-	-47	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER$\leq$ 10%)	-	-	-65.5	dBm
Maximum Input Level (PER < 10%)	-20	-	-	dBm

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

11.5. DC/RF Characteristics for IEEE802.11a - 5GHz

Normal Condition : 25deg.C, VBAT =3.6V, VIO=1.8V. **54Mbps** mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11a-5GHz			
Mode	OFDM			
Channel frequency (spacing)	5180 to 5320MHz (20MHz), 5500 to 5720MHz (20MHz), 5745 to 5825MHz (20MHz)			
Power setting (txpwr1-quarter, decimal)	14.5			
Current Consumption	**min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode		-	370	mA
(b) Rx mode		-	170	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	12.5	14.5	16.5	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-23	dBr
(b) at fc +/- 20MHz	-	-	-33	dBr
(c) at fc $\geq$ +/-30MHz	-	-	-43	dBr
Constellation Error	-	-	-27	dB
Spurious Emissions (BW=100kHz)				
(a) 30MHz -1GHz	-	-	-36	dBm
(b) 1GHz – 26.5GHz	-	-	-30	dBm
Receiver	**min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER $\leq$ 10%)	-	-	-72	dBm
Maximum Input Level (PER < 10%)	-30	-	-	dBm

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

11.6. DC/RF Characteristics for IEEE802.11n(HT 20MHz) - 5GHz

Normal Condition : 25deg.C, VBAT =3.6V, VIO=1.8V. **MCS7** mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11n-5GHz			
Mode	OFDM			
Channel frequency (spacing)	5180 to 5320MHz (20MHz), 5500 to 5720MHz (20MHz), 5745 to 5825MHz (20MHz)			
Power setting (txpwr1-quarter, decimal)	13.5			
Current Consumption	**min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode		-	350	mA
(b) Rx mode		-	170	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	11.5	13.5	15.5	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-23	dBr
(b) at fc +/- 20MHz	-	-	-31	dBr
(c) at fc ≥ +/-30MHz	-	-	-43	dBr
Constellation Error (measured at enhanced mode)	-	-	-30	dB
Spurious Emissions (BW=100kHz)				
(a) 30MHz -1GHz	-	-	-36	dBm
(b) 1GHz – 26.5GHz	-	-	-30	dBm
Receiver	**min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≤ 10%)	-	-	-69.5	dBm
Maximum Input Level (PER < 10%)	-30	-	-	dBm

11.7. DC/RF Characteristics for IEEE802.11ac(VHT 20MHz) - 5GHz

Normal Condition : 25deg.C, VBAT =3.6V. **MCS8** mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11n-5GHz			
Mode	OFDM			
Channel frequency (spacing)	5180 to 5320MHz (20MHz), 5500 to 5720MHz (20MHz), 5745 to 5825MHz (20MHz)			
Power setting (txpwr1-quarter, decimal)	12.5			
Current Consumption	**min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode		-	350	mA
(b) Rx mode		-	170	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	10.5	12.5	14.5	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-23	dBr
(b) at fc +/- 20MHz	-	-	-31	dBr
(c) at fc ≥ +/-30MHz	-	-	-43	dBr
Constellation Error (measured at enhanced mode)	-	-	-32	dB
Spurious Emissions (BW=100kHz)				
(a) 30MHz -1GHz	-	-	-36	dBm
(b) 1GHz – 26.5GHz	-	-	-30	dBm
Receiver	**min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≤ 10%)	-	-	-65	dBm
Maximum Input Level (PER < 10%)	-30	-	-	dBm

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

11.8. DC/RF Characteristics for IEEE802.11ac(VHT 40MHz) - 5GHz

Normal Condition : 25deg.C, VBAT =3.6V, VIO=1.8V. **MCS9** mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11n-5GHz			
Mode	OFDM			
Channel frequency (spacing)	5190 to 5310MHz (40MHz), 5510 to 5710MHz (40MHz), 5755 to 5795MHz (40MHz)			
Power setting (txpwr1-quarter, decimal)	11.5			
Current Consumption	**min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode		-	350	mA
(b) Rx mode		-	170	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	9.5	11.5	13.5	dBm
Spectrum Mask				
(a) at fc +/- 21MHz	-	-	-21	dBr
(b) at fc +/- 40MHz	-	-	-29	dBr
(c) at fc $\geq$ +/-60MHz	-	-	-41	dBr
Constellation Error (measured at enhanced mode)	-	-	-32	dB
Spurious Emissions (BW=100kHz)				
(a) 30MHz -1GHz	-	-	-36	dBm
(b) 1GHz – 26.5GHz	-	-	-30	dBm
Receiver	**min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER $\leq$ 10%)	-	-	-61	dBm
Maximum Input Level (PER < 10%)	-30	-	-	dBm

