W-LAN+Bluetooth Combo Module Data Sheet

NXP Chipset 88W8997
for 802.11a/b/g/n/ac 2x2 MU-MIMO
+ Bluetooth 5.2

P/N : LBEE5XV1YM-574

Revision History

Revision Code	Date	Changed Item	Comments
-	2020.01.15	First version	
A	2020.02.17	8. DIMENSIONS, MARKING AND TERMINAL CONFIGURATIONS 10. REFERENCE PERIPHERAL CIRCUIT	- Added label design information. - Added Reference Circuit
B	2020.06.15	TOP page 7. Module Pin Descriptions 11. Pin States	- Changed part number to LBEE5XV1YM - Changed pin name RXP/RXN/TXP/TXN to - PCIE_RXP/PCIE_RXN/PCIE_TXP/PCIE_TXN. - Added pin state table
C	2020.06.20	4. Dimensions	- Added Solder bump and defined T1 dimension
D	2020.08.07	9.10 DC/RF Characteristics for Bluetooth 9.11 DC/RF Characteristics for Bluetooth (LE)	- Defined output power - Defined output power
E	2020.11.06	Updated to new format 1. Scope 2. Key Features 5. Certification Information 6. Dimensions, Marking and Terminal configurations 9. Operating Conditions 12. DC/RF Characteristics 15.Tape and Reel Packing APPENDIX	 - Changed Bluetooth version 5.1 to 5.2 - Changed Bluetooth version 5.1 to 5.2 - Added certification information - Updated marking to final - Added peak current. - Fixed TBD specifications - Added packing information. - Added User manual and Antenna Installation Guide
F	2020.12.01	11.4 High-speed UART specifications	- Added.
G	2021.01.07	7.1 Pin Descriptions 7.2. Pin Descriptions APPENDIX	- Corrected Typo (Pin64) - Added description for PCM and UART related pins. - Added configuration manual
H	2020.01.26	TOP page, 3. Ordering Information 9.1 Operating Conditions	- Changed tentative P/N. - Updated VIO_SD
I	2021.3.04	11.4 High-speed UART specifications 2. Features 7.3. Configuration pins	- Added default baud rate information. - Added comment on USB IF - Added comment on USB IF
J	2021.4.01	2. Key feature & 5.2 Bluetooth Qualification 7.2 Pin Descriptions 9.1. Operating Conditions 14. Reference circuit	- Added a comment on supported Bluetooth functions - Updated the description of PMIC_EN - Added VIO_SD 1.8V mode - Added values of matching components
K	2021.04.26	7.2 Pin descriptions 7.3 Configuration pins 7.4 Pin States	- Added comment to AVDD18 pin - Added comment on pull-up - Changed DVDD18 to AVDD18 Added Internal pull values
L	2021.12.14	7.4 Pin States 9.1 Operating Conditions 9.2 External Sleep Clock Requirements 10. Power Sequence 14. Reference Peripheral Circuit	- Added SLP_CLK_IN - Defined IO current and Peak current - Added a comment - Defined timing parameters - Corrected locations of DC blocker for PCIE signal.

Table of Contents

1. Scope

This specification is applied to the IEEE802.11a/b/g/n/ac WLAN 2x2 MU-MIMO + Bluetooth 5.2 combo module.

2. Key Features

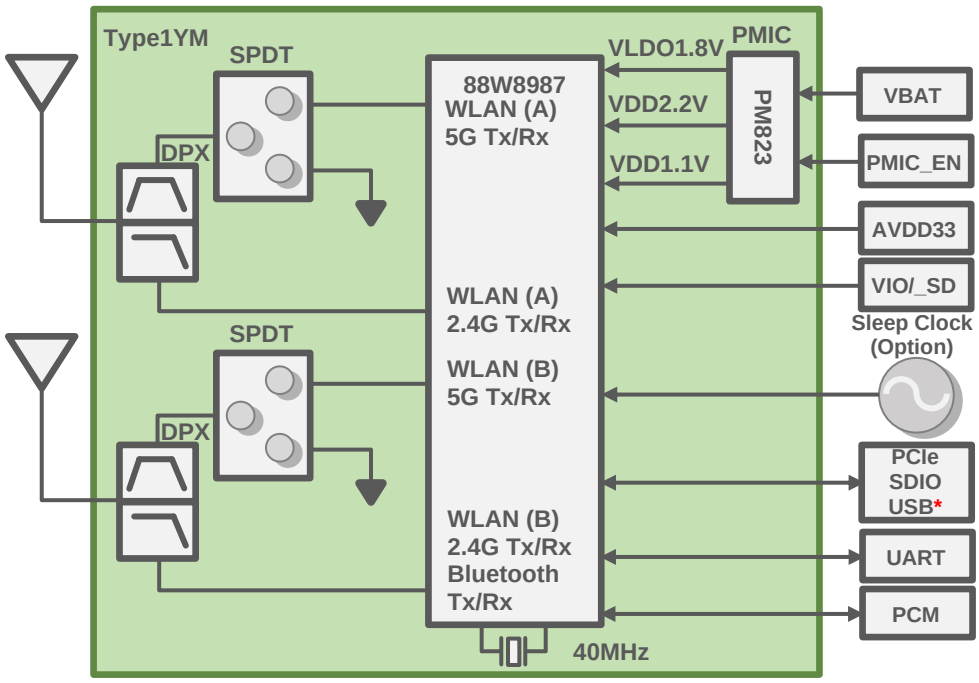
- NXP 88W8997 inside
- Compliant with IEEE802.11a/b/g/n/ac, MU-MIMO
- Compliant with Bluetooth specification v5.2 (See PICS for supported Bluetooth functions on Bluetooth SIG site)
- Supports standard PCI Express / SDIO3.0 / USB2.0&3.0* interfaces for WLAN
- UART / SDIO3.0 / USB2.0&3.0* interfaces support for Bluetooth is Host Controller Interface (HCI)
- Surface mount type 11.8 x 8.4 mm(Typical), H = 1.3 mm(Max.)
- Weight : 352 mg
- MSL : 3
- RoHS compliant

*Only if NXP supports USB SW

3. Ordering Information

Ordering Part Number	Description
LBEE5XV1YM-574	MP order
LBEE5XV1YM-SMP	In case of sample order

4. Block Diagram



*Only if NXP supports USB SW

5. Certification Information

5.1. Radio Certification

USA

FCC ID: VPYLB1YM
Country Code: US

Canada

IC: 772C-LB1YM
Country Code: CA

Europe

EN300328/301893, EN300440 conducted test report is prepared.
Country Code: DE

Japan

Japanese type certification is prepared.
Ⓡ 001-P01563
Country Code: JP

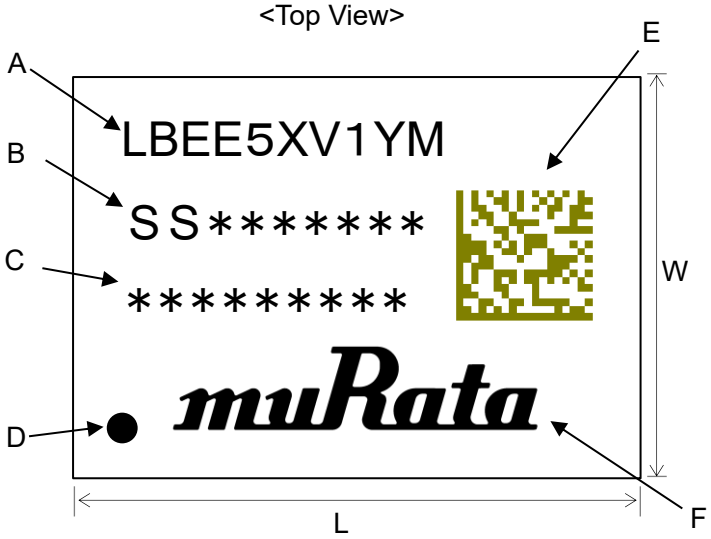
The each country code are defined by Murata's DB.txt file.
Please ask your contact person from Murata.

5.2. Bluetooth Qualification

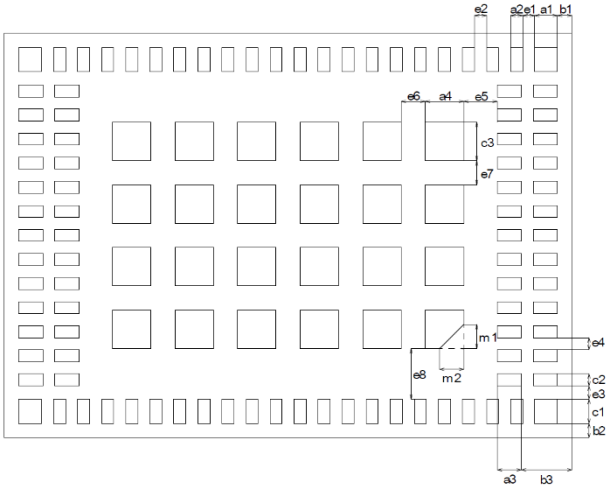
QDID: 157698
*Set Bluetooth Tx Power to Class1 by using "bt_power_config_1.sh".
**See PICS for supported Bluetooth functions on Bluetooth SIG site

6. Dimensions, Marking and Terminal Configurations

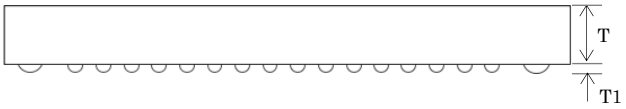
<Top View>



<Bottom View>



<Side View>



Marking	Meaning
A	Module Type
B	Production Process Number
C	Serial Number
D	Pin 1 Marking
E	2D code
F	Murata Logo

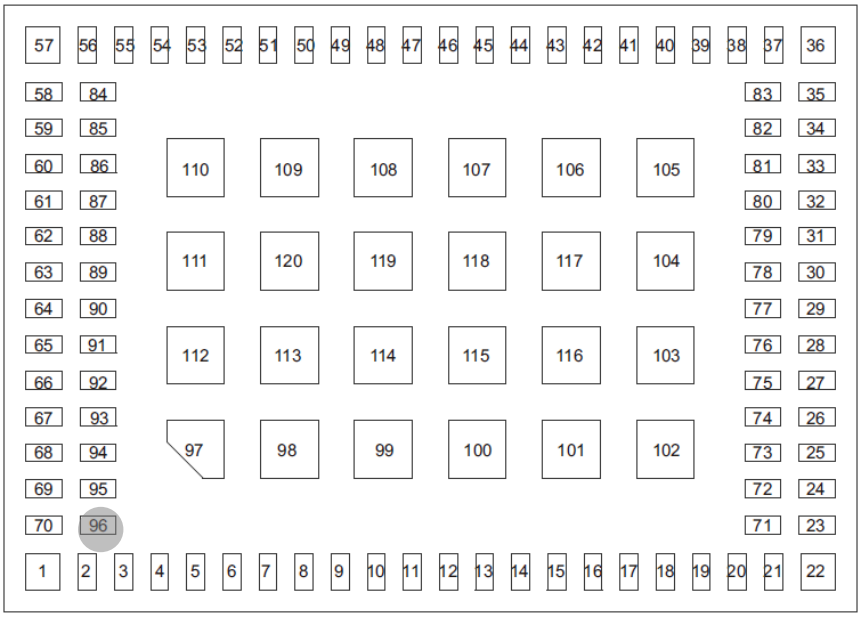
Mark	Dimensions	Mark	Dimensions	Mark	Dimensions	Mark	Dimensions
L	11.8 ± 0.2	W	8.4 ± 0.2	T	1.3 max.	a1	0.475 ± 0.1
a2	0.25 ± 0.1	a3	0.5 ± 0.2	a4	0.8 ± 0.1	b1	0.3 ± 0.2
b2	0.3 ± 0.2	b3	1.05 ± 0.2	c1	0.5 ± 0.1	c2	0.25 ± 0.1
c3	0.8 ± 0.1	e1	0.25 ± 0.1	e2	0.25 ± 0.1	e3	0.25 ± 0.1
e4	0.25 ± 0.1	e5	0.7 ± 0.1	e6	0.5 ± 0.1	e7	0.5 ± 0.1
e8	1.05 ± 0.1	m1	0.5 ± 0.2	m2	0.5 ± 0.2	T1	0.045 typ.

(unit : mm)

7. Module Pin Descriptions

7.1. Pin Assignments

<TOP VIEW>



No.	Terminal Name	No.	Terminal Name	No.	Terminal Name
1	GND	29	GND	57	GND
2	GPIO[24]	30	PMIC_EN	58	GND
3	GPIO[3]	31	GPIO[21]	59	WLAN_RF_A
4	GPIO[2]	32	PCIE_WAKE_N	60	GND
5	GPIO[17]	33	GPIO[5]	61	GPIO[6]
6	GPIO[16]	34	DNC	62	GPIO[9]
7	GPIO[15]	35	DNC	63	GPIO[8]
8	GPIO[14]	36	GND	64	GPIO[13]
9	VIO	37	GND	65	GPIO[10]
10	GPIO[20]	38	GND	66	GPIO[11]
11	GPIO[25]	39	PCIE_RXP	67	GPIO[12]
12	GND	40	PCIE_RXN	68	GND
13	DM	41	PCIE_TXP	69	WLAN_RF_B
14	DP	42	PCIE_TXN	70	GND
15	GND	43	PCIE_CLKP	71	GPIO[26]
16	VIO_SD	44	PCIE_CLKN	72	GPIO[27]
17	AVDD33	45	GND	73	GPIO[18]
18	SD_D1	46	GPIO[4]	74	GND
19	SD_D0	47	GPIO[0]	75	VBAT
20	SD_CLK	48	DNC	76	VBAT
21	SD_CMD	49	DNC	77	GND
22	GND	50	AVDD18	78	GPIO[1]
23	SD_D3	51	DNC	79	GPIO[23]
24	SD_D2	52	CONFIG_HOST_3	80	GPIO[22]
25	GPIO[19]	53	CONFIG_HOST_2	81	GPIO[7]
26	GND	54	CONFIG_HOST_1	82	PCIE_CLKREQ_N
27	VBAT	55	CONFIG_HOST_0	83	DNC
28	VBAT	56	SLP_CLK	84-120	GND

7.2. Pin Descriptions

No.	Pin name	Type	Connection to IC pin name	Description
1	GND	Ground	-	Ground
2	GPIO[24]	I/O	GPIO[24]	Programmable GPIO
3	GPIO[3]	I/O	GPIO[3]	Programmable GPIO
4	GPIO[2]	I/O	GPIO[2]	Programmable GPIO
5	GPIO[17]	I/O	GPIO[17]	Programmable GPIO
6	GPIO[16]	I/O	GPIO[16]	Programmable GPIO
7	GPIO[15] (HOST_WAKEUP_WLAN) *1	I/O	GPIO[15]	Programmable GPIO
8	GPIO[14] (WLAN_WAKEUP_HOST) *1	I/O	GPIO[14]	Programmable GPIO
9	VIO	Power	VIO	Power Supply
10	GPIO[20]	I/O	GPIO[20]	Programmable GPIO
11	GPIO[25]	I/O	GPIO[25]	Programmable GPIO
12	GND	Ground	-	Ground
13	DM	I/O	USB_DMNS	USB Serial Differential Data-Negative
14	DP	I/O	USB_DPLS	USB Serial Differential Data-Positive
15	GND	Ground	-	Ground
16	VIO_SD	Power	VIO_SD	1.8V/3.3V Digital I/O SDIO Power Supply
17	AVDD33	Power	AVDD33	3.3V Analog Power Supply
18	SD_D1	I/O	SD_DAT[1]	SDIO 4-bit mode: Data line Bit[1] SDIO 1-bit mode: Interrupt
19	SD_D0	I/O	SD_DAT[0]	SDIO 4-bit mode: Data line Bit[0] SDIO 1-bit mode: Data line
20	SD_CLK	I/O	SD_CLK	SDIO 4-bit mode: Clock SDIO 1-bit mode: Clock
21	SD_CMD	I/O	SD_CMD	SDIO 4-bit mode: Command line SDIO 1-bit mode: Command line
22	GND	Ground	-	Ground
23	SD_D3	I/O	SD_DAT[3]	SDIO 4-bit mode: Data line Bit[3] SDIO 1-bit mode: Not used
24	SD_D2	I/O	SD_DAT[2]	SDIO 4-bit mode: Data line Bit[2] or Read Wait (optional) SDIO 1-bit mode: Interrupt (optional)
25	NC (GPIO[19])	I/O	GPIO[19] DVS1(PMIC)	NC
26	GND	Ground	-	Ground
27	VBAT	Power	PVIN(PMIC)	Power Supply
28	VBAT	Power	PVIN(PMIC)	Power Supply
29	GND	Ground	-	Ground
30	PMIC_EN	I	EN(PMIC)	Enable build-in PMIC. Logic high enables internal regulators and internal hardware reset is de-asserted. Logic low disables regulators and internal hardware reset is asserted. ・ **Do not float this pin**
31	GPIO[21]	I/O	GPIO[21]	Programmable GPIO
			PCIE_PERSTn	PCIe host indication to reset the device (input) (active low)
32	PCIE_WAKE_N	I/O	PCIE_WAKEn	PCIe wake signal (active low)
33	GPIO[5] (BT_PCM_DOUT)	I/O	GPIO[5]	Programmable GPIO
		O	PCM_DOUT	PCM Data

34	NC	-	-	No Connect
35	NC	-	-	No Connect
36	GND	Ground	-	Ground
37	GND	Ground	-	Ground
38	GND	Ground	-	Ground
39	PCIE_RXP	I	PCIE_RX_P	PCI Express Lane 0, Receive Pair, Positive Signal 2.5GHz serial low-voltage interface
			USB3_RX_P	USB 3.0 receive data – positive
40	PCIE_RXN	I	PCIE_RX_N	PCI Express Lane 0, Receive Pair, Negative Signal 2.5GHz serial low-voltage interface
			USB3_RX_N	USB 3.0 receive data - negative
41	PCIE_TXP	O	PCIE_TX_P	PCI Express Lane 0, Transmit Pair, Positive Signal 2.5GHz serial low-voltage interface
			USB3_TX_P	USB3.0 transmit data - positive
42	PCIE_TXN	O	PCIE_TX_N	PCI Express Lane 0, Transmit Pair, Negative Signal 2.5GHz serial low-voltage interface
			USB3_TX_N	USB3.0 transmit data - negative
43	PCIE_CLKP	I	PCIE_RCLK_P	PCI Express Platform Reference Clock Positive signal of differential pair 100 MHz low-voltage interface
44	PCIE_CLKN	I	PCIE_RCLK_N	PCI Express Platform Reference Clock Negative signal of differential pair 100 MHz low-voltage interface
45	GND	Ground	-	Ground
46	GPIO[4] (BT_PCM_DIN)	I/O	GPIO[4]	Programmable GPIO
		I	PCM_DIN	PCM Data
47	GPIO[0]	I/O	GPIO[0]	Programmable GPIO Oscillator Mode : XOSC_EN/CLK_REQ(output)(active high) 0 = disable external oscillator 1 = enable external oscillator *Internal Pull-up
48	DNC	-	DNC	Do Not Connect
49	DNC	-	DNC	Do Not Connect
50	AVDD18	O	VLDO(PMIC)	LDO Output. Use for CONFIG_HOST pull-up.
51	DNC	DNC	DNC	Do Not Connect
52	CONFIG_HOST_3		CONFIG_HOST[3]	Configuration interface[3] See 0 Configuration Pins
53	CONFIG_HOST_2		CONFIG_HOST[2]	Configuration interface[2] See 0 Configuration Pins
54	CONFIG_HOST_1		CONFIG_HOST[1]	Configuration interface[1] See 0 Configuration Pins
55	CONFIG_HOST_0		CONFIG_HOST[0]	Configuration interface[0] See 0 Configuration Pins
56	SLP_CLK	I	SLP_CLK_IN	Sleep Clock Input Used for WLAN and Bluetooth low power modes. If no sleep clock input is provided, an internal sleep clock (derived from reference clock) will be used. if SLP_CLK is not connected, the internal circuit will detect no signal, and firmware will initialize the sleep clock based on the reference clock.
57	GND	Ground	-	Ground
58	GND	Ground	-	Ground
59	WLAN_RF_A	I/O	RF_TR_2_A RF_TR_5_A	RF Transmit / Receive (2.4G/5 GHz) – PathA
60	GND	Ground	-	Ground
61	GPIO[6] (BT_PCM_CLK)	I/O	GPIO[6]	Programmable GPIO
		I/O	PCM_CLK	PCM Clock Signal Output if PCM master. Input if PCM slave.