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

11.9. DC/RF Characteristics for IEEE802.11ac(VHT 80MHz)-5GHz

Normal Condition : 25deg.C, VBAT =3.6V, VIO=1.8V. **MCS9** mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11ac-5GHz			
Mode	OFDM			
Channel frequency (spacing)	5210 to 5290MHz (80MHz), 5530 to 5690MHz (80MHz), 5775MHz (80MHz)			
Power setting (txpwr1-quarter, decimal)	11.5			
Current Consumption	**min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode		-	380	mA
(b) Rx mode		-	170	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	9.5	11.5	13.5	dBm
Spectrum Mask				
(a) at fc +/- 41MHz	-	-	-21	dBr
(b) at fc +/- 80MHz	-	-	-29	dBr
(c) at fc $\geq$ +/-120MHz	-	-	-41	dBr
Constellation Error (measured at enhanced mode)	-	-	-32	dB
Spurious Emissions (BW=100kHz)				
(a) 30MHz -1GHz	-	-	-36	dBm
(b) 1GHz – 26.5GHz	-	-	-30	dBm
Receiver	**min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER $\leq$ 10%)	-	-	-57	dBm
Maximum Input Level (PER < 10%)	-30	-	-	dBm

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

11.10. DC/RF Characteristics for Bluetooth

Normal conditions : 25 deg.C, VBAT = 3.6V, VIO=1.8V

Items	Contents			
Bluetooth specification (power class)	Version 5.0 (Class1)			
Channel frequency (spacing)	2402 to 2480 MHz (1MHz)			
Transmitter	**Min.**	**Typ.**	**Max.**	**Unit**
Output Power	6	9	12	dBm
20dB bandwidth	-		1	MHz
Modulation characteristics				
(a) Modulation Δf1avg	140	-	175	kHz
(b) Modulation Δf2max	115		-	kHz
(c) Modulation Δf2avg / Δf1avg	0.8	-	-	
Carrier Frequency Drift				
(a) 1slot	-25	-	+25	kHz
(b) 3slot / 5slot	-40	-	+40	kHz
(c) Maximum drift rate	-20	-	+20	kHz/50us
EDR Relative Power	-4	-	+1	dB
EDR Carrier Frequency Stability and Modulation Accuracy				
(a) ωi	-75	-	+75	kHz
(b) ωi+ωo	-75	-	+75	kHz
(c) ωo	-10	-	+10	kHz
(d) RMS DEVM (DQPSK)	-	-	20	%
(e) Peak DEVM (DQPSK)	-	-	35	%
(f) 99% DEVM (DQPSK)	-	-	30	%
(g) RMS DEVM (8DPSK)	-	-	13	%
(h) Peak DEVM (8DPSK)	-	-	25	%
(i) 99% DEVM (8DPSK)	-	-	20	%
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Sensitivity (BER≤0.1%)	-	-	-80	dBm
Maximum Input Level (BER≤0.1%)	-20	-	-	dBm
EDR Sensitivity (BER≤0.007%)				
(a) 8DPSK	-	-	-77	dBm

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

11.11. DC/RF Characteristics for Bluetooth（LE）

Normal conditions : 25 deg.C, VBAT = 3.6V, VIO=1.8V

Items	Contents			
Bluetooth specification (power class)	Version 5.0 (LE)			
Channel frequency (spacing)	2402 to 2480 MHz (2MHz)			
Number of RF Channel	40			
Item / Condition	Min.	Typ.	Max.	Unit
Center Frequency	2402	-	2480	MHz
Output power	-	-	10	dBm
Modulation Characteristics				
1) $\Delta f1_{avg}$	225	-	275	kHz
2) $\Delta f2_{max}$ (at 99.9%)	185	-	-	kHz
3) $\Delta f2_{avg} / \Delta f1_{avg}$	0.8	-	-	-
Carrier frequency offset and drift				
1) $f_n - f_{TX}$, n=0,1,2,3,…k	-150	-	150	kHz
2) $\| f_0 - f_n \|$, n=2,3,4,…k	-	-	50	kHz
3) $\| f_1 - f_0 \|$	-	-	20	kHz
4) $\| f_n - f_{n-5} \|$, n=6,7,8,…k	-	-	20	kHz
Receiver sensitivity (PER < 30.8%)	-	-	-70	dBm
Maximum input signal level (PER < 30.8%)	-10	-	-	dBm
PER Report Integrity (-30dBm input)	50	-	-	%

Note

  The above mentioned values have been obtained according to our own measuring methods and may very depend on the circuit, in which the component is actually incorporated. Therefore, you are kindly requested to test the performance of the component actually in your set.

12. LAND PATTERN (TOP VIEW)

Outline of the module

(mm)
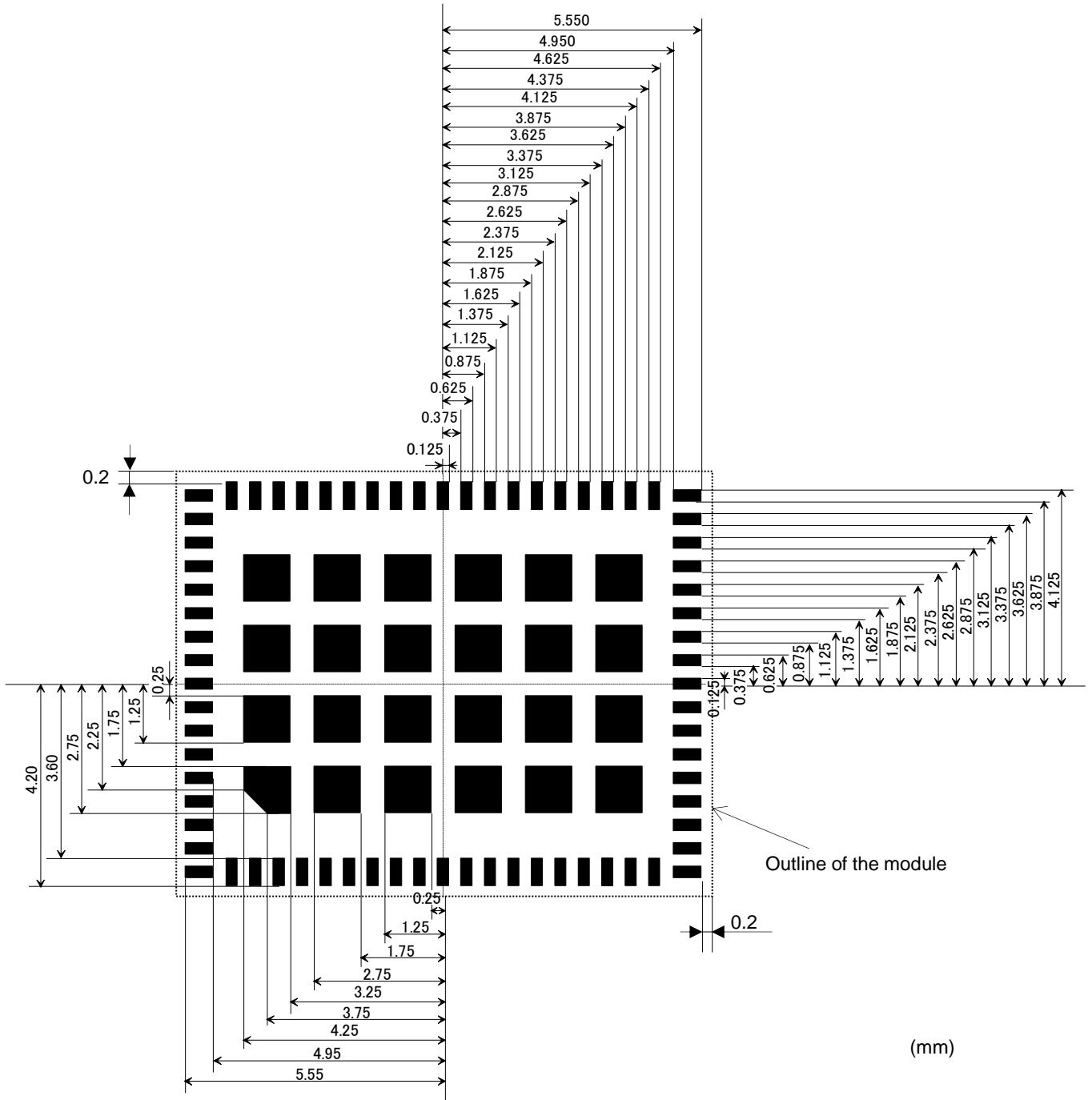
* To avoid the short-circuit between the side shielding and a solder on the module land after the reflow, please locate the module land at 0.2mm away from module outline as above figure.
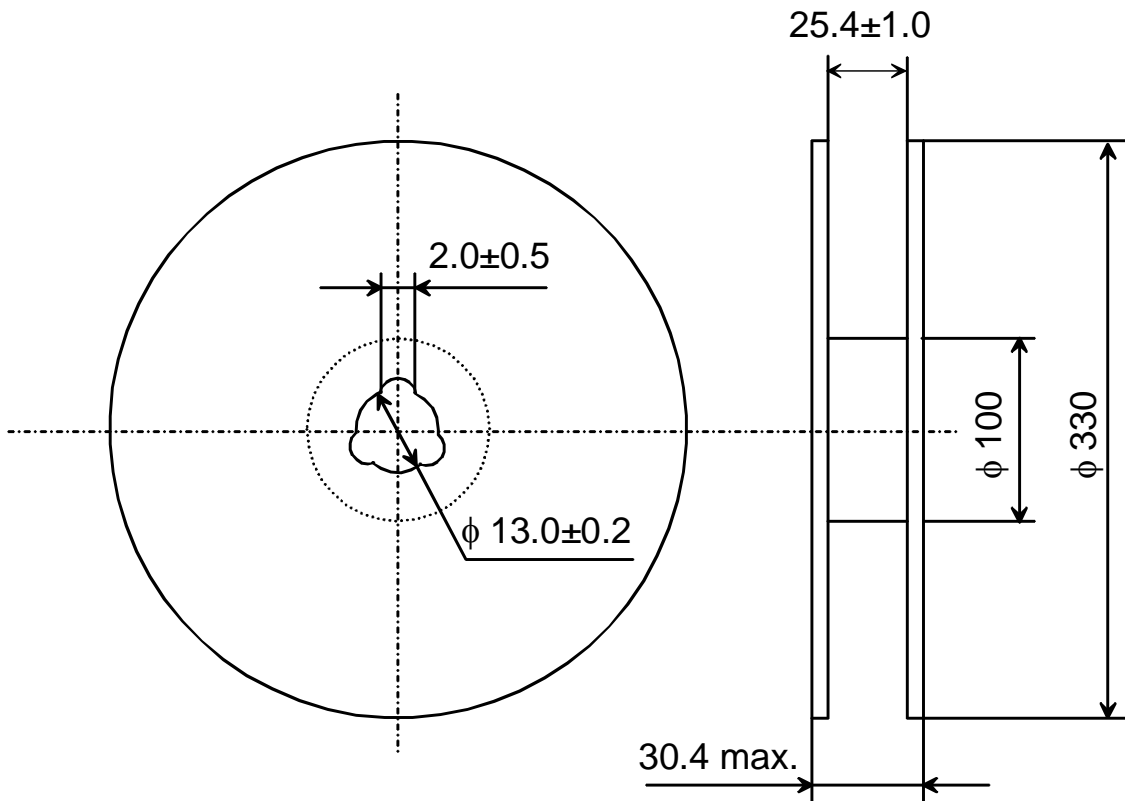
Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