		O	PCM_MCLK	PCM Clock Signal (optional) Optional clock used for some codecs. Derived from PCM_CLK.
62	GPIO[9] (BT_UART_RXD)	I/O	GPIO[9]	Programmable GPIO
		I	UART_SIN	Serial data Input from modem, data set, or peripheral device.
63	GPIO[8] (BT_UART_TXD)	I/O	GPIO[8]	Programmable GPIO
		O	UART_SOUT	Serial data Output to modem, data set, or peripheral device.
64	GPIO[13] (BT_WAKEUP_HOST) *1	I/O	GPIO[13]	Programmable GPIO
		O	UART_DTRn	Data Terminal Ready Output to modem, data set, or peripheral device (active low).
65	GPIO[10] (BT_UART_CTSn)	I/O	GPIO[10]	Programmable GPIO
		I	UART_CTSn	Clear To Send Input from modem, data set, or peripheral device (active low).
66	GPIO[11] (BT_UART_RTSn)	I/O	GPIO[11]	Programmable GPIO
		O	UART_RTSn	Request To Send Output to modem, data set, or peripheral device (active low).
67	GPIO[12] (HOST_WAKEUP_BT) *1	I/O	GPIO[12]	Programmable GPIO
		I	UART_DSRn	Data Set Ready Input from modem, data set, or peripheral device (active low).
68	GND	Ground	-	Ground
69	WLAN_RF_B	I/O	RF_TR_2_A RF_TR_5_A	RF Transmit / Receive (2.4G/5 GHz) – PathB
70	GND	Ground	-	Ground
71	GPIO[26]	I/O	GPIO[26]	Programmable GPIO
72	GPIO[27]	I/O	GPIO[27]	Programmable GPIO
73	NC (GPIO[18])	I/O	GPIO[18] DVS0(PMIC)	NC
74	GND	Ground	-	Ground
75	VBAT	Power	PVIN(PMIC)	Power Supply
76	VBAT	Power	PVIN(PMIC)	Power Supply
77	GND	Ground	-	Ground
78	GPIO[1] (USB_VBUS_ON)	I/O	GPIO[1]	Programmable GPIO
79	GPIO[23]	I/O	GPIO[23]	Programmable GPIO
80	GPIO[22]	I/O	GPIO[22]	Programmable GPIO
			PCIE_W_DISABLEn	PCIe host indication to disable the WLAN function of the device (input) (active low)
81	GPIO[7] (BT_PCM_SYNC)	I/O	GPIO[7]	Programmable GPIO
		I/O	PCM_SYNC	PCM Sync Pulse Signal Output if PCM master. Input if PCM slave.
82	PCIE_CLKREQ_N	I/O	PCIE_CLKRQn	PCI Express Wake Signal
83	NC	-	-	No Connect
84-120	GND	Ground	-	Ground

*( ) of “pin name” is BSP configuration of NXP iMX8.
*1 : NXP recommended GPIO. Check whether NXP software can support this function or not.

7.3. Configuration Pins

Configuration Bits	Pin Name	Configuration Function
CON[2]	CONFIG_HOST[2]	Firmware Boot Options No hardware impact. Software reads and boots accordingly. See table below.
CON[1]	CONFIG_HOST[1]	
CON[0]	CONFIG_HOST[0]	

Strap Value	WLAN	Bluetooth /BLE	ROM Notes	Firmware Download Mode	Number of SDIO Functions
000	SDIO	UART	--	Parallel	1 (WLAN)
001	SDIO	SDIO	--	Parallel	2 (WLAN, Bluetooth)
010*	PCIe	USB 2.0	Initialize USB 2.0 PHY and COM PHY PCIe portion	Parallel	
011	PCIe	UART	Initialize only COM PHY PCIe portion	Parallel	
100*	USB 3.0/2.0	UART	Initialize both COM PHY USB 3.0 and USB 2.0 PHY	Parallel	
101*	USB 2.0	USB 2.0	Initialize only USB 2.0 PHY	Parallel	
110*	USB 3.0/2.0	USB 3.0/2.0	Initialize both COM PHY USB 3.0 and USB 2.0 PHY	Parallel	
111*	USB3.0	USB 3.0	Initialize only COM PHY USB 3.0 portion	Parallel	

AVDD18 output can be used to pull-up CONFIG_HOST pins.
*USB : Only if NXP supports USB SW

7.4. Pin States

Pin states information for the tables below include:

- After firmware is downloaded, the pads (GPIO, Serial interface, RF control) are programmed in functional mode per the functionality of the pins.
- For SDIO, once the command is received from the host, the pads are configured accordingly.
- Pull-up and pull-down are only effective when the pad is in input mode.
- The power-down state shown is the default configuration. Many pads have programmable power-down values, which can be set by firmware.

I/O State Table

Pin Name	Supply	No Pad Power State	Reset State	HW[1] State	PD[2] State	PD[3] Prog	Internal PU/PD	Int'l Pull Value[Ω]
GPIO[0]	VIO	tristate	output	output	drive low	yes	nominal PU	90K
GPIO[1]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[2]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[3]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[4]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[5]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[6]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[7]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[8]	VIO	tristate	input	input	drive low	yes	weak PU	800K
GPIO[9]	VIO	tristate	input	input	tristate	yes	weak PU	800K
GPIO[10]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[11]	VIO	tristate	input	input	drive high	yes	weak PU	800K
GPIO[12]	VIO	tristate	input	input	tristate	yes	nominal PD	90K
GPIO[13]	VIO	tristate	input	input	drive high	yes	nominal PU	90K
GPIO[14]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[15]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[16]	VIO	tristate	input	input	tristate	yes	nominal PD	90K
GPIO[17]	VIO	tristate	input	input	tristate	yes	nominal PD	90K
GPIO[18]	VIO	tristate	input	input	tristate	yes	nominal PD	90K
GPIO[19]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[20]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[21]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[22]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[23]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[24]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[25]	VIO	tristate	input	input	drive high	yes	nominal PU	90K
GPIO[26]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
GPIO[27]	VIO	tristate	input	input	tristate	yes	nominal PU	90K
SD_CLK	VIO_SD	tristate	input	input	tristate	no	nominal PU	90K
SD_CMD	VIO_SD	tristate	input	input	tristate	no	nominal PU	90K
SD_D0	VIO_SD	tristate	input	input	tristate	no	nominal PU	90K
SD_D1	VIO_SD	tristate	input	input	tristate	no	nominal PU	90K
SD_D2	VIO_SD	tristate	input	input	tristate	no	nominal PU	90K
SD_D3	VIO_SD	tristate	input	input	tristate	no	nominal PU	90K
PCIE_CLKP	AVDD18	-	-	-	-	-	-	-
PCIE_CLKN	AVDD18	-	-	-	-	-	-	-
PCIE_TXP	AVDD18	-	-	-	-	-	-	-
PCIE_TXN	AVDD18	-	-	-	-	-	-	-
PCIE_RXP	AVDD18	-	-	-	-	-	-	-
PCIE_RXN	AVDD18	-	-	-	-	-	-	-
PCIE_WAKE_N	VIO	tristate	input	output	N/A	N/A	N/A	-
PCIE_CLKREQ_N	VIO	tristate	input	output	N/A	N/A	N/A	-
CONFIG_HOST_0	AVDD18	tristate	input	input	tristate	no	weak PU	800K
CONFIG_HOST_1	AVDD18	tristate	input	input	tristate	no	weak PU	800K
CONFIG_HOST_2	AVDD18	tristate	input	input	tristate	no	weak PU	800K
CONFIG_HOST_3	AVDD18	tristate	input	input	tristate	no	weak PU	800K
SLP_CLK_IN	VIO	tristate	input[4]	input	tristate	no	nominal PU	90K

[1] : Hardware default state after reset

[2] : Power-down state

[3] : Power-down state programmable

[4] : Input mode after reset

8. Absolute Maximum Ratings

Parameter		Min	Max	Unit
Storage Temperature		-30	+85	deg.C
Supply Voltage	VBAT	--	6.0	V
	VIO	--	2.2	V
		--	3.0	V
		--	4.0	V
	VIO_SD	--	2.2	V
		--	4.0	V
	AVDD33	--	4.0	V

Note) 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 are set within operating condition.

9. Operating Conditions

9.1. Operating Conditions

Parameter		Min	Typ	Max	Unit
Operating Temperature		-30	--	+85	deg.C
Operating Voltage	VBAT	2.7	--	5.5	V
	VIO	1.62	1.8	1.98	V
		2.25	2.5	2.75	V
		2.97	3.3	3.47	V
	VIO_SD	1.62	1.8	1.98	V
		2.97	3.3	3.47	V
	AVDD33*	2.97	3.3	3.63	V
IO Current	VIO&VIO_SD	-	0.2	0.6	mA
Peak current**	VBAT	—	1.0	1.3	A

Note) Operation beyond the recommended operating conditions is neither recommended nor guaranteed.

* AVDD33 is used for only when USB interface is used.

**Peak current of VBAT (RF portion) is happen during DPD calibration when the firmware is downloaded.

9.2. External Sleep Clock Requirements

Symbol	Parameter	Min	Typ	Max	Unit
CLK	Clock frequency range/accuracy • CMOS input clock signal type • ±250 ppm (initial, aging, temperature)	--	32.768	--	kHz
V_{IH}	Input levels, where VIO = 1.8, 2.5, 3.3 V	0.7*VIO	--	VIO+0.4	V
V_{IL}		-0.4	--	0.3*VIO	V
PN	Phase noise requirement (@100kHz)	--	-125	--	dBc/Hz
Jc	Cycle jitter	--	1.5	--	ns(RMS)
SR	Slew rate limit (10-90%)	--	--	100	ns
DC	Duty cycle tolerance	20	--	80	%

Voltage input levels = 1.8 or 3.3V

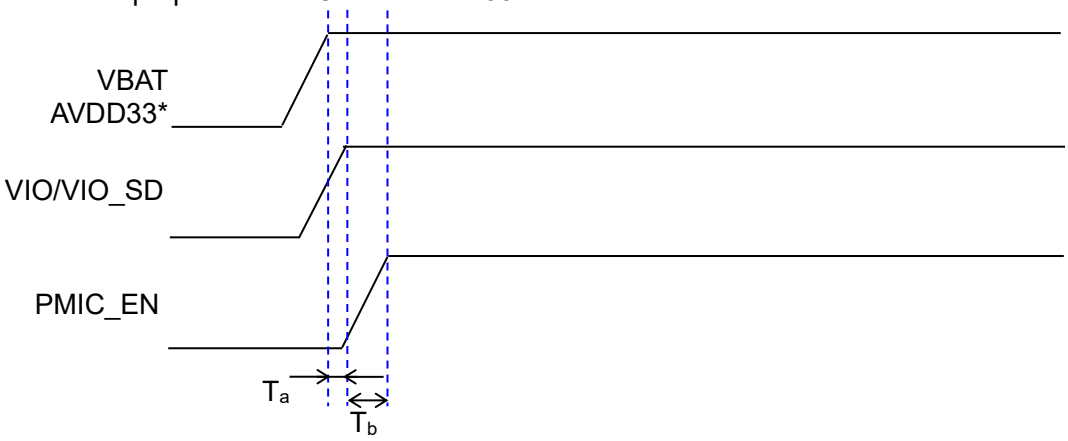
9.3. Digital I/O Requirements

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{IH}	Input high voltage	-	0.7*VIO	-	VIO+0.4	V
V_{IL}	Input low voltage	-	-0.4	-	0.3*VIO	V
V_{HYS}	Input hysteresis	-	100	-	-	mV
V_{OH}	Output high voltage	-	VIO-0.4	-	-	V
V_{OL}	Output low voltage	-	-	-	0.4	V

10. Power Sequence

10.1. Power On Sequence

- VBAT and VIO must be good (90%) at the same time or before assert PMIC_EN (= 0 to 1).
- Rump-up time of VIO must be <100ms

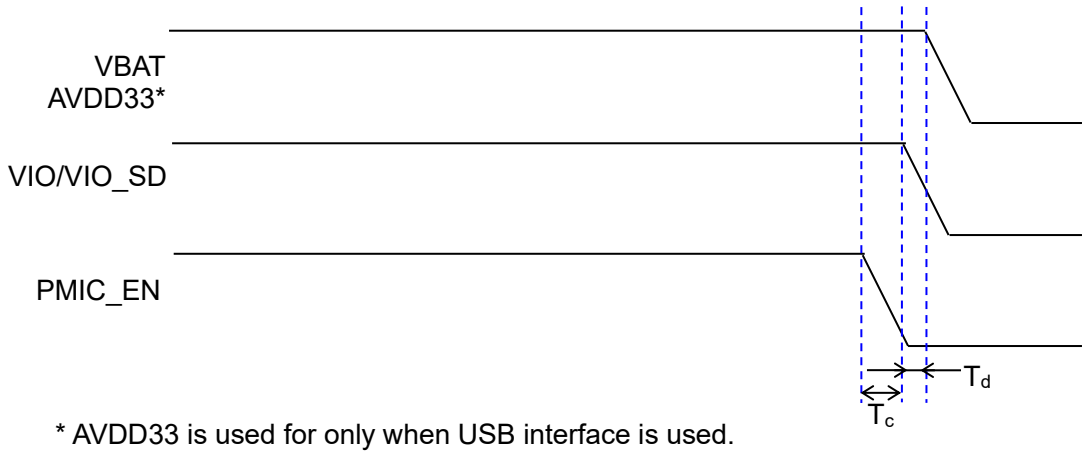


* AVDD33 is used for only when USB interface is used.

Symbol	Parameter	Min	Typ	Max	Unit
T_a	VBAT/AVDD33 to VIO time	0	-	-	msec
T_b	VIO to PMIC_EN time	0	-	-	msec

10.2. Power Off Sequence

- VBAT and VIO must be down at the same time or before de-assert PMIC_EN (= 1 to 0).
- Rump-down time of VIO must be <100ms



* AVDD33 is used for only when USB interface is used.

Symbol	Parameter	Min	Typ	Max	Unit
T_c	PMIC_EN to VIO time	0	-	-	msec
T_d	VIO to VBAT/AVDD33 time	0	-	-	msec

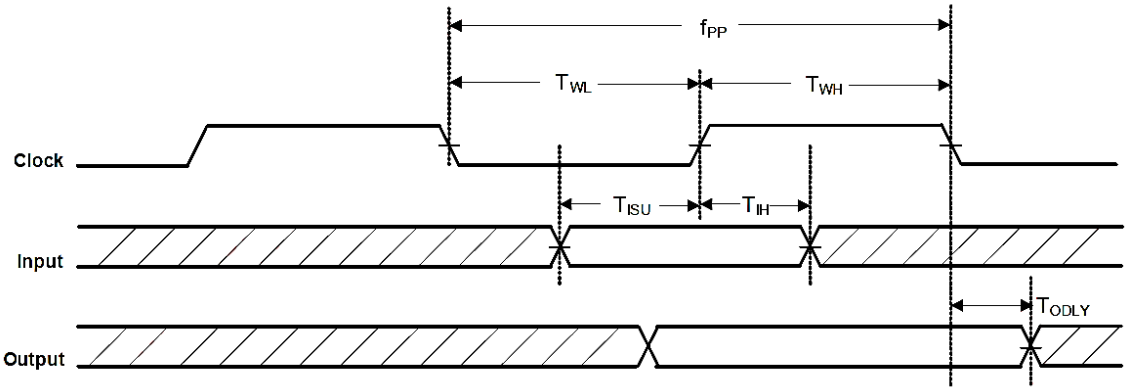
11. Host Interface Specification

11.1. SDIO Specifications

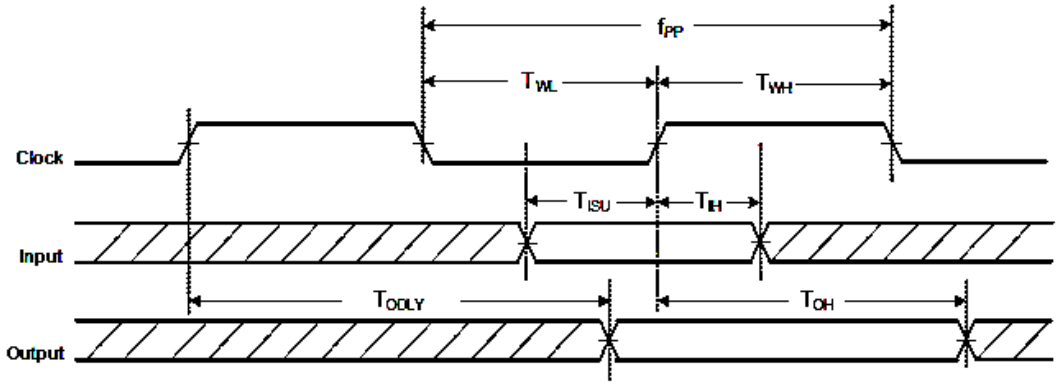
The SDIO host interface pins are powered from the VIO_SD voltage supply.
The SDIO electrical specifications are identical for 4-bit SDIO and 1-bit SDIO transfer modes.