13. TAPE AND REEL PACKING

(1) Dimensions of Tape (Plastic tape)

    *1. Cumulative tolerance of max. 40.0 ± 0.15 every 10 pitches
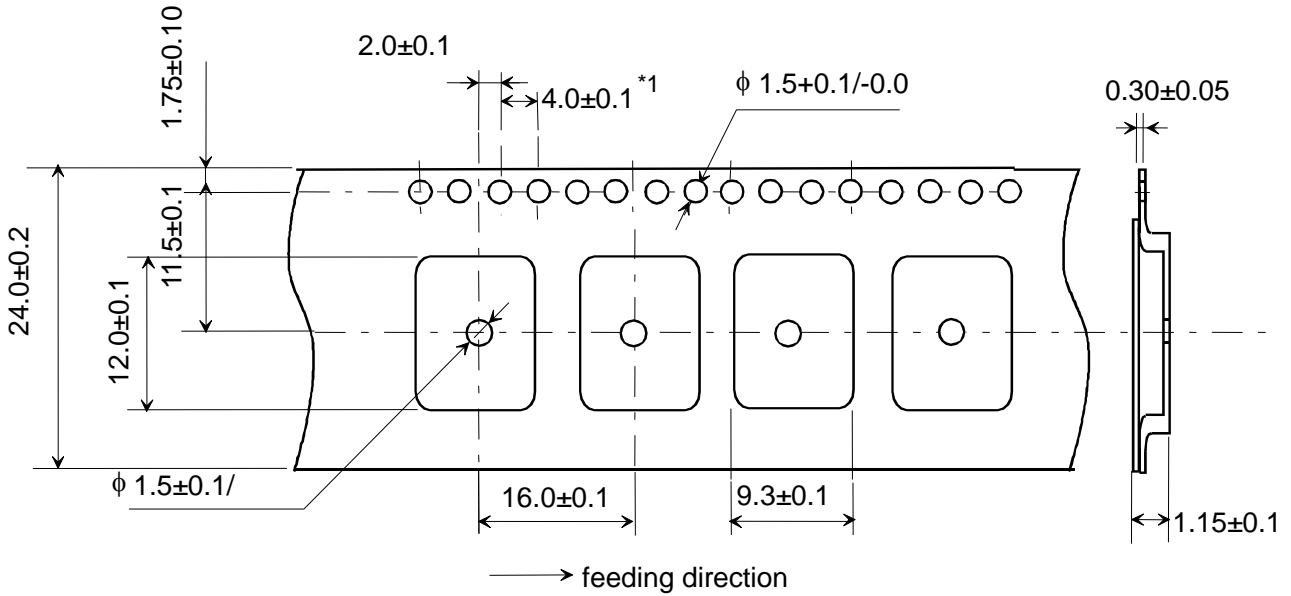
feeding direction

(2) Dimensions of Reel

(3) Taping Diagrams

[1] Feeding Hole : As specified in (1)
[2] Hole for chip : As specified in (1)
 [3] Cover tape : 62 um in thickness
[4] Base tape : As specified in (1)
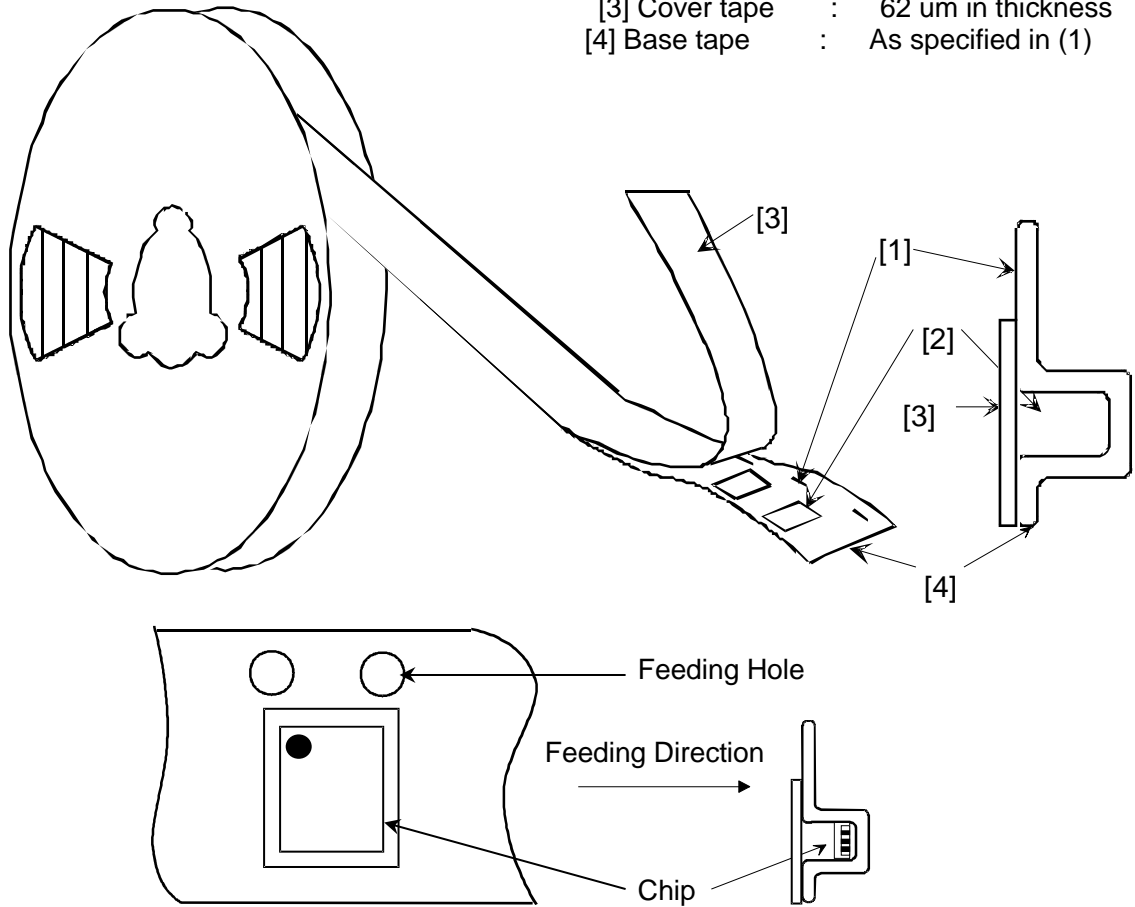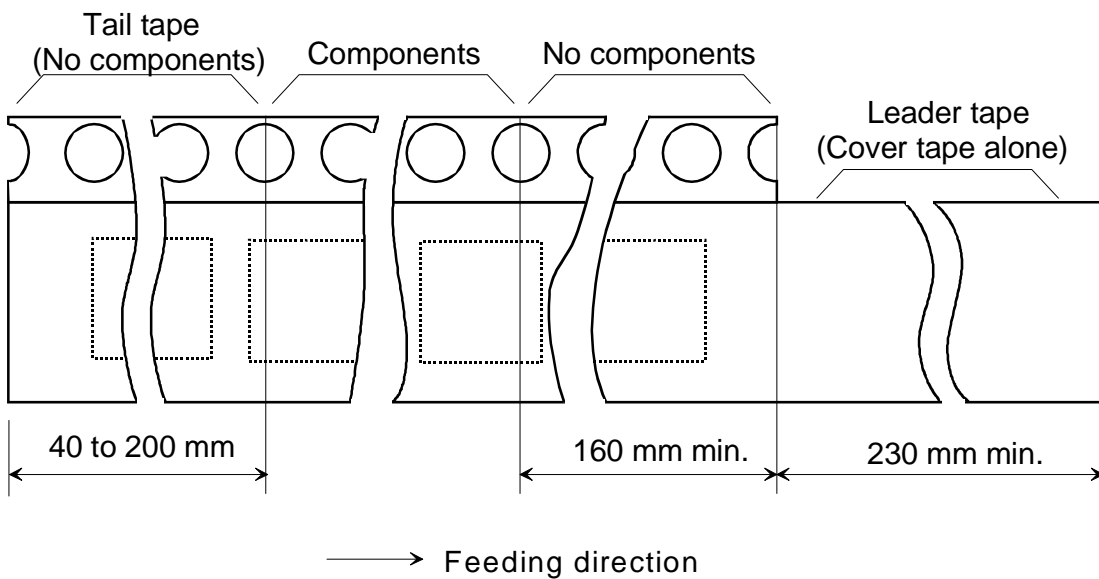
[3]

[1]

[2]

[3]

[4]

Feeding Hole

Feeding Direction

Chip

(4) Leader and Tail tape

Tail tape
(No components)

Components

No components

Leader tape
(Cover tape alone)

40 to 200 mm

160 mm min.