11.1.1. Default Speed, High-Speed Modes

SDIO Protocol Timing Diagram—Default Speed Mode (3.3V)



SDIO Protocol Timing Diagram—High Speed Mode (3.3V)



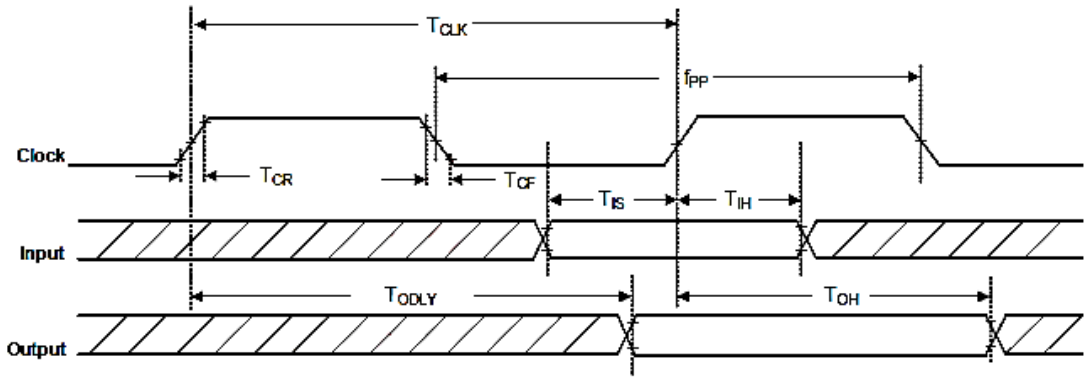
SDIO Timing Data—Default Speed, High-Speed Modes (3.3V)

Note: Over full range of values specified in the Recommended Operating Conditions unless otherwise specified.

Symbol	Parameter	Condition	Min	Typ	Max	Units
f_{PP}	Clock frequency	Normal	0	-	25	MHz
		High-speed	0	-	50	MHz
T_{WL}	Clock low time	Normal	10	-	-	ns
		High-speed	7	-	-	ns
T_{WH}	Clock high time	Normal	10	-	-	ns
		High-speed	7	-	-	ns
T_{ISU}	Input setup time	Normal	5	-	-	ns
		High-speed	6	-	-	ns
T_{IH}	Input hold time	Normal	5	-	-	ns
		High-speed	2	-	-	ns
T_{ODLY}	Output delay time	Normal	-	-	14	ns
	CL ≤ 40 pF (1 card)	High-speed	-	-	14	ns
T_{OH}	Output hold time	High-speed	2.5	-	-	ns

11.1.2. SDR12, SDR25, SDR50 Modes (up to 100 MHz) (1.8 V)

SDIO protocol Timing Diagram—SDR12, SDR25, SDR50 Modes (up to 100 MHz) (1.8 V)

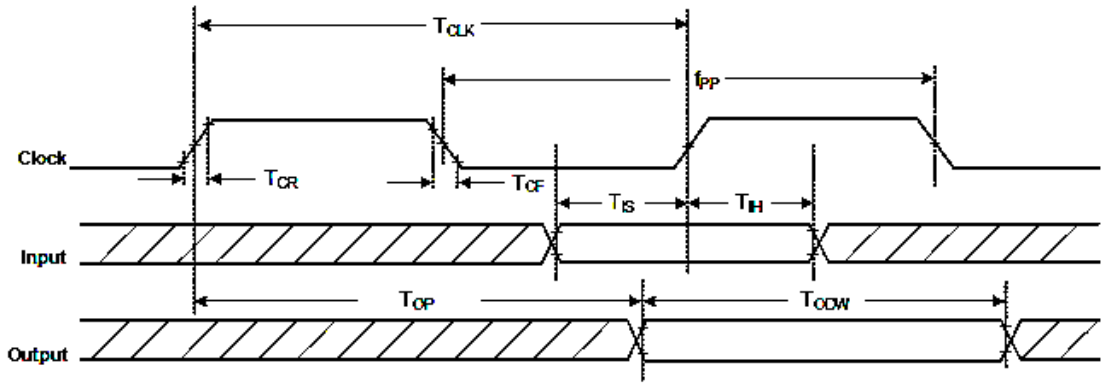


SDIO Timing Data—SDR12, SDR25, SDR50 Modes (up to 100 MHz) (1.8 V)

Note: Over full range of values specified in the Recommended Operating Conditions unless otherwise specified.

Symbol	Parameter	Condition	Min	Typ	Max	Units
f_{PP}	Clock frequency	SDR12/25/50	25	-	100	MHz
T_{IS}	Input setup time	SDR12/25/50	3	-	-	ns
T_{IH}	Input hold time	SDR12/25/50	0.8	-	-	ns
T_{CLK}	Clock time	SDR12/25/50	10	-	40	ns
T_{CR}, T_{CF}	Rise time, fall time TCR, TCF< 2ns(max) at 100 MHz CCARD=10 pF	SDR12/25/50	-	-	0.2*T_{CLK}	ns
T_{ODLY}	Output dekay time CL ≤ 30pF	SDR12/25/50	-	-	7.5	ns
T_{OH}	Output hold time CL=15 pF	SDR12/25/50	1.5	-	-	ns

11.1.3. SDR104 Mode (208 MHz) (1.8 V)
SDIO Protocol Timing Diagram—SDR104 Mode (208 MHz)



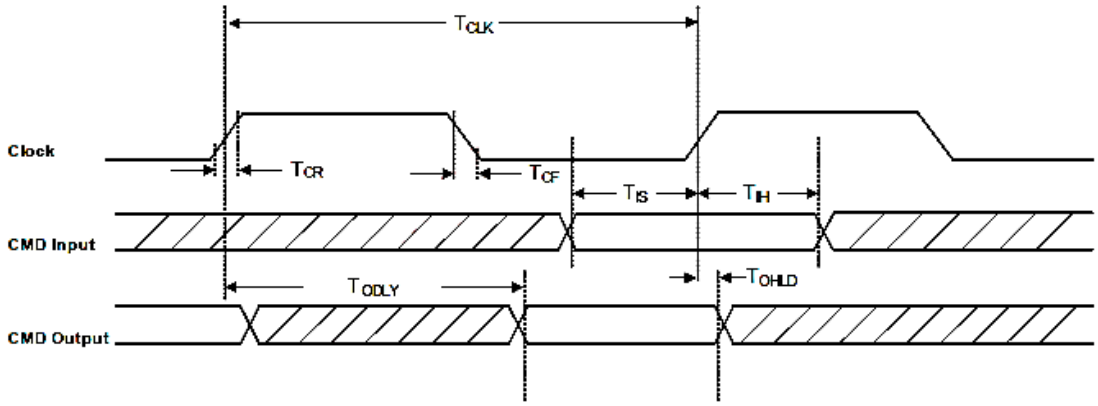
SDIO Timing Data—SDR104 Mode (208 MHz)

Note: Over full range of values specified in the Recommended Operating Conditions unless otherwise specified.

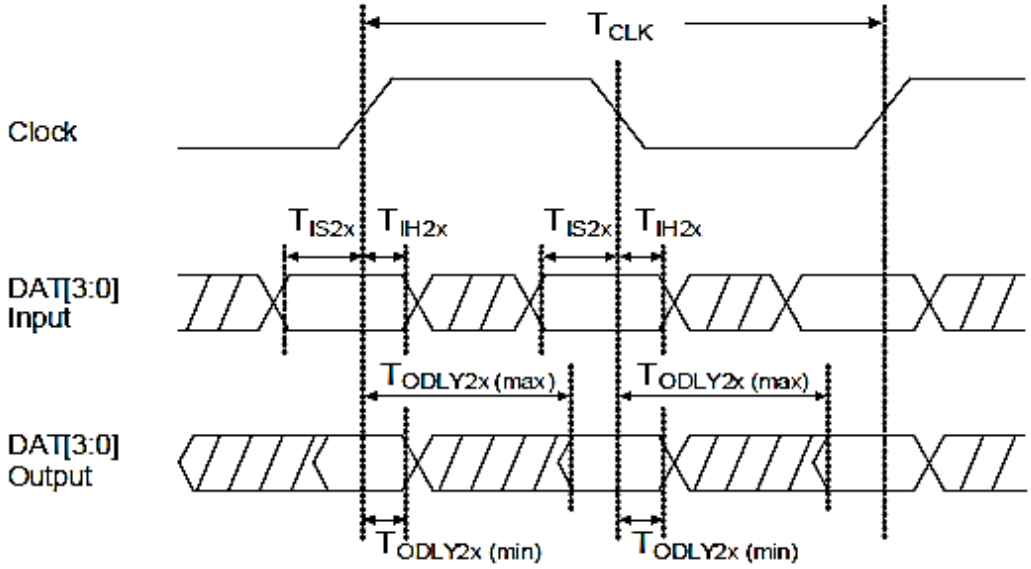
Symbol	Parameter	Condition	Min	Typ	Max	Units
f_{PP}	Clock frequency	SDR104	0	-	208	MHz
T_{IS}	Input setup time	SDR104	1.4	-	-	ns
T_{IH}	Input hold time	SDR104	0.8	-	-	ns
T_{CLK}	Clock time	SDR104	4.8	-	-	ns
T_{CR}, T_{CF}	Rise time, fall time TCR, TCF< 0.96 ns(max) at 208 MHz CCARD=10 pF	SDR104	-	-	0.2*T_{CLK}	ns
T_{OP}	Card output phase	SDR104	0	-	10	ns
T_{ODW}	Output timimg of variable data window	SDR104	2.88	-	-	ns

11.1.4. DDR50 Mode (50 MHz) (1.8 V)

SDIO CMD Timing Diagram—DDR50 Mode (50 MHz)



SDIO DAT[3:0] Timing Diagram—DDR50 Mode (50 MHz)



SDIO Timing Data—DDR50 Mode (50 MHz)

Note: Over full range of values specified in the Recommended Operating Conditions unless otherwise specified

Symbol	Parameter	Condition	Min	Typ	Max	Units
Clock						
T_{CLK}	Clock time 50 MHz (max) between rising edges	DDR50	20	-	-	ns
T_{CR}, T_{CF}	Rise time, fall time T_{CR}, T_{CF}< 4.00 ns(max) at 50 MHz C_{CARD}=10 pF	DDR50	-	-	0.2*T_{CLK}	ns
Clock Duty	-	DDR50	45	-	55	%
CMD Input (referenced to clock rising edge)						
T_{IS}	Input setup time C_{CARD} ≤ 10 pF (1 card)	DDR50	6	-	-	ns
T_{IH}	Input hold time C_{CARD} ≤ 10 pF (1 card)	DDR50	0.8	-	-	ns
CMD Output (referenced to clock rising edge)						
T_{ODLY}	Output delay time during data transfer mode C_L ≤ 30 pF (1 card)	DDR50	-	-	13.7	ns
T_{OHLD}	Output hold time C_L ≥ 15 pF (1 card)	DDR50	1.5	-	-	ns
DAT[3:0] Input (referenced to clock rising and falling edges)						
T_{IS2x}	Input setup time C_{CARD} ≤ 10 pF (1 card)	DDR50	3	-	-	ns
T_{IH2x}	Input hold time C_{CARD} ≤ 10 pF (1 card)	DDR50	0.8	-	-	ns
DAT[3:0] Output (referenced to clock rising and falling edges)						
T_{ODLY2x} (max)	Output delay time during data transfer mode C_L ≤ 25 pF (1 card)	DDR50	-	-	7.0	ns
T_{ODLY2x} (min)	Output hold time C_L ≥ 15 pF (1 card)	DDR50	1.5	-	-	ns

11.2. PCI Express Specifications

The PCI Express host interface pins are powered from the AVDD18 voltage supply.

11.2.1. Differential Tx Output Electricals

PCI Express Tx Output Specifications Data—2.5 GT/s

Note: In accordance with PCI Express Base Specification, Revision 2.1 March 4. 2009.

Symbol	Parameter	Min	Typ	Max	Units
UI	Unit Interval (UI) The specified UI is equivalent to a tolerance of ±300 ppm for each Refclk source. Period does not account for SSC induced variations.	399.88	--	400.12	ps
$V_{TX-DIFF-PP}$	Differential peak-to-peak Tx voltage swing $V_{TX-DFFpp} = 2*\|V_{TXD+} - V_{TXD-}\|$	0.8	--	1.2	V
$V_{TX-DIFF-PP-LOW}$	Low power differential peak-to-peak tTx voltage swing $V_{TX-DFFpp} = 2*\|VT_{XD+} - V_{TXD-}$	0.4	--	1.2	V
$V_{TX-DE-RATIO-3.5dB}$	Tx de-emphasis level ratio (3.5 dB)	3.0	--	4.0	dB
T_{TX-EYE}	Tx eye including all jitter sources	0.75	--	--	UI
$T_{TX-EYE-MEDIAN-to-MAX-JITTER}$	Maximum time between jitter median and maximum deviation from median	--	--	0.125	UI
$T_{TX-RISE-FALL}$	Tx rise/fall time Measured differentially from 20% to 80% of swing.	0.125	--	--	UI
$RL_{TX-DIFF}$	Tx package plus Si differential return loss	10	--	--	dB
RL_{TX-CM}	Tx package plus Si common mode return loss	6	--	--	dB
$V_{TX-CM-AC-P}$	Tx AC common mode voltage	--	20	--	mV
$I_{TX-SHORT}$	Tx short circuit current limit	--	--	90	mA
$V_{TX-DC-CM}$	Tx DC common mode voltage	0	--	3.6	V
$V_{TX-CM-DC-ACTIVE-IDLE-DELTA}$	Absolute delta of DC common mode voltage during L0 and electrical idle	0	--	100	mV
$V_{TX-IDLE-DIFF-AC-p}$	Electrical idle differential peak output voltage	0	--	20	mV
$V_{TX-RCV-DETECT}$	Voltage change allowed during receiver detection	--	--	600	mV
$T_{TX-IDLE-MIN}$	Minimum time spent in electrical idle	20	--	--	ns
$T_{TX-IDLE-SET-TO-IDLE}$	Maximum time to transition to a valid electrical idle after sending an electrical idle ordered set	--	--	8	ns
$T_{TX-IDLE-TO-DIFF-DATA}$	Maximum time to transition to valid diff signaling after leaving electrical idle	--	--	8	ns
$T_{CROSSLINK}$	Crosslink random timeout	--	--	1.0	ms
C_{TX}	AC coupling capacitor	75	--	200	nF

PCI Express Tx Output Specifications Data—5 GT/s

Note: In accordance with PCI Express Base Specification, Revision 2.1 March 4, 2009.

Symbol	Parameter	Min	Typ	Max	Units
UI	Unit Interval (UI) The specified UI is equivalent to a tolerance of ±300 ppm for each Refclk source. Period does not account for SSC induced variations.	199.94	--	200.06	ps
$V_{TX-DIFFpp}$	Differential peak-to-peak Tx voltage swing $V_{TX-DFFpp} = 2*\|V_{TXD+} - V_{TXD-}\|$	0.8	--	1.2	V
$V_{TX-DIFFpp-LOW}$	Low power differential peak-to-peak Tx voltage swing $V_{TX-DFFpp} = 2*\|VT_{XD+} - V_{TXD-}\|$	0.4	--	1.2	V
$V_{TX-DE-RATIO-3.5dB}$	Tx de-emphasis level ratio (3.5 dB)	3.0	--	4.0	dB
$V_{TX-DE-RATIO-6dB}$	Tx de-emphasis level ratio (6 dB)	5.5	--	6.5	dB
$T_{MIN-PULSE}$	Instantaneous lone pulse width Measured relative to rising/falling pulse.	0.9	--	--	UI
T_{TX-EYE}	Tx eye including all jitter sources	0.75	--	--	UI
$T_{TX-HF-DJ-DD}$	Tx deterministic jitter > 1.5 MHz Deterministic jitter only.	--	--	0.15	UI
$T_{TX-LF-RMS}$	Tx RMS jitter < 1.5 MHz Total energy measured over a 10 kHz—1.5 MHz range.	--	3.0	--	Ps RMS
$T_{TX-RISE-FALL}$	Tx rise/fall time Measured differentially from 20% to 80% of swing.	0.15	--	--	UI
$RL_{TX-DIFF}$	Tx package plus Si differential return loss (1.25-2.5 GHz)	10	--	--	dB
	Tx package plus Si differential return loss (0.05-1.25 GHz)	8	--	--	
RL_{TX-CM}	Tx package plus Si common mode return loss	6	--	--	dB
$V_{TX-CM-AC-PP}$	Tx AC common mode voltage	--	--	100	mVPP
$I_{TX-SHORT}$	Tx short circuit current limit	--	--	90	mA
$V_{TX-DC-CM}$	Tx DC common mode voltage	0	--	3.6	V
$V_{TX-CM-DC-ACTIVE-IDLE-DELTA}$	Absolute delta of DC common mode voltage during L0 and electrical idle	0	--	100	mV
$V_{TX-IDLE-DIFF-AC-p}$	Electrical idle differential peak output voltage $V_{TX-IDLE-DIFF-DC} = \|V_{TX-Idle-D+} - V_{TX-Idle-D-}\| \leq 20$ mV	0	--	20	mV
$V_{TX-IDLE-DIFF-DC}$	DC Electrical idle differential peak output voltage $V_{TX-IDLE-DIFF-DC} = \|V_{TX-Idle-D+} - V_{TX-Idle-D-}\| \leq 5$ mV	0	--	5	mV
$V_{TX-RCV-DETECT}$	Voltage change allowed during receiver detection	--	--	600	mV
$T_{TX-IDLE-MIN}$	Minimum time spent in electrical idle	20	--	--	ns
$T_{TX-IDLE-SET-TO-IDLE}$	Maximum time to transition to a valid electrical idle after sending an electrical idle ordered set	--	--	8	ns
$T_{TX-IDLE-TO-DIFF-DATA}$	Maximum time to transition to valid differential signaling after leaving electrical idle	--	--	8	ns
$T_{CROSSLINK}$	Crosslink random timeout	--	--	1.0	ms
C_{TX}	AC coupling capacitor	75	--	200	nF

11.2.2. Differential Rx Input Electricals

PCI Express Rx Input Specifications Data—2.5 GT/s

Note: In accordance with PCI Express Base Specification, Revision 2.1 March 4, 2009.