230 mm min.

Feeding direction

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

-The tape for chips are wound clockwise, the feeding holes to the right side as the tape is pulled
     toward the user.

-The cover tape and base tape are not adhered at no components area for 250 mm min.

-Tear off strength against pulling of cover tape: 5 N min.

-Packaging unit: 1000 pcs/ reel

- Material: Base tape: Plastic
        Reel   : Plastic
        Cover tape, cavity tape and reel are made the anti-static processing.

- Peeling of force: 1.1 N max. in the direction of peeling as shown below.
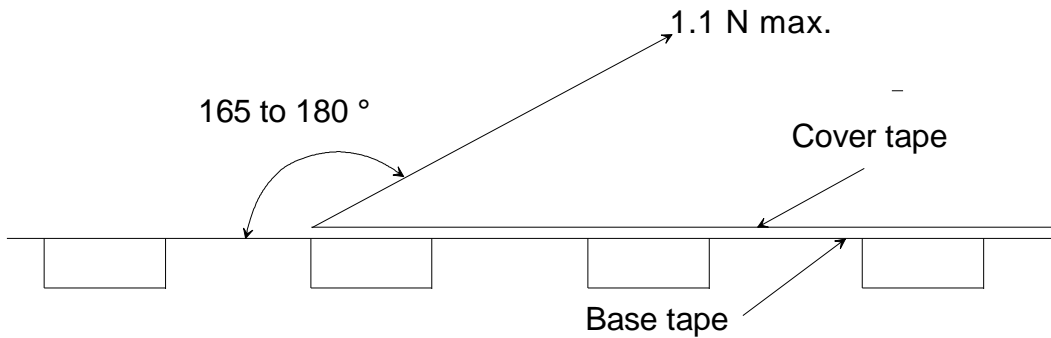
- PACKAGE (Humidity proof packing)
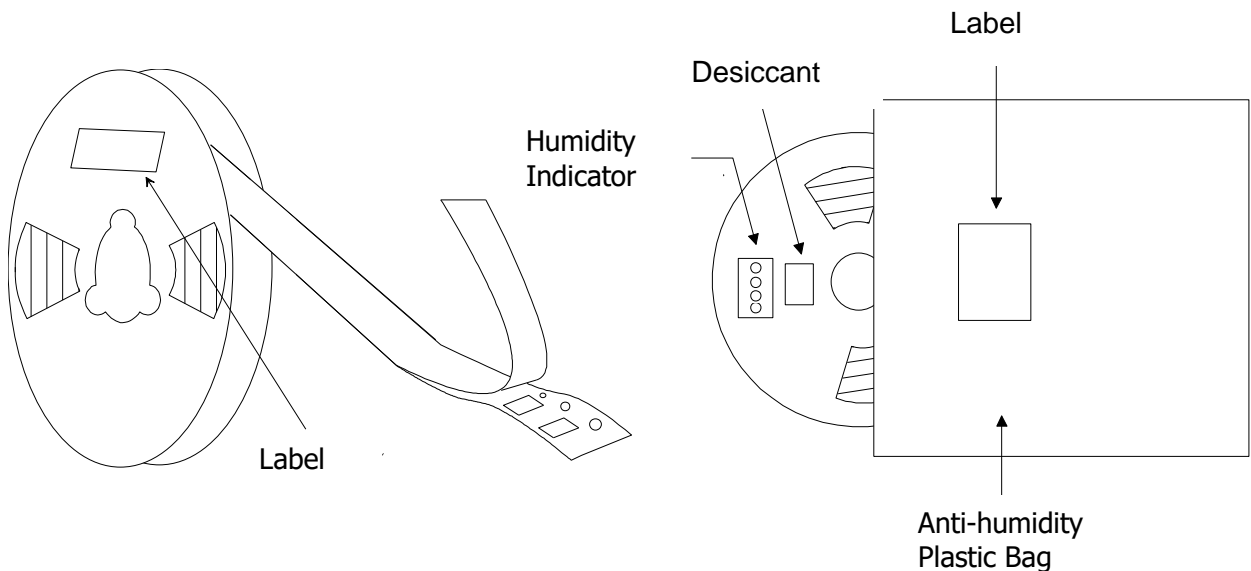
Tape and reel must be sealed with the anti-humidity plastic bag. The bag contains the desiccant and the humidity indicator.

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

14. NOTICE
14.1.   Storage Conditions:

Please use this product within 6month after receipt.
- The product shall be stored without opening the packing under the ambient temperature from 5 to 35deg.C and humidity from 20 to 70%RH.
(Packing materials, in particular, may be deformed at the temperature over 40deg.C.)
- The product left more than 6months after reception, it needs to be confirmed the solderbility before used.
- The product shall be stored in non corrosive gas (Cl_2, NH_3, SO_2, No_x, etc.).
- Any excess mechanical shock including, but not limited to, sticking the packing materials by sharp object and dropping the product, shall not be applied in order not to damage the packing materials.

This product is applicable to MSL3 (Based on JEDEC Standard J-STD-020)
- After the packing opened, the product shall be stored at $\leq$30deg.C / $\leq$60%RH and the product shall be used within 168hours.
- When the color of the indicator in the packing changed, the product shall be baked before soldering.

        Baking condition: 125+5/-0deg.C, 24hours, 1time
The products shall be baked on the heat-resistant tray because the material (Base Tape, Reel Tape and Cover Tape) are not heat-resistant.

14.2.   Handling Conditions:

Be careful in handling or transporting products because excessive stress or mechanical shock may break products.

Handle with care if products may have cracks or damages on their terminals, the characteristics of products may change. Do not touch products with bear hands that may result in poor solder ability and destroy by static electrical charge.

14.3.   Standard PCB Design (Land Pattern and Dimensions):

All the ground terminals should be connected to the ground patterns. Furthermore, the ground pattern should be provided between IN and OUT terminals. Please refer to the specifications for the standard land dimensions.

The recommended land pattern and dimensions is as Murata's standard. The characteristics of products may vary depending on the pattern drawing method, grounding method, land dimensions, land forming method of the NC terminals and the PCB material and thickness. Therefore, be sure to verify the characteristics in the actual set. When using non-standard lands, contact Murata beforehand.

14.4.   Notice for Chip Placer:

When placing products on the PCB, products may be stressed and broken by uneven forces from a worn-out chucking locating claw or a suction nozzle. To prevent products from damages, be sure to follow the specifications for the maintenance of the chip placer being used. For the positioning of products on the PCB, be aware that mechanical chucking may damage products.

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

14.5.   Soldering Conditions:

The recommendation conditions of soldering are as in the following figure.
Soldering must be carried out by the above mentioned conditions to prevent products from damage. Set up the highest temperature of reflow within 260 ℃.   Contact Murata before use if concerning other soldering conditions.

Reflow soldering standard conditions (Example)
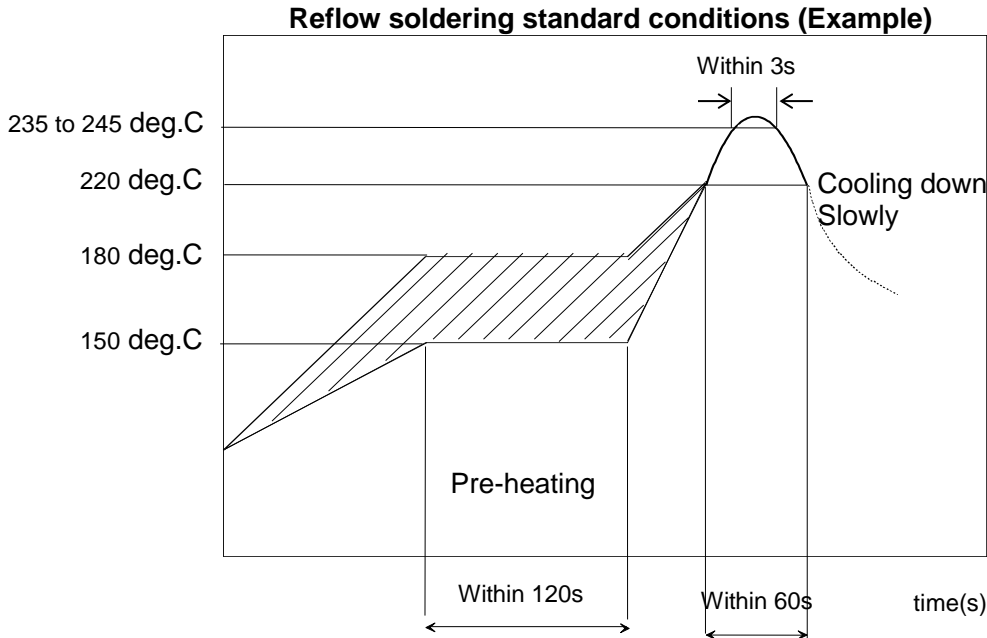
Please use the reflow within 2 times.
Use rosin type flux or weakly active flux with a chlorine content of 0.2 wt % or less.

14.6.   Cleaning:

Since this Product is Moisture Sensitive, any cleaning is not recommended. If any cleaning process is done the customer is responsible for any issues or failures caused by the cleaning process.

14.7.   Operational Environment Conditions:

Products are designed to work for electronic products under normal environmental conditions (ambient temperature, humidity and pressure). Therefore, products have no problems to be used under the similar conditions to the above-mentioned. However, if products are used under the following circumstances, it may damage products and leakage of electricity and abnormal temperature may occur.