Symbol	Parameter	Min	Typ	Max	Units
UI	Unit Interval (UI) UI does not account for SSC induced variations.	399.88	--	400.12	ps
$V_{RX-DIFF-PP-CC}$	Differential Rx peak-to-peak voltage for common Refclk Rx architecture	0.175	--	1.2	V
$V_{RX-DIFF-PP-DC}$	Differential Rx peak-to-peak voltage for data clocked Rx architecture	0.175	--	1.2	V
T_{RX-EYE}	Rx eye time opening Minimum eye time at Rx pins to yield a 10^{-12} BER.	0.40	--	--	UI
$T_{RX-EYE-MEDIAN-to-MAX-JITTER}$	Maximum time delta between median and deviation from median	--	--	0.3	UI
$V_{RX-CM-ACp}$	AC peak common mode input voltage	--	--	150	mV
$RL_{RX-DIFF}$	Differential return loss	15	--	--	dB
RL_{RX-CM}	Common mode return loss	0	--	3.6	dB
$Z_{RX-DIFF-DC}$	DC differential input impedance	80	100	120	W
Z_{RX-DC}	DC input impedance	40	50	60	W
$Z_{RX-HIGH-IMP-DC}$	Powered down DC input impedance	200	--	--	kΩ
$V_{RX-IDLE-DET-DIFF-p-p}$	Electrical idle detect threshold	65	--	175	mV
$T_{RX-IDLE-DET-DIFF-ENTERTIME}$	Unexpected electrical idle enter detect threshold integration time	--	--	10	ms
$L_{RX-SKEW}$	Total skew	--	--	20	ns

PCI Express Rx Input Specifications Data—5 GT/s

Note: In accordance with PCI Express Base Specification, Revision 2.1 March 4, 2009.

Symbol	Parameter	Min	Typ	Max	Units
UI	Unit Interval (UI) UI does not account for SSC induced variations.	199.94	--	200.06	ps
$V_{RX-DIFF-PP-CC}$	Differential Rx peak-to-peak voltage for common Refclk Rx architecture	0.120	--	1.2	V
$V_{RX-DIFF-PP-DC}$	Differential Rx peak-to-peak voltage for data clocked Rx architecture	0.100	--	1.2	V
$T_{RX-TJ-CC}$	Maximum Rx inherent total timing error for common Refclk Rx architecture	--	--	0.40	UI
$T_{RX-TJ-DC}$	Maximum Rx inherent total timing error for data clocked Rx architecture	--	--	0.34	UI
$T_{RX-DJ-DD-CC}$	Maximum Rx inherent deterministic timing error for common Refclk Rx architecture		--	0.30	UI
$T_{RX-DJ-DD-DC}$	Maxximum Rx inherent deterministic timing error for data clocked Rx architeuture		--	0.24	UI
$T_{RX-MIN-PLISE}$	Minimum width pulse at Rx Measured to account for worst Tj at 10^{-12} BER.	0.6	--	--	UI
$V_{RX-CM-ACp}$	AC peak common mode input voltage	--	--	150	mV
$RL_{RX-DIFF}$	Differential return loss	15	--	--	dB
RL_{RX-CM}	Common mode return loss	0	--	3.6	dB
$Z_{RX-DIFF-DC}$	DC differential input impedance	80	100	120	W
Z_{RX-DC}	DC input impedance	40	50	60	W
$Z_{RX-HIGH-IMP-DC}$	Powered down DC input impedance	200	--	--	kΩ
$V_{RX-IDLE-DET-DIFF-p-p}$	Electrical idle detect threshold	65	--	175	mV
$T_{RX-IDLE-DET-DIFF-ENTERTIME}$	Unexpected electrical idle enter detect threshold integration time	--	--	10	ms
$L_{RX-SKEW}$	Total skew	--	--	20	ns

11.3. USB Specifications

The USB 3.0 device interface pins are powered from the AVDD33 voltage supply.
Only if NXP supports USB SW

11.3.1. USB LS Driver and Receiver Parameters

USB LS Driver and Receiver Specifications Data

Note: In accordance with Universal Serial Bus 2.0 Specification, Revision 2.0, April 2000.
Note: The load is 100Ω differential for these parameters, unless other specified.

Symbol	Parameter	Min	Typ	Max	Units
BR	Baud rate	--	1.5	--	Gbps
BR_{PPM}	Baud rate tolerance	-15000.0	--	15000.0	ppm
Driver Specifications					
V_{OH}	Output signal ended high Defined with 1.425 kΩ pull-up resister to 3.6V.	2.8	--	3.6	V
V_{OL}	Output signal ended low Defined with 1.425 kΩ pull-down register to ground.	0.0	--	0.3	V
V_{CRS}	Output signal crossover voltage See figure 42, USB LS/FS Data Rise and Fall Time Diagram, on page 162.	1.3	--	2.0	V
T_{LR}	Data fall time ・See figure 42, USB LS/FS Data Rise and Fall Time Diagram, on page 162. ・Defined from 10% to 90% for rise time and 90% to 10% for fall time.	75.0	--	300.0	ns
T_{LF}	Data rise time ・See figure 42, USB LS/FS Data Rise and Fall Time Diagram, on page 162. ・Defined from 10% to 90% for rise time and 90% to 10% for fall time.	75.0	--	300.0	ns
T_{LRFM}	Rise and fall time matching	80.0	--	125.0	%
T_{UDJ1}	Source jitter total: to next transition ・Including frequency tolerance. Timing difference between the differential data signals. ・Defined at crossover point of differential data signals.	-95.0	--	95.0	ns
T_{UDJ2}	Source jitter total: for paired transitions ・Including frequency tolerance. Timing difference between the differential data signals. ・Defined at crossover point of differential data signals.	-150.0	--	150.0	ns
Receiver Specifications					
V_{IH}	Input signal ended high	2.0	--	--	V
V_{IL}	Input signal ended low	--	--	0.8	V
V_{DI}	Differential input sensitivity	0.2	--	--	V

11.3.2. USB FS Driver and Receiver Parameters

USB FS Driver and Receiver Specifications Data

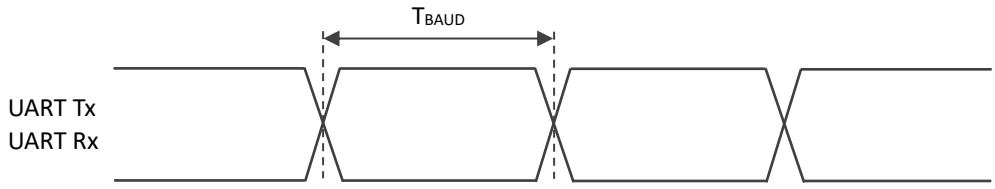
Note: In accordance with Universal Serial Bus 2.0 Specification, Revision 2.0, April 2000.

Note: The load is 100Ω differential for these parameters, unless other specified.

Symbol	Parameter	Min	Typ	Max	Units
BR	Baud rate	--	12.0	--	Mbps
BR_{PPM}	Baud rate tolerance	-2500.0	--	2500.0	ppm
Driver Specifications					
V_{OH}	Output signal ended high Defined with 1.425 kΩ pull-up resister to 3.6V.	2.8	--	3.6	V
V_{OL}	Output signal ended low Defined with 1.425 kΩ pull-down register to ground.	0.0	--	0.3	V
V_{CRS}	Output signal crossover voltage See figure 42, USB LS/FS Data Rise and Fall Time Diagram, on page 162.	1.3	--	2.0	V
T_{FR}	Output rise time ・See figure 42, USB LS/FS Data Rise and Fall Time Diagram, on page 162. ・Defined from 10% to 90% for rise time and 90% to 10% for fall time.	-4.0	--	20.0	ns
T_{FL}	Output fall time ・See figure 42, USB LS/FS Data Rise and Fall Time Diagram, on page 162. ・Defined from 10% to 90% for rise time and 90% to 10% for fall time.	-4.0	--	20.0	ns
T_{DJ1}	Source jitter total: to next transition ・Including frequency tolerance. Timing difference between the differential data signals. ・Defined at crossover point of differential data signals.	-3.5	--	3.5	ns
T_{DJ2}	Source jitter total: for paired transitions ・Including frequency tolerance. Timing difference between the differential data signals. ・Defined at crossover point of differential data signals.	-4.0	--	4.0	ns
T_{FDEOP}	Source jitter for differential transition to SE0 transition Defined at crossover point of differential data signals.	-2.0	--	5.0	ns
Receiver Specifications					
V_{IH}	Input signal ended high	2.0	--	--	V
V_{IL}	Input signal ended low	--	--	0.8	V
V_{DI}	Differential input sensitivity	0.2	--	--	V
T_{JR1}	Receiver jitter: to next transition Defined at crossover point of differential data signals.	-18.5	--	18.5	ns

11.4. High-speed UART specifications

Default bard rate is 115200 bps. Baud rate is configurable by the host stack.



Symbol	Parameter	Condition	Min	Typ	Max	Unit
T_{BAUD}	Baud rate	40MHz	250	-	-	ns

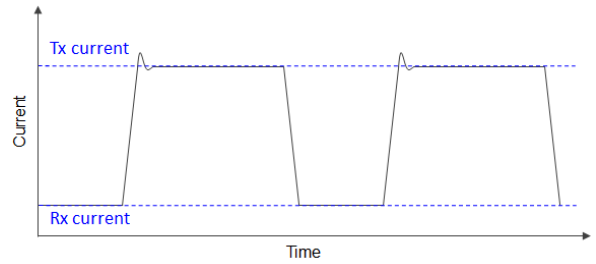
* The acceptable deviation from the UART Rx target baud rate is ±3%.

12. DC / RF Characteristics

・ALL DC/RF characteristics are defined by following files.

WLAN Tx Power	txpower_US.bin, txpower_CA.bin, txpower_EU.bin, txpower_JP.bin
WLAN Regulatory Limit	db.txt
Energy Detect	ed_mac.bin
Bluetooth Power	bt_power_config_1.sh (Class1), bt_power_config_2.sh (Class2)

・Burst current definition



12.1. DC/RF Characteristics for IEEE802.11b - 2.4G

Items	Contents
Specification	IEEE802.11b-2.4GHz
Mode	DSSS / CCK
Channel frequency (spacing)	2412 to 2472 MHz (5MHz)
Data rate	1, 2, 5.5,11Mbps

12.1.1. High Rate Condition for IEEE802.11b – 2.4GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=17dBm at module pad, 11Mbps mode (1-Antenna)

Current Consumption	Min.	Typ.	Max.	Unit
(a) Tx mode (99% Tx mode)	-	420	540	mA
(b) Rx mode	-	110	160	mA
Transmitter	**Min.**	**Typ.**	**Max.**	**Unit**
Power Levels	15	17	19	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	-	-	35	%
Frequency tolerance	-20	-	20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-12750MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (FER≤ 8%)	-	-	-76	dBm
Maximum Input Level (FER ≤ 8%)	-10	-	-	dBm
Adjacent Channel Rejection (FER ≤ 8%)	35	-	-	dB

12.1.2. Low Rate Condition for IEEE802.11b – 2.4GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=17dBm at module pad, 1Mbps mode (1-Antenna)

Current Consumption	**Min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode (99% Tx mode)	-	420	540	mA
(b) Rx mode	-	110	160	mA
Transmitter	**Min.**	**Typ.**	**Max.**	**Unit**
Power Levels	15	17	19	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	-	-	35	%
Frequency tolerance	-20	-	20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-12750MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (FER≤ 8%)	-	-	-80	dBm
Maximum Input Level (FER ≤ 8%)	-4	-	-	dBm
Adjacent Channel Rejection (FER ≤ 8%)	35	-	-	dB

12.2. DC/RF Characteristics for IEEE802.11g - 2.4G

Items	Contents
Specification	IEEE802.11g-2.4GHz
Mode	OFDM
Channel frequency (spacing)	2412 to 2472 MHz (5MHz)
Data rate	6, 9, 12, 18, 24, 36, 48, 54Mbps

12.2.1. High Rate Condition for IEEE802.11g – 2.4GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=13dBm at module pad, 54Mbps mode (1-Antenna)

Current Consumption	Min.	Typ.	Max.	unit
(a) Tx mode (99% Tx mode)	-	310	380	mA
(b) Rx mode	-	110	160	mA
Transmitter	**Min.**	**Typ.**	**Max.**	**unit**
Power Levels	11	13	15	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≥ +/-30MHz	-	-	-40	dBr
Constellation Error	-	-	-25	dB
Frequency tolerance	-20		20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-12750MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**unit**
Minimum Input Level (PER ≤ 10%)	-	-	-65	dBm
Maximum Input Level (PER ≤ 10%)	-20	-	-	dBm
Adjacent Channel Rejection (PER ≤ 10%)	-1	-	-	dB

12.2.2. Low Rate Condition for IEEE802.11g – 2.4GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=16dBm at module pad, 6Mbps mode (1-Antenna)

Current Consumption	**Min.**	**Typ.**	**Max.**	**unit**
(a) Tx mode (99% Tx mode)	-	380	470	mA
(b) Rx mode	-	110	160	mA
Transmitter	**Min.**	**Typ.**	**Max.**	**unit**
Power Levels	14	16	18	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≥ +/-30MHz	-	-	-40	dBr
Constellation Error	-	-	-5	dB
Frequency tolerance	-20		20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-12750MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**unit**
Minimum Input Level (PER ≤ 10%)	-	-	-82	dBm
Maximum Input Level (PER ≤ 10%)	-20	-	-	dBm
Adjacent Channel Rejection (PER ≤ 10%)	-1	-	-	dB

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

Items	Contents
Specification	IEEE802.11n-2.4GHz
Mode	OFDM
Channel frequency (spacing)	2412 to 2472 MHz (5MHz)
Data rate	6.5, 13, 19.5, 26, 39, 52, 58.5, 65Mbps

12.3.1. High Rate Condition for IEEE802.11n – 2.4GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=12dBm at module pad, MCS7 mode (1-Antenna)

Current Consumption	Min.	Typ.	Max.	unit
(a) Tx mode (99% Tx mode)	-	300	360	mA
(b) Rx mode	-	110	160	mA
Transmitter	**Min.**	**Typ.**	**Max.**	**unit**
Power Levels	10	12	14	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≥ +/-30MHz	-	-	-45	dBr
Constellation Error (measured at enhanced mode)	-	-	-27	dB
Frequency tolerance	-20	-	20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-12750MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**unit**
Minimum Input Level (PER ≤ 10%)	-	-	-64	dBm
Maximum Input Level (PER ≤ 10%)	-20	-	-	dBm
Adjacent Channel Rejection (PER ≤ 10%)	-2	-	-	dB

12.3.2. Low Rate Condition for IEEE802.11n – 2.4GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=15dBm at module pad, MCS0 mode (1-Antenna)

Current Consumption	**Min.**	**Typ.**	**Max.**	**unit**
(a) Tx mode (99% Tx mode)	-	360	440	mA
(b) Rx mode	-	110	160	mA
Transmitter	**Min.**	**Typ.**	**Max.**	**unit**
Power Levels	13	15	17	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≥ +/-30MHz	-	-	-45	dBr
Constellation Error (measured at enhanced mode)	-	-	-5	dB
Frequency tolerance	-20	-	20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-12750MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**unit**
Minimum Input Level (PER ≤ 10%)	-	-	-82	dBm
Maximum Input Level (PER ≤ 10%)	-20	-	-	dBm
Adjacent Channel Rejection (PER ≤ 10%)	-2	-	-	dB

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

Items	Contents
Specification	IEEE802.11a-5GHz
Mode	OFDM
Channel frequency (spacing)	5180 - 5825MHz
Data rate	6, 9, 12, 18, 24, 36, 48, 54Mbps

12.4.1. High Rate Condition for IEEE802.11a – 5GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=12dBm at module pad, 54Mbps mode (1-Antenna)

Current Consumption	Min.	Typ.	Max.	Unit
(a) Tx mode (99% Tx mode)	-	330	390	mA
(b) Rx mode	-	125	180	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	10	12	14	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≥ +/-30MHz	-	-	-40	dBr
Constellation Error	-	-	-25	dB
Frequency tolerance	-20		20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-5150MHz (BW=1MHz)	-	-	-30	dBm
k) 5350-5470MHz (BW=1MHz)	-	-	-30	dBm
l) 5725-26000MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≤ 10%)	-	-	-65	dBm
Maximum Input Level (PER ≤ 10%)	-30	-	-	dBm
Adjacent Channel Rejection (PER < 10%)	-1			dB

12.4.2. Low Rate Condition for IEEE802.11a – 5GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=14dBm at module pad, 6Mbps mode (1-Antenna)

Current Consumption	**Min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode (99% Tx mode)	-	360	440	mA
(b) Rx mode	-	125	180	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	12	14	16	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≧ +/-30MHz	-	-	-40	dBr
Constellation Error	-	-	-5	dB
Frequency tolerance	-20		20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-5150MHz (BW=1MHz)	-	-	-30	dBm
k) 5350-5470MHz (BW=1MHz)	-	-	-30	dBm
l) 5725-26000MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≦ 10%)	-	-	-82	dBm
Maximum Input Level (PER ≦ 10%)	-30	-	-	dBm
Adjacent Channel Rejection (PER < 10%)	-1			dB

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

Items	Contents
Specification	IEEE802.11n-5GHz
Mode	OFDM
Channel frequency (spacing)	5180 - 5825MHz
Data rate	6.5, 13, 19.5, 26, 39, 52, 58.5, 65Mbps