- In an atmosphere containing corrosive gas (Cl_2, NH_3, SO_x, NO_x etc.).
- In an atmosphere containing combustible and volatile gases.
- Dusty place.
- Direct sunlight place.
- Water splashing place.
- Humid place where water condenses.
- Freezing place.

If there are possibilities for products to be used under the preceding clause, consult with Murata before actual use.

As it might be a cause of degradation or destruction to apply static electricity to products, do not apply static electricity or excessive voltage while assembling and measuring.

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

14.8.   Input Power Capacity:

Products shall be used in the input power capacity as specified in these specifications.
Inform Murata beforehand, in case that the components are used beyond such input power capacity range.

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

15. PRECONDITION TO USE OUR PRODUCTS
PLEASE READ THIS NOTICE BEFORE USING OUR PRODUCTS.

Please make sure that your product has been evaluated and confirmed from the aspect of the fitness for the specifications of our product when our product is mounted to your product.

All the items and parameters in this product specification/datasheet/catalog have been prescribed on the premise that our product is used for the purpose, under the condition and in the environment specified in this specification. You are requested not to use our product deviating from the condition and the environment specified in this specification.

Please note that the only warranty that we provide regarding the products is its conformance to the specifications provided herein. Accordingly, we shall not be responsible for any defects in products or equipment incorporating such products, which are caused under the conditions other than those specified in this specification.

WE HEREBY DISCLAIMS ALL OTHER WARRANTIES REGARDING THE PRODUCTS, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, THAT THEY ARE DEFECT-FREE, OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS.

You agree that you will use any and all software or program code (including but not limited to hcd, firmware, nvram, and blob) we may provide or to be embedded into our product ("Software") provided that you use the Software bundled with our product. YOU AGREE THAT THE SOFTWARE SHALL BE PROVIDED TO YOU "AS- IS" BASIS, MURATA MAKES NO REPRESENTATIONS OR WARRANTIES THAT THE SOFTWARE IS ERROR-FREE OR WILL OPERATE WITHOUT INTERRUPTION. AND MORE, MURATA MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED WITH RESPECT TO THE SOFTWARE. MURATA EXPRESSLY DISCLAIM ANY AND ALL WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE NOR THE WARRANTY OF TITLE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS.

You shall indemnify and hold harmless us, our affiliates and our licensor from and against any and all claims, costs, expenses and liabilities (including attorney's fees), which arise in connection with the using the Software.

The product shall not be used in any application listed below which requires especially high reliability for the prevention of such defect as may directly cause damage to the third party's life, body or property. You acknowledge and agree that, if you use our products in such applications, we will not be responsible for any failure to meet such requirements. Furthermore, YOU AGREE TO INDEMNIFY AND DEFEND US AND OUR AFFILIATES AGAINST ALL CLAIMS, DAMAGES, COSTS, AND EXPENSES THAT MAY BE INCURRED, INCLUDING WITHOUT LIMITATION, ATTORNEY FEES AND COSTS, DUE TO THE USE OF OUR PRODUCTS AND THE SOFTWARE IN SUCH APPLICATIONS.

   - Aircraft equipment.   - Aerospace equipment   - Undersea equipment.
   - Power plant control equipment   - Medical equipment.
   - Transportation equipment (vehicles, trains, ships, elevator, etc.).
   - Traffic signal equipment.   - Disaster prevention / crime prevention equipment.
   -Burning / explosion control equipment
   - Application of similar complexity and/ or reliability requirements to the applications listed in the above.

We expressly prohibit you from analyzing, breaking, reverse-engineering, remodeling altering, and reproducing our product. Our product cannot be used for the product which is prohibited from being manufactured, used, and sold by the regulations and laws in the world.

We do not warrant or represent that any license, either express or implied, is granted under any our patent right, copyright, mask work right, or our other intellectual property right relating to any combination, machine, or process in which our products or services are used. Information provided by us regarding third-party products or services does not constitute a license from us to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from us under our patents or other intellectual property.

Please do not use our products, our technical information and other data provided by us for the purpose of developing of mass-destruction weapons and the purpose of military use.

Moreover, you must comply with "foreign exchange and foreign trade law", the "U.S. export administration regulations", etc.

Please note that we may discontinue the manufacture of our products, due to reasons such as end of supply of materials and/or components from our suppliers.

By signing on specification sheet or approval sheet, you acknowledge that you are the legal representative for your company and that you understand and accept the validity of the contents herein. When you are not able to return the signed version of specification sheet or approval sheet within 30 days from receiving date of specification sheet or approval sheet, it shall be deemed to be your consent on the content of specification sheet or approval sheet. Customer acknowledges that engineering samples may deviate from specifications and may contain defects due to their development status. We reject any liability or product warranty for engineering samples. In particular we disclaim liability for damages caused by

- the use of the engineering sample other than for evaluation purposes, particularly the installation or integration in the product to be sold by you,

-deviation or lapse in function of engineering sample,

-improper use of engineering samples.

We disclaim any liability for consequential and incidental damages.

If you can't agree the above contents, you should inquire our sales.

Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.