12.5.1. High Rate Condition for IEEE802.11n(HT20) – 5GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=11dBm at module pad, MCS7 mode (1-Antenna)

Current Consumption	Min.	Typ.	Max.	Unit
(a) Tx mode (99% Tx mode)	-	320	370	mA
(b) Rx mode	-	125	180	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	9	11	13	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≥ +/-30MHz	-	-	-40	dBr
Constellation Error (measured at enhanced mode)	-	-	-27	dB
Frequency tolerance	-20		20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-5150MHz (BW=1MHz)	-	-	-30	dBm
k) 5350-5470MHz (BW=1MHz)	-	-	-30	dBm
l) 5725-26000MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≤ 10%)	-	-	-64	dBm
Maximum Input Level (PER ≤ 10%)	-30	-	-	dBm
Adjacent Channel Rejection (PER < 10%)	16	-	-	dB

12.5.2. Low Rate Condition for IEEE802.11n(HT20) – 5GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=14dBm at module pad, MCS0 mode (1-Antenna)

Current Consumption	**Min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode (99% Tx mode)	-	370	440	mA
(b) Rx mode	-	125	180	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	12	14	16	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≧ +/-30MHz	-	-	-40	dBr
Constellation Error (measured at enhanced mode)	-	-	-5	dB
Frequency tolerance	-20		20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-5150MHz (BW=1MHz)	-	-	-30	dBm
k) 5350-5470MHz (BW=1MHz)	-	-	-30	dBm
l) 5725-26000MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≦ 10%)	-	-	-82	dBm
Maximum Input Level (PER ≦ 10%)	-30	-	-	dBm
Adjacent Channel Rejection (PER < 10%)	16	-	-	dB

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

Items	Contents
Specification	IEEE802.11n-5GHz
Mode	OFDM
Channel frequency (spacing)	5180 - 5825MHz
Data rate	6.5, 13, 19.5, 26, 39, 52, 58.5, 65, 78Mbps

12.6.1. High Rate Condition for IEEE802.11ac(VHT20) – 5GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=10dBm at module pad, MCS8 mode (1-Antenna)

Current Consumption	Min.	Typ.	Max.	Unit
(a) Tx mode (99% Tx mode)	-	300	355	mA
(b) Rx mode	-	125	180	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	8	10	12	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≥ +/-30MHz	-	-	-40	dBr
Constellation Error (measured at enhanced mode)	-	-	-30	dB
Frequency tolerance	-20		20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-5150MHz (BW=1MHz)	-	-	-30	dBm
k) 5350-5470MHz (BW=1MHz)	-	-	-30	dBm
l) 5725-26000MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≤ 10%)	-	-	-59	dBm
Maximum Input Level (PER ≤ 10%)	-30	-	-	dBm
Adjacent Channel Rejection (PER < 10%)	16	-	-	dB

12.6.2. Low Rate Condition for IEEE802.11ac(VHT20) – 5GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=14dBm at module pad, MCS0 mode (1-Antenna)

Current Consumption	**Min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode (99% Tx mode)	-	360	435	mA
(b) Rx mode	-	125	180	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	12	14	16	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≧ +/-30MHz	-	-	-40	dBr
Constellation Error (measured at enhanced mode)	-	-	-5	dB
Frequency tolerance	-20		20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-5150MHz (BW=1MHz)	-	-	-30	dBm
k) 5350-5470MHz (BW=1MHz)	-	-	-30	dBm
l) 5725-26000MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≦ 10%)	-	-	-82	dBm
Maximum Input Level (PER ≦ 10%)	-30	-	-	dBm
Adjacent Channel Rejection (PER < 10%)	16	-	-	dB

12.7. DC/RF Characteristics for IEEE802.11n(HT 40MHz) - 5GHz

Items	Contents
Specification	IEEE802.11n-5GHz
Mode	OFDM
Channel frequency (spacing)	5180 - 5825MHz
Data rate	13.5,27,40.5,54,81,108,121.5,135Mbps

12.7.1. High Rate Condition for IEEE802.11n(HT40) – 5GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=11dBm at module pad, MCS7 mode (1-Antenna)

Current Consumption	Min.	Typ.	Max.	Unit
(a) Tx mode (99% Tx mode)	-	310	370	mA
(b) Rx mode	-	140	200	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	9	11	13	dBm
Spectrum Mask				
(a) at fc +/- 21MHz	-	-	-20	dBr
(b) at fc +/- 40MHz	-	-	-28	dBr
(c) at fc ≥ +/-60MHz	-	-	-40	dBr
Constellation Error (measured at enhanced mode)	-	-	-27	dB
Frequency tolerance	-20		20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-5150MHz (BW=1MHz)	-	-	-30	dBm
k) 5350-5470MHz (BW=1MHz)	-	-	-30	dBm
l) 5725-26000MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≤ 10%)	-	-	-61	dBm
Maximum Input Level (PER ≤ 10%)	-30	-	-	dBm
Adjacent Channel Rejection (PER < 10%)	-2			dB

12.7.2. Low Rate Condition for IEEE802.11n(HT40) – 5GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=13dBm at module pad, MCS0 mode (1-Antenna)

Current Consumption	**Min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode (99% Tx mode)	-	350	415	mA
(b) Rx mode	-	140	200	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	11	13	15	dBm
Spectrum Mask				
(a) at fc +/- 21MHz	-	-	-20	dBr
(b) at fc +/- 40MHz	-	-	-28	dBr
(c) at fc ≧ +/-60MHz	-	-	-40	dBr
Constellation Error (measured at enhanced mode)	-	-	-5	dB
Frequency tolerance	-20		20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-5150MHz (BW=1MHz)	-	-	-30	dBm
k) 5350-5470MHz (BW=1MHz)	-	-	-30	dBm
l) 5725-26000MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≦ 10%)	-	-	-79	dBm
Maximum Input Level (PER ≦ 10%)	-30	-	-	dBm
Adjacent Channel Rejection (PER < 10%)	-2			dB

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

Items	Contents
Specification	IEEE802.11ac-5GHz
Mode	OFDM
Channel frequency (spacing)	5190 - 5795MHz
Data rate	13.5,27,40.5,54,81,108,121.5,135,162,180Mbps

12.8.1. High Rate Condition for IEEE802.11ac(VHT40) – 5GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=10dBm at module pad, MCS9 mode (1-Antenna)

Current Consumption	Min.	Typ.	Max.	Unit
(a) Tx mode (99% Tx mode)	-	300	350	mA
(b) Rx mode	-	140	200	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	8	10	12	dBm
Spectrum Mask				
(a) at fc +/- 21MHz	-	-	-20	dBr
(b) at fc +/- 40MHz	-	-	-28	dBr
(c) at fc ≥ +/-60MHz	-	-	-40	dBr
Constellation Error (measured at enhanced mode)	-	-	-32	dB
Frequency tolerance	-20		20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-5150MHz (BW=1MHz)	-	-	-30	dBm
k) 5350-5470MHz (BW=1MHz)	-	-	-30	dBm
l) 5725-26000MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≤ 10%)	-	-	-54	dBm
Maximum Input Level (PER ≤ 10%)	-30	-	-	dBm

12.8.2. Low Rate Condition for IEEE802.11ac(VHT40) – 5GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=13dBm at module pad, MCS0 mode (1-Antenna)

Current Consumption	**Min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode (99% Tx mode)	-	350	410	mA
(b) Rx mode	-	140	200	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	11	13	15	dBm
Spectrum Mask				
(a) at fc +/- 21MHz	-	-	-20	dBr
(b) at fc +/- 40MHz	-	-	-28	dBr
(c) at fc ≧ +/-60MHz	-	-	-40	dBr
Constellation Error (measured at enhanced mode)	-	-	-5	dB
Frequency tolerance	-20		20	ppm
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-5150MHz (BW=1MHz)	-	-	-30	dBm
k) 5350-5470MHz (BW=1MHz)	-	-	-30	dBm
l) 5725-26000MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≦ 10%)	-	-	-79	dBm
Maximum Input Level (PER ≦ 10%)	-30	-	-	dBm

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

Items	Contents
Specification	IEEE802.11ac-5GHz
Mode	OFDM
Channel frequency (spacing)	5210 - 5775MHz
Data rate	29.3,58.5,87.8,117,175.5,234,263.3,292.5,351,390 Mbps

12.9.1. High Rate Condition for IEEE802.11ac(VHT80) – 5GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=10dBm at module pad, MCS9 mode (1-Antenna)

Current Consumption	Min.	Typ.	Max.	Unit
(a) Tx mode (99% Tx mode)	-	310	365	mA
(b) Rx mode	-	160	220	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	8	10	12	dBm
Spectrum Mask				
(a) at fc +/- 41MHz	-	-	-20	dBr
(b) at fc +/- 80MHz	-	-	-28	dBr
(c) at fc ≥ +/-120MHz	-	-	-40	dBr
Constellation Error (measured at enhanced mode)	-	-	-32	dB
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-5150MHz (BW=1MHz)	-	-	-30	dBm
k) 5350-5470MHz (BW=1MHz)	-	-	-30	dBm
l) 5725-26000MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≤ 10%)	-	-	-51	dBm
Maximum Input Level (PER ≤ 10%)	-30	-	-	dBm
Adjacent Channel Rejection (PER < 10%)	-9			dB

12.9.2. Low Rate Condition for IEEE802.11ac(VHT80) – 5GHz

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V, Output power setting=12dBm at module pad, MCS0 mode (1-Antenna)

Current Consumption	**Min.**	**Typ.**	**Max.**	**Unit**
(a) Tx mode (99% Tx mode)	-	340	395	mA
(b) Rx mode	-	160	220	mA
Transmitter	**min.**	**Typ.**	**Max.**	**Unit**
Power Levels	10	12	14	dBm
Spectrum Mask				
(a) at fc +/- 41MHz	-	-	-20	dBr
(b) at fc +/- 80MHz	-	-	-28	dBr
(c) at fc ≧ +/-120MHz	-	-	-40	dBr
Constellation Error (measured at enhanced mode)	-	-	-5	dB
Spurious Emissions (BW=100kHz)				
a) 30-47MHz (BW=100kHz)	-	-	-36	dBm
b) 47-74MHz (BW=100kHz)	-	-	-54	dBm
c) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
d) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
e) 118-174MHz (BW=100kHz)	-	-	-36	dBm
f) 174-230MHz (BW=100kHz)	-	-	-54	dBm
g) 230-470MHz (BW=100kHz)	-	-	-36	dBm
h) 470-862MHz (BW=100kHz)	-	-	-54	dBm
i) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
j) 1000-5150MHz (BW=1MHz)	-	-	-30	dBm
k) 5350-5470MHz (BW=1MHz)	-	-	-30	dBm
l) 5725-26000MHz (BW=1MHz)	-	-	-30	dBm
Receiver	**Min.**	**Typ.**	**Max.**	**Unit**
Minimum Input Level (PER ≦ 10%)	-	-	-76	dBm
Maximum Input Level (PER ≦ 10%)	-30	-	-	dBm
Adjacent Channel Rejection (PER < 10%)	-9			dB

12.10. DC/RF Characteristics for Bluetooth

Items	Contents
Bluetooth specification (power class)	Version 5.2 (Class1)
Channel frequency (spacing)	2402 to 2480 MHz (1MHz)
Number of RF Channel	79

12.10.1. Basic Data Rate Condition

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V

Items	Contents			
Current Consumption	**Min.**	**Typ.**	**Max.**	**Unit**
1) Tx mode DH5	-	70	150	mA
2) Rx mode DH5	-	70	125	mA
- Tx Characteristics -	Min.	Typ.	Max.	**Unit**
Output Power@DH5	0	3	6	dBm
Frequency range	2400	-	2483.5	MHz
20dB bandwidth	-		1	MHz
Adjacent Channel Power *1				
1) [M-N] =2	-	-	-20	dBm
2) [M-N] ≥3	-	-	-40	dBm
Modulation characteristics				
1) Modulation Δf1avg	140	151	175	kHz
2) Modulation Δf2max	115		-	kHz
3) Modulation Δf2avg / Δf1avg	0.8	1	-	
Carrier Frequency Drift				
1) 1slot	-25	-	25	kHz
2) 3slot / 5slot	-40	-	40	kHz
3) Maximum drift rate		-	20	kHz/50us
- Rx Characteristics -	**Min.**	**Typ.**	**Max.**	**Unit**
BDR Sensitivity (BER≤0.1%)	-	-96	-70	dBm
Maximum Input Level (BER≤0.1%)	-20	-	-	dBm

* Up to three spurious responses within Bluetooth limits are allowed.

12.10.2. Enhanced Data Rate Condition

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V

Items	Contents			
Current Consumption	**Min.**	**Typ.**	**Max.**	**Unit**
1) Tx mode 2DH5	-	70	150	mA
2) Rx mode 2DH5	-	70	125	mA
3) Tx mode 3DH5	-	70	150	mA
4) Rx mode 3DH5	-	70	125	mA
- Tx Characteristics -	Min.	Typ.	Max.	**Unit**
Output Power@2DH5/3DH5	-3	0	3	dBm
Frequency range	2400	-	2483.5	MHz
20dB bandwidth	-		1	MHz
Adjacent Channel Power *1				
1) [M-N] =2	-	-	-20	dBm
2) [M-N] ≥3	-	-	-40	dBm
EDR Relative Power	-4	-	1	dB
EDR Carrier Frequency Stability and Modulation Accuracy				
1) ωi	-75	-	75	kHz
2) ωi+ωo	-75	-	75	kHz
3) ωo	-10	-	10	kHz
4) RMS DEVM (DQPSK)	-	-	20	%
5) Peak DEVM (DQPSK)	-	-	35	%
6) 99% DEVM (DQPSK)	-	-	30	%
7) RMS DEVM (8DPSK)	-	-	13	%
8) Peak DEVM (8DPSK)	-	-	25	%
9) 99% DEVM (8DPSK)	-	-	20	%
Spurious Emissions				
1) 30-47MHz (BW=100kHz)	-	-	-36	dBm
2) 47-74MHz (BW=100kHz)	-	-	-54	dBm
3) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
4) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
5) 118-174MHz (BW=100kHz)	-	-	-36	dBm
6) 174-230MHz (BW=100kHz)	-	-	-54	dBm
7) 230-470MHz (BW=100kHz)	-	-	-36	dBm
8) 470-862MHz (BW=100kHz)	-	-	-54	dBm
9) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
10) 1000-12750MHz (BW=1MHz)	-	-	-30	dBm
- Rx Characteristics -	**Min.**	**Typ.**	**Max.**	**Unit**
EDR Sensitivity (BER≤0.007%)@8DPSK	-	-88	-70	dBm
Maximum Input Level (BER≤0.1%)	-20	-	-	dBm

* Up to three spurious responses within Bluetooth limits are allowed.

12.11. DC/RF Characteristics for Bluetooth Low Energy

Items	Contents
Bluetooth specification (power class)	Version 5.2 (Class1.5)
Channel frequency (spacing)	2402 to 2480 MHz (2MHz)
Number of RF Channel	40

12.11.1. 1Mbps PHY Condition

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V

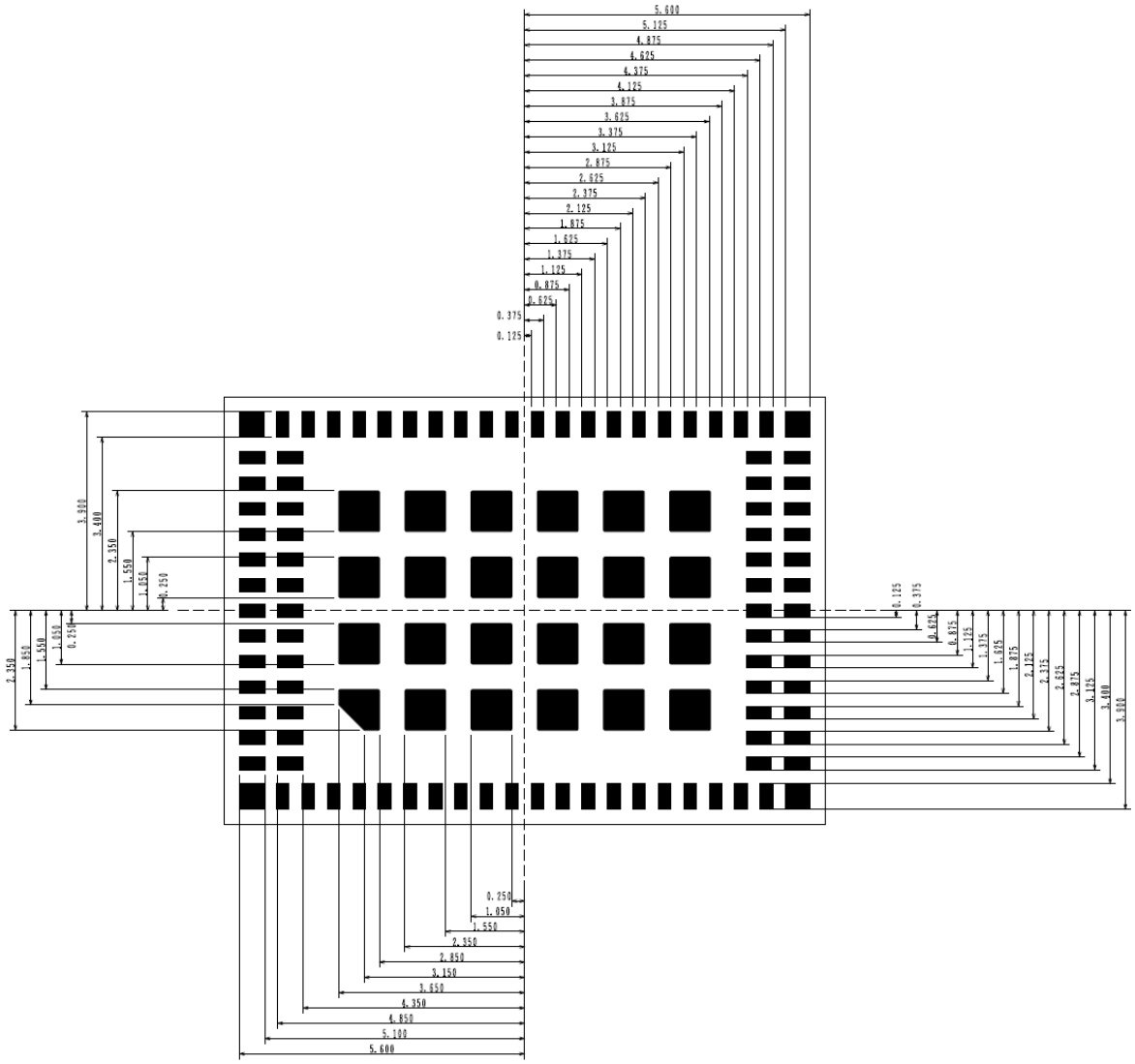
Items	Contents			
Current Consumption	**Min.**	**Typ.**	**Max.**	**Unit**
1) Tx mode	-	70	150	mA
2) Rx mode	-	70	125	mA
- Tx Characteristics -	**Min.**	**Typ.**	**Max.**	**Unit**
Center Frequency	2402	-	2480	MHz
Channel Spacing	-	2	-	MHz
Number of RF channel	-	40	-	-
Output power	0	3	6	dBm
In-band emission				
1) f_{TX}+/-2MHz	-	-	-20	dBm
2) f_{TX}+/-[3+n]MHz; n=0,1,2…	-	-	-30	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	-	-	-
Stable Modulation Characteristics				
1) $\Delta f1_{avg}$	247.5	-	252.5	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) Frequency offset (fn); n=0,1,2,3…k	-150	-	150	kHz
2) Frequency drift ($\|f_0-f_n\|$); n=2,3,4…k	-	-	50	kHz
3) Drift rate				
a) $\|f_1-f_0\|$	-	-	23	kHz
b) $\|f_n-f_{n-5}\|$; n=6,7,8,…k	-	-	20	kHz
Spurious Emissions				
1) 30-47MHz (BW=100kHz)	-	-	-36	dBm
2) 47-74MHz (BW=100kHz)	-	-	-54	dBm
3) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
4) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
5) 118-174MHz (BW=100kHz)	-	-	-36	dBm
6) 174-230MHz (BW=100kHz)	-	-	-54	dBm
7) 230-470MHz (BW=100kHz)	-	-	-36	dBm
8) 470-862MHz (BW=100kHz)	-	-	-54	dBm
9) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
10) 1000-12750MHz (BW=1MHz)	-	-	-30	dBm
- Rx Characteristics -	**Min.**	**Typ.**	**Max.**	**Unit**
Receiver sensitivity (PER < 30.8%)	-	-97	-70	dBm
Maximum input signal level (PER < 30.8%)	-10	-	-	dBm
PER Report Integrity (-30dBm input)	50	-	65.4	%

12.11.2. 2Mbps PHY Condition

Conditions : 25deg.C, VBAT=3.3V, VIO=3.3V

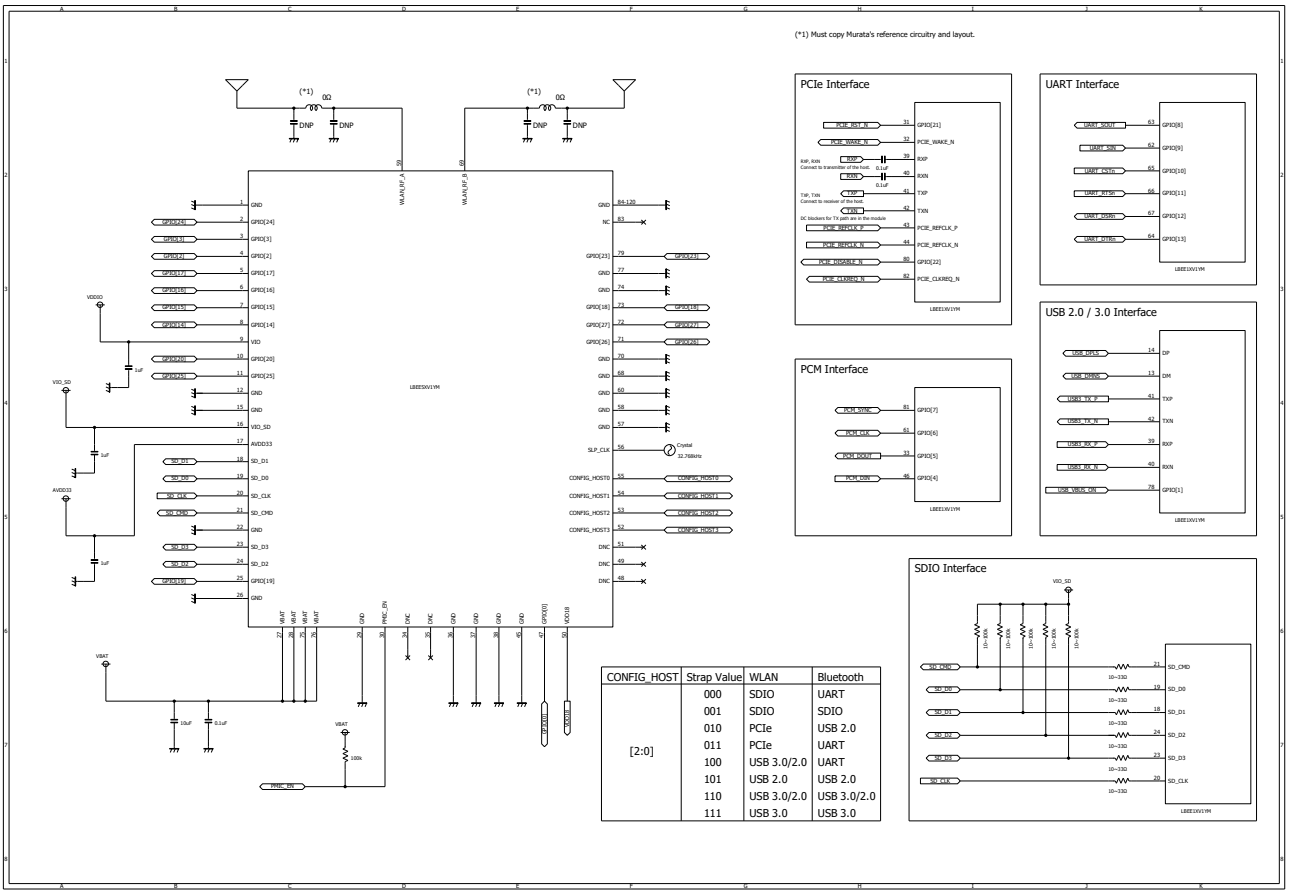
Items	Contents			
Current Consumption	**Min.**	**Typ.**	**Max.**	**Unit**
1) Tx mode	-	70	150	mA
2) Rx mode	-	70	125	mA
- Tx Characteristics -	**Min.**	**Typ.**	**Max.**	**Unit**
Center Frequency	2402	-	2480	MHz
Channel Spacing	-	2	-	MHz
Number of RF channel	-	40	-	-
Output power	0	3	6	dBm
In-band emission				
1) f_{TX}+/-4MHz	-	-	-20	dBm
2) f_{TX}+/-5MHz	-	-	-20	dBm
2) f_{TX}+/-[6+n]MHz; n=0,1,2…	-	-	-30	dBm
Modulation Characteristics				
1) $\Delta f1_{avg}$	450	-	550	kHz
2) $\Delta f2_{max}$ (at 99.9%)	370	-	-	kHz
3) $\Delta f2_{avg}$ / $\Delta f1_{avg}$	0.8	-	-	-
Stable Modulation Characteristics				
1) $\Delta f1_{avg}$	495	-	505	kHz
2) $\Delta f2_{max}$ (at 99.9%)	370	-	-	kHz
3) $\Delta f2_{avg}$ / $\Delta f1_{avg}$	0.8	-	-	-
Carrier frequency offset and drift				
1) Frequency offset (fn); n=0,1,2,3…k	-150	-	150	kHz
2) Frequency drift ($\|f_0-f_n\|$); n=2,3,4…k	-	-	50	kHz
3) Drift rate				
a) $\|f_1-f_0\|$	-	-	23	kHz
b) $\|f_n-f_{n-5}\|$; n=6,7,8,…k	-	-	20	kHz
Spurious Emissions				
1) 30-47MHz (BW=100kHz)	-	-	-36	dBm
2) 47-74MHz (BW=100kHz)	-	-	-54	dBm
3) 74-87.5MHz (BW=100kHz)	-	-	-36	dBm
4) 87.5-118MHz (BW=100kHz)	-	-	-54	dBm
5) 118-174MHz (BW=100kHz)	-	-	-36	dBm
6) 174-230MHz (BW=100kHz)	-	-	-54	dBm
7) 230-470MHz (BW=100kHz)	-	-	-36	dBm
8) 470-862MHz (BW=100kHz)	-	-	-54	dBm
9) 862-1000MHz (BW=100kHz)	-	-	-36	dBm
10) 1000-12750MHz (BW=1MHz)	-	-	-30	dBm
- Rx Characteristics -	**Min.**	**Typ.**	**Max.**	**Unit**
Receiver sensitivity (PER < 30.8%)	-	-95	-70	dBm
Maximum input signal level (PER < 30.8%)	-10	-	-	dBm
PER Report Integrity (-30dBm input)	50	-	65.4	%

13. Land Pattern



Top View. Unit : mm

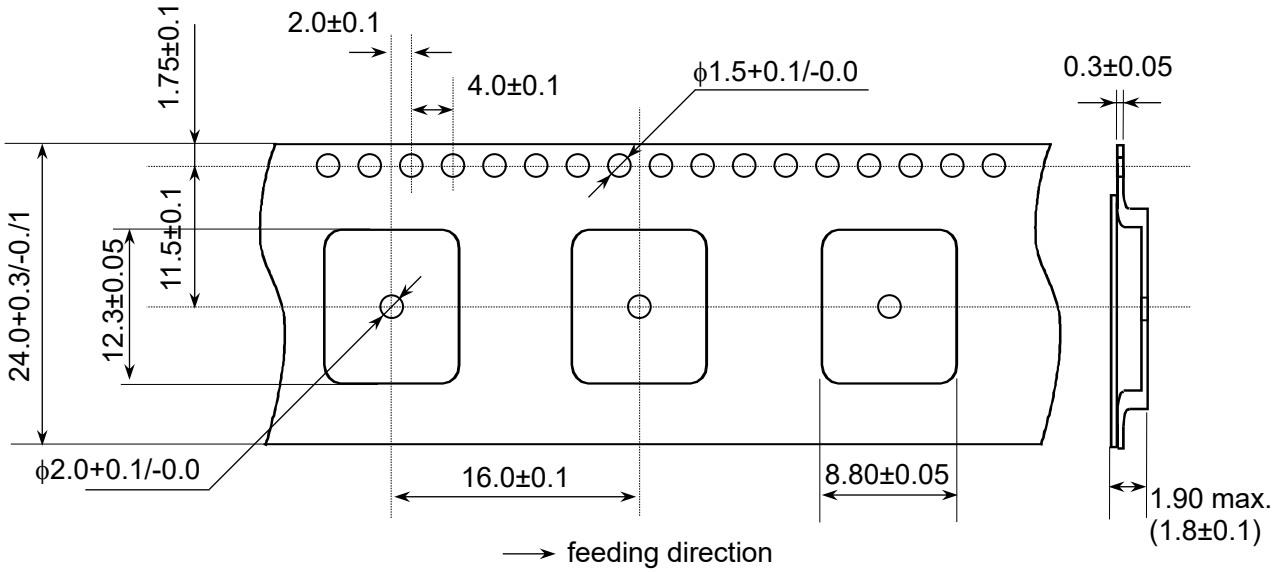
14. Reference Peripheral Circuit



CONFIG_HOST	Strap Value	WLAN	Bluetooth
[2:0]	000	SDIO	UART
	001	SDIO	SDIO
	010	PCIe	USB 2.0
	011	PCIe	UART
	100	USB 3.0/2.0	UART
	101	USB 2.0	USB 2.0
	110	USB 3.0/2.0	USB 3.0/2.0
	111	USB 3.0	USB 3.0

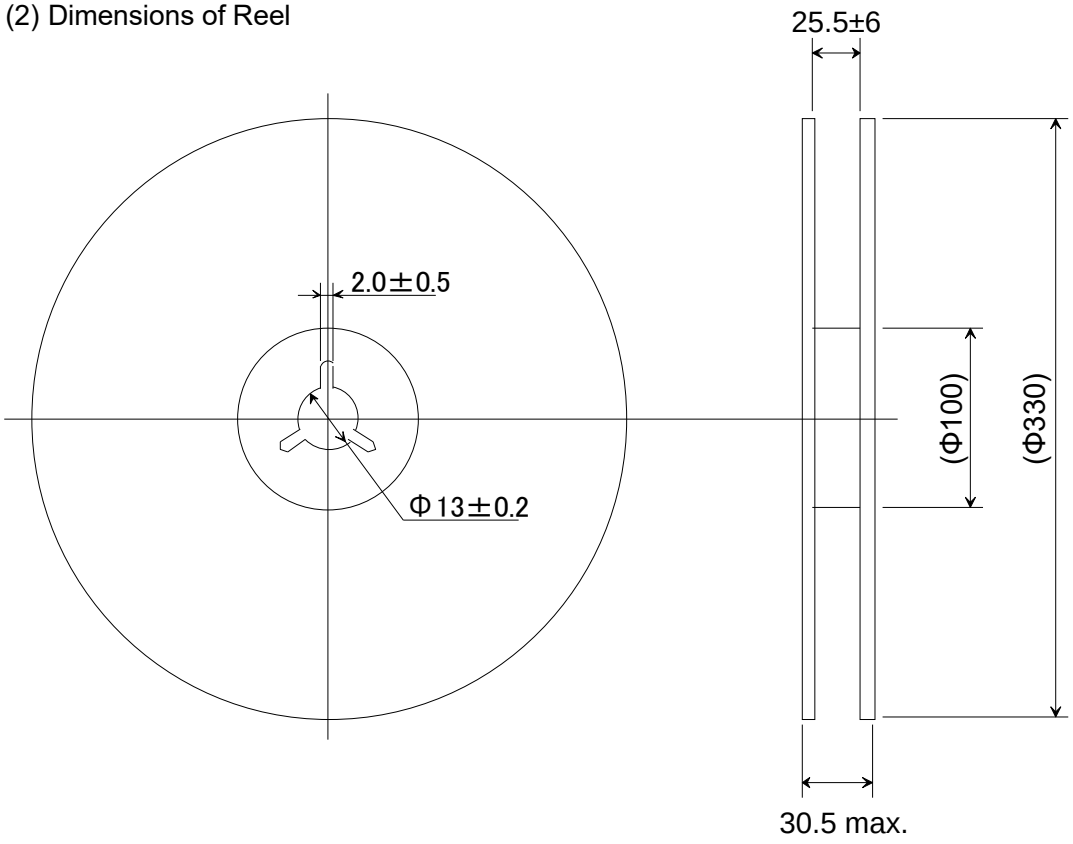
15. Tape and Reel Packing

(1) Dimensions of Tape (Plastic tape)



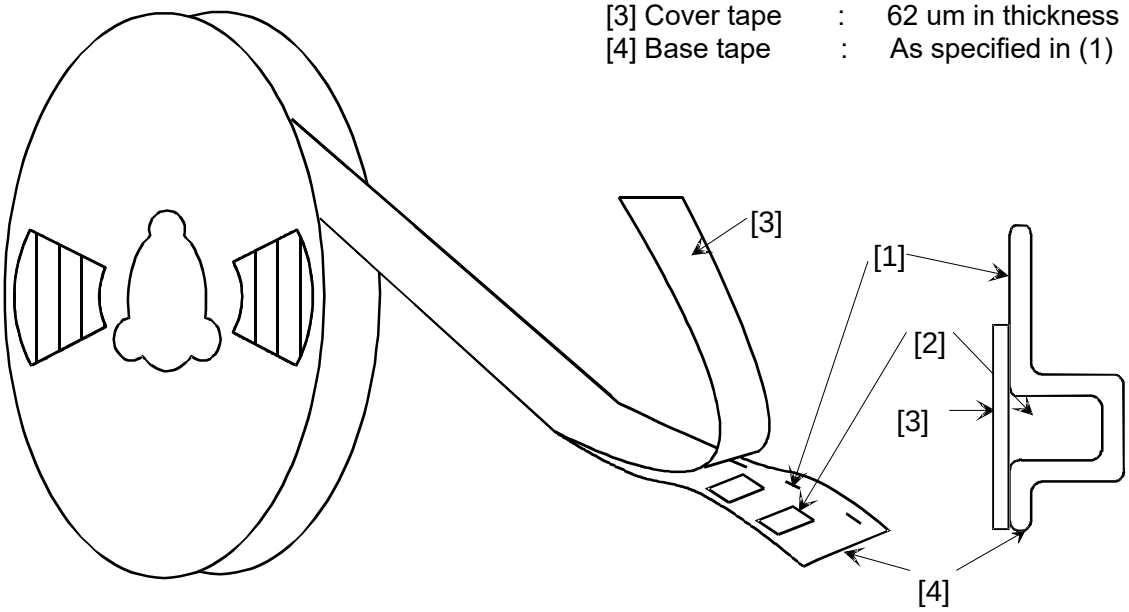
1) The corner and ridge radiuses (R) of inside cavity are 0.3mm max.
2) Cumulative tolerance of 10 pitches of the sprocket hole is +/-0.15mm
3) Measuring of cavity positioning is based on cavity center in accordance with JIS/IES standard.

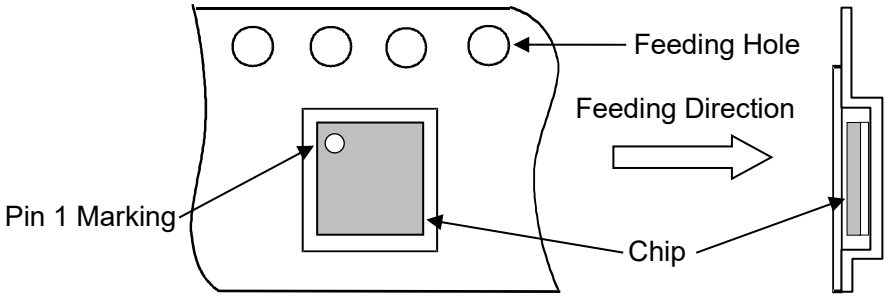
(2) Dimensions of Reel



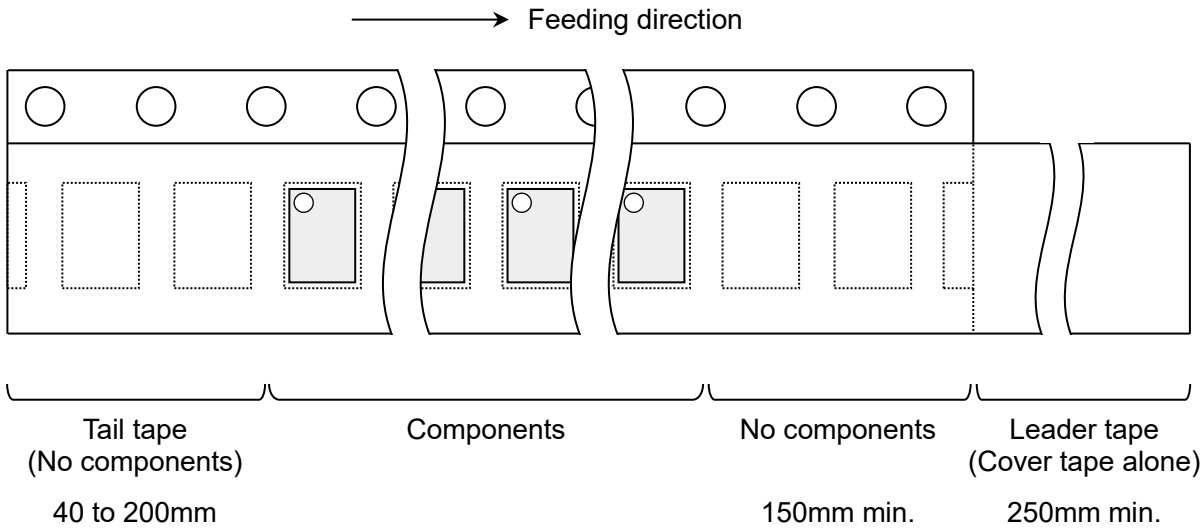
(3) Taping Diagrams

[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)





(4) Leader and Tail tape



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

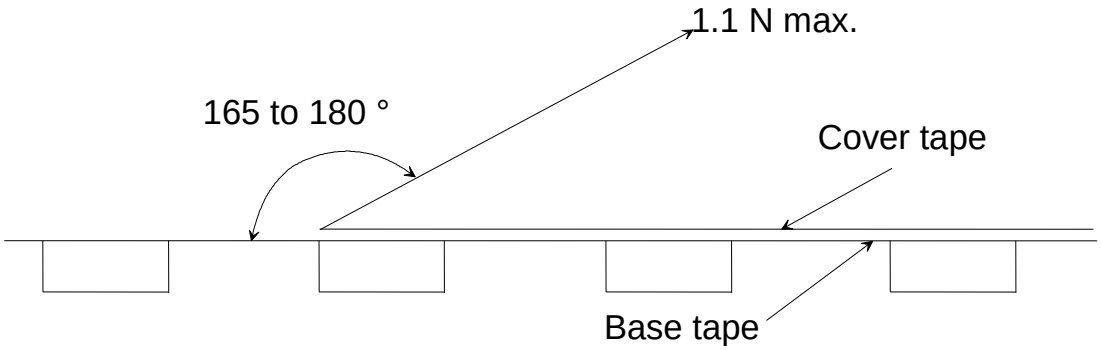
(6) The cover tape and base tape are not adhered at no components area for 250mm min.

(7) Tear off strength against pulling of cover tape: 5N min.

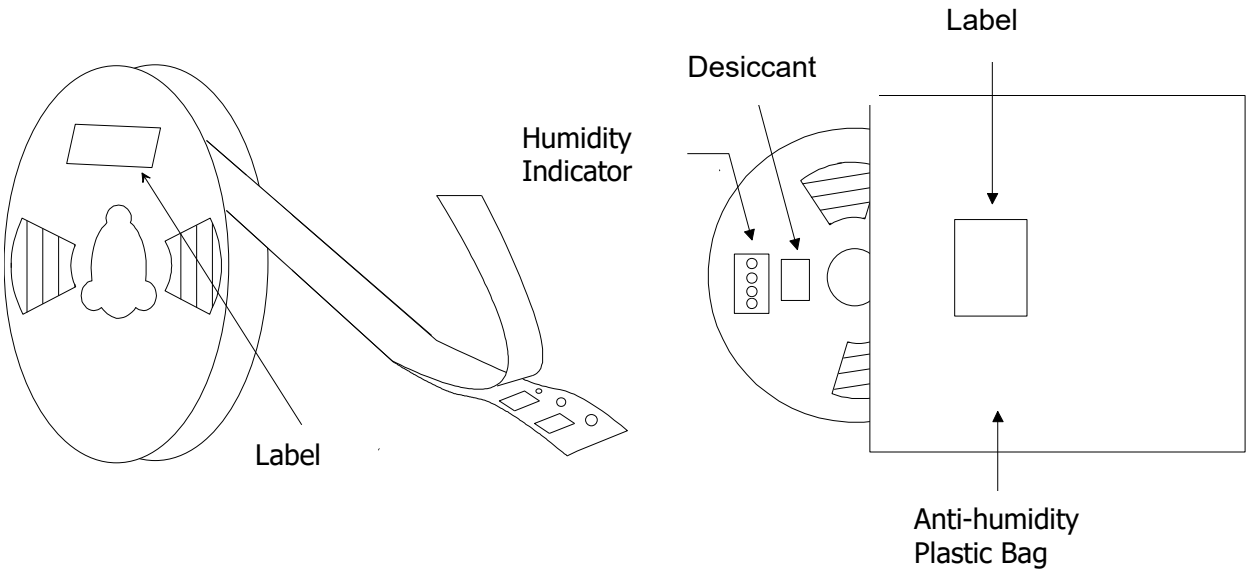
(8) Packaging unit : 1000pcs./ reel

(9) material - Base tape : Plastic
Reel : Plastic
Cover tape, cavity tape and reel are made the anti-static processing.

(10) Peeling of force: 1.1N max. in the direction of peeling as shown below.



(11) 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.

16. Notice

16.1. 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 ≦30deg.C / ≦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.

16.2. 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.

16.3. 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.

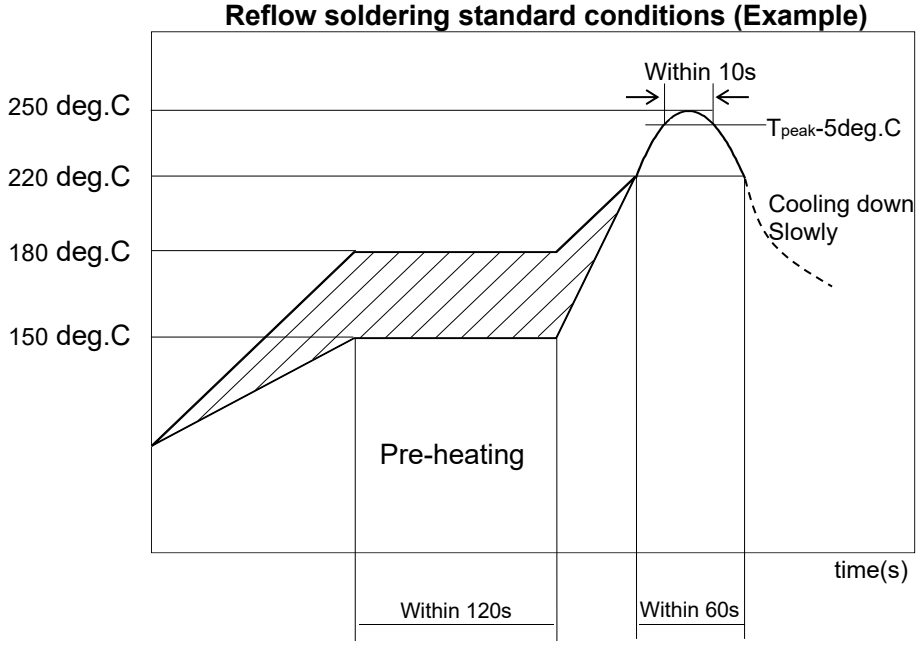
16.4. Notice for Chip Placer:

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.

16.5. 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 °C. 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.

16.6. 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.

16.7. 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.

16.8. Input Power Capacity:

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

17. Preconditions 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.
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 IN SUCH APPLICATIONS.

- Aircraft equipment.
- Aerospace equipment
- Undersea equipment.
- Power plant control equipment
- Medical equipment.
- Traffic signal equipment.
- Burning / explosion control equipment
- Disaster prevention / crime prevention equipment.
- Transportation equipment (vehicles, trains, ships, elevator, etc.).
- 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.

APPENDIX

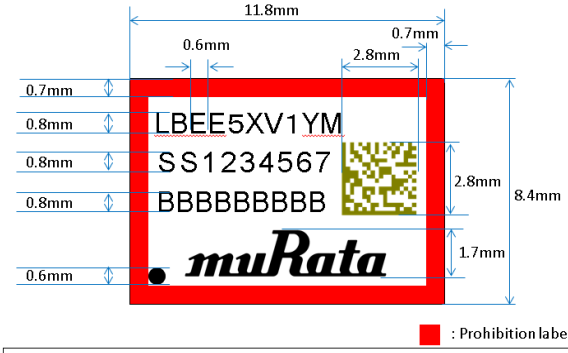
TABLE OF CONTENTS

1. General for Radio Regulatory Certification for LBEE5XV1YM

Application model part number

Basically, we apply for “LBEE5XV1YM” in each country.

Label

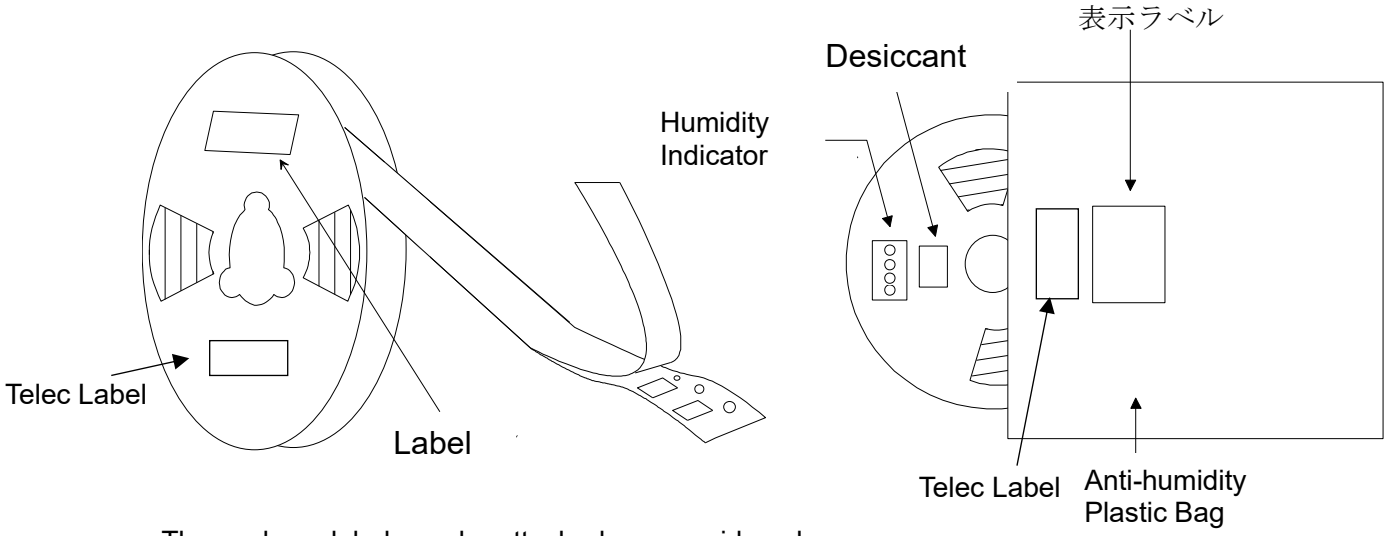


LBEE5XV1YM	:Module type
SS1234567	:Inspection Number
BBBBBBBBB	:Serial Number
●	:Pin 1 Marking
muRata	:Name of manufacture(Murata Logo mark)

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 or package.

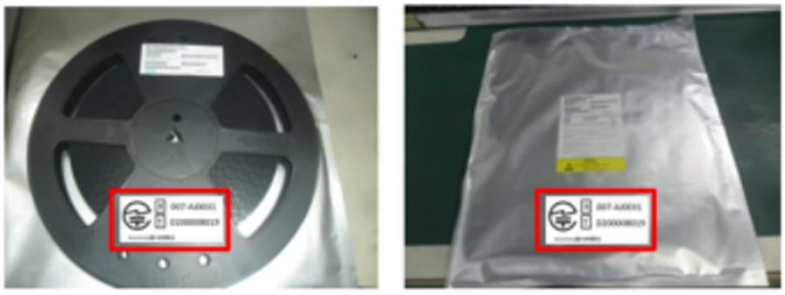
Package Label

PACKAGE (Humidity proof Packing)



The package label may be attached on one side only.

Package label display example



※捺通マークの直径は3mm以上

Country of Origin

China
SHENZHEN MURATA TECHNOLOGY CO., LTD.

Some countries have applied for 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 by country for LBEE5XV1YM

<日本電波法>
製造者名（端末機器の製造者名）：株式会社村田製作所
型式又は名称（端末機器の名称）：LBEE5XV1YM

当モジュールは日本電波法に基づく工事設計認証を受けた製品です。
【（警告）5GHz の周波数帯においては、5.2GHz/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。5.2GHz/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。】

Power Table

■2.4GHz

		1 ~ 13ch		
パワー(単位dBm)		**Min**	**Typ**	**Max**
11b	1~11M	10.0	12.0	14.0
11g	6~54M	10.0	12.0	14.0
11n_HT20	MCS0~7	10.0	12.0	14.0
11ac_VHT20	MCS0~7	10.0	12.0	14.0
	MCS8	9.0	11.0	13.0

		2402 ~ 2480MHz		
BT	BR	0.0	3.0	6.0
	EDR	-3.0	0.0	3.0
BLE	1Mbps	0.0	3.0	6.0
	2Mbps	0.0	3.0	6.0

■W52

		36 ~ 48ch		
Pw typ.(単位dBm)		**Min**	**Typ**	**Max**
11a	6~54M	8.0	10.0	12.0
11n HT20	MCS0~7	8.0	10.0	12.0
11ac VHT20	MCS0~8	8.0	10.0	12.0

■W52

		36 ~ 48ch		
Pw typ.(単位dBm)		**Min**	**Typ**	**Max**
11a	6~54M	8.0	10.0	12.0
11n HT20	MCS0~7	8.0	10.0	12.0
11ac VHT20	MCS0~8	8.0	10.0	12.0

■W56

		100 ~ 144ch		
Pw typ.(単位dBm)		Min	Typ	Max
11a	6~18M	11.0	13.0	15.0
	24~54M	10.0	12.0	14.0
11n HT20	MCS0~2	11.0	13.0	15.0
	MCS3~7	9.0	11.0	13.0
11ac VHT20	MCS0~2	11.0	13.0	15.0
	MCS3~7	9.0	11.0	13.0
	MCS8	8.0	10.0	12.0

		38 ~ 46ch		
11n HT40	MCS0~2	11.0	13.0	15.0
	MCS3~7	9.0	11.0	13.0
11ac VHT40	MCS0~2	11.0	13.0	15.0
	MCS3~7	9.0	11.0	13.0
	MCS8~9	8.0	10.0	12.0

		42ch		
11ac VHT80	MCS0~2	10.0	12.0	14.0
	MCS3~7	9.0	11.0	13.0
	MCS8~9	8.0	10.0	12.0

アンテナポートは 2 つ
SISO×2 の同時送信や MIMO あり
上記の表は全て設定値で SISO×1, SISO×2, MIMO のいずれでも同じ値
よって、SISO×2 や MIMO では、SISO×1 より 3dBm 高い出力（理論値）になる。
設定値は Typ、WLAN の偏差は±2dB、BTBLE の偏差は±3dB

日本電波法認証申請を行い登録されているアンテナ

No.	Maker	Support Antenna						
		P/N	Form factor	Type	Gain		Size	Detail
					2.4GHz	5GHz		
1	Molex	146153	u.FL/flexible	Dipole	3.2	4.25	35x9x0.1mm	Flexible//horizontal
2	Molex	146187	u.FL/flexible	Dipole	3.4	4.75	40.95x9x0.7mm	Rigid//horizontal
3	Molex	206994	u.FL/flexible	Monopole	3.6	3.6	15.4x6.4x0.15mm	adhesive // flexible //vertical

表記について
下記①または②の内容を、当モジュールを組み込む製品に記載を推奨します。
製品上への表示（①または②）に支障がある場合は当モジュールを組み込む製品のユーザーマニュアルや包装（梱包）パッケージへの表示または電子表示を推奨いたします。
電子表示の場合は、『電子表示していること』＋『その表示までの操作方法』を製品のマニュアルに記載いただく必要がございます。
****
① 【本製品は、電波法に基づく工事設計認証(認証番号:001-P01563)を受けた特定無線設備を内蔵しています。】
もしくは
② 技適マーク+モジュールの電波法の認証番号を製品上への表示 および 下記文言の表示
【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。】
****

<FCC>
FCC ID: VPYLB1YM

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

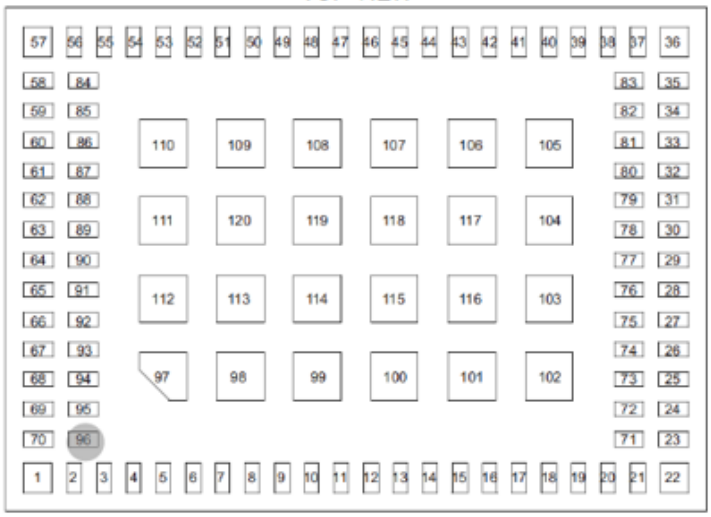
The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The 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.

Pin Layout

<TOP VIEW>



No.	Terminal Name	No.	Terminal Name	No.	Terminal Name
1	GND	29	GND	57	GND
2	GPIO[24]	30	PMIC_EN	58	GND
3	GPIO[3]	31	GPIO[21]	59	WLAN_RF_A
4	GPIO[2]	32	PCIE_WAKE_N	60	GND
5	GPIO[17]	33	GPIO[5]	61	GPIO[6]
6	GPIO[16]	34	DNC	62	GPIO[9]
7	GPIO[15]	35	DNC	63	GPIO[8]
8	GPIO[14]	36	GND	64	GPIO[13]
9	VIO	37	GND	65	GPIO[10]
10	GPIO[20]	38	GND	66	GPIO[11]
11	GPIO[25]	39	PCIE_RXP	67	GPIO[12]
12	GND	40	PCIE_RXN	68	GND
13	DM	41	PCIE_TXP	69	WLAN_RF_B
14	DP	42	PCIE_TXN	70	GND
15	GND	43	PCIE_CLKP	71	GPIO[26]
16	VIO_SD	44	PCIE_CLKN	72	GPIO[27]
17	AVDD33	45	GND	73	GPIO[18]
18	SD_D1	46	GPIO[4]	74	GND
19	SD_D0	47	GPIO[0]	75	VBAT
20	SD_CLK	48	DNC	76	VBAT
21	SD_CMD	49	DNC	77	GND
22	GND	50	AVDD18	78	GPIO[1]
23	SD_D3	51	DNC	79	GPIO[23]
24	SD_D2	52	CONFIG_HOST_3	80	GPIO[22]
25	GPIO[19]	53	CONFIG_HOST_2	81	GPIO[7]
26	GND	54	CONFIG_HOST_1	82	PCIE_CLKREQ_N
27	VBAT	55	CONFIG_HOST_0	83	DNC
28	VBAT	56	SLP_CLK	84-120	GND

Supply Voltage

DUT PIN Name	Min.	Typ.	Max.	unit
VBAT *	2.7	3.3	5.5	V
VIO	1.62 2.25 2.97	1.8 2.5 3.3	1.98 2.75 3.47	V
VIO_SD	1.62 2.97	1.8 3.3	1.98 3.47	V
AVDD33	2.97	3.3	3.47	V
VDDIO_AO *	3.14 / 1.71	3.3 / 1.8	3.46 / 1.89	V

*VBAT: Only this power supply affects the RF characteristics.

Power Level 2.4GHz WLAN

SISO, MIMO, Simultaneous transmission
Per Antenna port

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11b	2.4GHz	1~11	All Rate	13.0 ± 2.0
IEEE 802.11g	2.4GHz	1, 2, 10, 11	All Rate	10.0 ± 2.0
		3~9	6Mbps, 9Mbps, 12Mbps, 18Mbps	16.0 ± 2.0
			24Mbps, 36Mbps, 48Mbps, 54Mbps	13.0 ± 2.0
IEEE 802.11n(HT20)	2.4GHz	1, 2, 10, 11	All Rate	10.0 ± 2.0
		3~9	MCS0~MCS2	15.0 ± 2.0
			MCS3~MCS7	12.0 ± 2.0
IEEE 802.11ac(VHT20)	2.4GHz	1, 2, 10, 11	All Rate	10.0 ± 2.0
		3~9	VHT_SS1_MCS0~VHT_SS1_MCS2	15.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	12.0 ± 2.0
			VHT_SS1_MCS8	11.0 ± 2.0

Power Level 2.4GHz BT/BLE

Mode	MAXIMUM TUNE UP TOLERANCE [dBm]
BR	3.0 ± 3.0
EDR	0.0 ± 3.0
LE	3.0 ± 3.0
LE 2Mbps	3.0 ± 3.0

Power Level 5GHz WLAN

SISO, MIMO, Simultaneous transmission
Per Antenna port

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11a	W52	36~48	All Rate	8.0 ± 2.0
	W53	52~60	6Mbps, 9Mbps, 12Mbps, 18Mbps	14.0 ± 2.0
		3~9 64	24Mbps, 36Mbps, 48Mbps, 54Mbps	12.0 ± 2.0
			All Rate	10.0 ± 2.0
	W56	100	All Rate	9.0 ± 2.0
		104~136, 144	6Mbps, 9Mbps, 12Mbps, 18Mbps	14.0 ± 2.0
			24Mbps, 36Mbps, 48Mbps, 54Mbps	10.0 ± 2.0
		140	All Rate	7.0 ± 2.0
	W58	149~165	6Mbps, 9Mbps, 12Mbps, 18Mbps	15.0 ± 2.0
			24Mbps, 36Mbps, 48Mbps, 54Mbps	12.0 ± 2.0

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11n(HT20)	W52	36~48	All Rate	8.0 ± 2.0
	W53	52~60	MCS0~MCS2	14.0 ± 2.0
			MCS3~MCS7	11.0 ± 2.0
		64	All Rate	10.0 ± 2.0
	W56	100	All Rate	9.0 ± 2.0
		104~136, 144	MCS0~MCS2	14.0 ± 2.0
			MCS3~MCS7	11.0 ± 2.0
		140	All Rate	7.0 ± 2.0
	W58	149~165	MCS0~MCS2	15.0 ± 2.0
			MCS3~MCS7	11.0 ± 2.0

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11n(HT40)	W52	38	All Rate	7.0 ± 2.0
		46	All Rate	10.0 ± 2.0
	W53	54	MCS0~MCS2	13.0 ± 2.0
			MCS3~MCS7	11.0 ± 2.0
		62	All rate	7.0 ± 2.0
	W56	102	All Rate	7.0 ± 2.0
		110~126,142	MCS0~MCS2	13.0 ± 2.0
			MCS3~MCS7	11.0 ± 2.0
		134	All Rate	10.0 ± 2.0
	W58	151	MCS0~MCS2	13.0 ± 2.0
		159	MCS3~MCS7	14.0 ± 2.0
		151~159	All Rate	11.0 ± 2.0

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11ac(VHT20)	W52	36~48	All Rate	8.0 ± 2.0
	W53	52~60	VHT_SS1_MCS0~VHT_SS1_MCS2	14.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8	10.0 ± 2.0
		64	All Rate	9.0 ± 2.0
	W56	100	All Rate	9.0 ± 2.0
		104~144	VHT_SS1_MCS0~VHT_SS1_MCS2	14.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8	10.0 ± 2.0
	W58	149~165	VHT_SS1_MCS0~VHT_SS1_MCS2	15.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8	10.0 ± 2.0

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11ac(VHT40)	W52	38	All Rate	7.0 ± 2.0
		46	All Rate	10.0 ± 2.0
	W53	54	VHT_SS1_MCS0~VHT_SS1_MCS2	13.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8, VHT_SS1_MCS9	10.0 ± 2.0
		62	All rate	7.0 ± 2.0
	W56	102	All Rate	7.0 ± 2.0
		110~142	VHT_SS1_MCS0~VHT_SS1_MCS2	13.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8, VHT_SS1_MCS9	10.0 ± 2.0
	W58	151~159	VHT_SS1_MCS0~VHT_SS1_MCS2	13.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8, VHT_SS1_MCS9	10.0 ± 2.0

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11ac(VHT80)	W52	42	All Rate	5.0 ± 2.0
	W53	58	All rate	5.0 ± 2.0
	W56	106	All Rate	5.0 ± 2.0
		122, 138	VHT_SS1_MCS0~VHT_SS1_MCS2	12.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8, VHT_SS1_MCS9	10.0 ± 2.0
	W58	155	VHT_SS1_MCS0~VHT_SS1_MCS2	13.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8, VHT_SS1_MCS9	10.0 ± 2.0

Theory of Operation

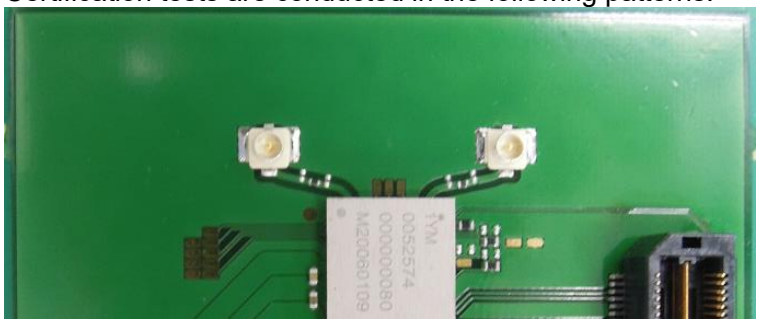
Frequency of Operation			Scan	Ad-hoc mode
2.4GHz	11b/g/n (HT20)/ac(VHT20)	2412-2462MHz	Active	Yes
W52	11a/n/ac ((V)HT20)	5180-5240MHz	Active	Yes
	11n/ac ((V)HT40)	5190-5230MHz	Active	Yes
	11ac (VHT80)	5210MHz	Active	Yes
W53	11a/n/ac ((V)HT20)	5260-5320MHz	Passive	No
	11n/ac ((V)HT40)	5270-5310MHz	Passive	No
	11ac (VHT80)	5290MHz	Passive	No
W56	11a/n/ac ((V)HT20)	5500-5720MHz (*ISED:5600-5650MHz disable)	Passive	No
	11n/ac ((V)HT40)	5510-5710MHz (*ISED:5600-5650MHz disable)	Passive	No
	11ac (VHT80)	5530-5690MHz (*ISED:5600-5650MHz disable)	Passive	No
W58	11a/n/ac ((V)HT20)	5745-5825MHz	Active	Yes
	11n/ac ((V)HT40)	5755-5795MHz	Active	Yes
	11ac (VHT80)	5775MHz	Active	Yes

Antenna

No.	Maker	Support Antenna						
		P/N	Form factor	Type	Gain		Size	Detail
					2.4GHz	5GHz		
1	Molex	146153	u.FL/flexible	Dipole	3.2	4.25	35x9x0.1mm	Flexible//horizontal
2	Molex	146187	u.FL/flexible	Dipole	3.4	4.75	40.95x9x0.7mm	Rigid//horizontal

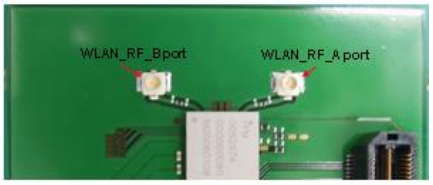
Do not mix two antenna ports with the P/N of another antenna.
There is only one set of trace line patterns between the U.FL connector and the module RF OUT PIN.

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



The 50ohm microstrip line needs to be copied
when module is installed in the End product.
Murata provides set makers with Gerber data or something similar.

Port Name



JIG ANT port name	Function
WLAN_RF_A port	WLAN
WLAN_RF_B port	WLAN and BT(LE)

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

Contains Transmitter Module FCC ID:VPYLB1YM

or

Contains FCC ID: VPYLB1YM

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 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

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

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. Type1VY 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.

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

<ISED>
HVIN：LBEE5XV1YM
PMN：LBEE5XV1YM
IC Number: 772C-LB1YM

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-LB1YM

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

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.
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.

This radio transmitter (IC Number : 772C-LB1YM) 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. Chain0 & Chain1 : 2.4GHz 146153 Dual Dipole antenna Gain: +3.2 dBi : 5GHz 146153 Dual Dipole antenna Gain: +4.25 dBi : 2.4GHz 146187 Dual Dipole antenna Gain: +3.4 dBi : 5GHz 146187 Dual Dipole antenna Gain: +4.75 dBi
Le présent émetteur radio (IC Number : 772C-LB1YM) 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 Chain0 & Chain1 : 2.4GHz 146153 Dual Dipole antenna Gain: +3.2 dBi : 5GHz 146153 Dual Dipole antenna Gain: +4.25 dBi : 2.4GHz 146187 Dual Dipole antenna Gain: +3.4 dBi : 5GHz 146187 Dual Dipole antenna Gain: +4.75 dBi

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;

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.
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.

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.
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.

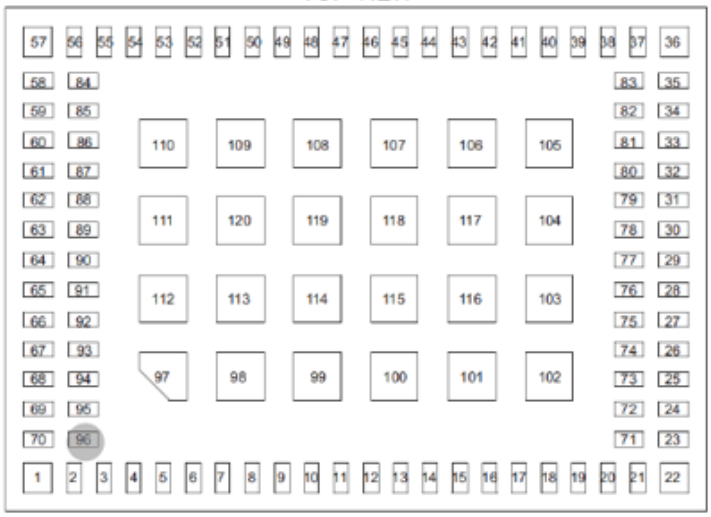
The available scientific evidence does not show that any health problems are associated with using low power wireless devices. There is no proof, however, that these low power wireless devices are absolutely safe. Low power Wireless devices emit low levels of radio frequency energy (RF) in the microwave 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. Type1VY 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.
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. Type1VY 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.

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.

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

Pin Layout

<TOP VIEW>



No.	Terminal Name	No.	Terminal Name	No.	Terminal Name
1	GND	29	GND	57	GND
2	GPIO[24]	30	PMIC_EN	58	GND
3	GPIO[3]	31	GPIO[21]	59	WLAN_RF_A
4	GPIO[2]	32	PCIE_WAKE_N	60	GND
5	GPIO[17]	33	GPIO[5]	61	GPIO[6]
6	GPIO[16]	34	DNC	62	GPIO[9]
7	GPIO[15]	35	DNC	63	GPIO[8]
8	GPIO[14]	36	GND	64	GPIO[13]
9	VIO	37	GND	65	GPIO[10]
10	GPIO[20]	38	GND	66	GPIO[11]
11	GPIO[25]	39	PCIE_RXP	67	GPIO[12]
12	GND	40	PCIE_RXN	68	GND
13	DM	41	PCIE_TXP	69	WLAN_RF_B
14	DP	42	PCIE_TXN	70	GND
15	GND	43	PCIE_CLKP	71	GPIO[26]
16	VIO_SD	44	PCIE_CLKN	72	GPIO[27]
17	AVDD33	45	GND	73	GPIO[18]
18	SD_D1	46	GPIO[4]	74	GND
19	SD_D0	47	GPIO[0]	75	VBAT
20	SD_CLK	48	DNC	76	VBAT
21	SD_CMD	49	DNC	77	GND
22	GND	50	AVDD18	78	GPIO[1]
23	SD_D3	51	DNC	79	GPIO[23]
24	SD_D2	52	CONFIG_HOST_3	80	GPIO[22]
25	GPIO[19]	53	CONFIG_HOST_2	81	GPIO[7]
26	GND	54	CONFIG_HOST_1	82	PCIE_CLKREQ_N
27	VBAT	55	CONFIG_HOST_0	83	DNC
28	VBAT	56	SLP_CLK	84-120	GND

Supply Voltage

DUT PIN Name	Min.	Typ.	Max.	unit
VBAT *	2.7	3.3	5.5	V
VIO	1.62 2.25 2.97	1.8 2.5 3.3	1.98 2.75 3.47	V
VIO_SD	1.62 2.97	1.8 3.3	1.98 3.47	V
AVDD33	2.97	3.3	3.47	V
VDDIO_AO *	3.14 / 1.71	3.3 / 1.8	3.47 / 1.89	V

*VBAT: Only this power supply affects the RF characteristics.

Power Level 2.4GHz WLAN

SISO, MIMO, Simultaneous transmission
Per Antenna port

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11b	2.4GHz	1~11	All Rate	13.0 ± 2.0
IEEE 802.11g	2.4GHz	1, 2, 10, 11	All Rate	10.0 ± 2.0
		3~9	6Mbps, 9Mbps, 12Mbps, 18Mbps	16.0 ± 2.0
			24Mbps, 36Mbps, 48Mbps, 54Mbps	13.0 ± 2.0
IEEE 802.11n(HT20)	2.4GHz	1, 2, 10, 11	All Rate	10.0 ± 2.0
		3~9	MCS0~MCS2	15.0 ± 2.0
			MCS3~MCS7	12.0 ± 2.0
IEEE 802.11ac(VHT20)	2.4GHz	1, 2, 10, 11	All Rate	10.0 ± 2.0
		3~9	VHT_SS1_MCS0~VHT_SS1_MCS2	15.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	12.0 ± 2.0
			VHT_SS1_MCS8	11.0 ± 2.0

Power Level 2.4GHz BT/BLE

Mode	MAXIMUM TUNE UP TOLERANCE [dBm]
BR	3.0 ± 3.0
EDR	0.0 ± 3.0
LE	3.0 ± 3.0
LE 2Mbps	3.0 ± 3.0

Power Level 5GHz WLAN

SISO, MIMO, Simultaneous transmission
Per Antenna port

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11a	W52	36~48	All Rate	8.0 ± 2.0
	W53	52~60	6Mbps, 9Mbps, 12Mbps, 18Mbps	14.0 ± 2.0
		3~9 64	24Mbps, 36Mbps, 48Mbps, 54Mbps	12.0 ± 2.0
			All Rate	10.0 ± 2.0
	W56	100	All Rate	9.0 ± 2.0
		104~136, 144 Not include 120~128	6Mbps, 9Mbps, 12Mbps, 18Mbps	14.0 ± 2.0
			24Mbps, 36Mbps, 48Mbps, 54Mbps	10.0 ± 2.0
		140	All Rate	7.0 ± 2.0
	W58	149~165	6Mbps, 9Mbps, 12Mbps, 18Mbps	15.0 ± 2.0
			24Mbps, 36Mbps, 48Mbps, 54Mbps	12.0 ± 2.0

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11n(HT20)	W52	36~48	All Rate	8.0 ± 2.0
	W53	52~60	MCS0~MCS2	14.0 ± 2.0
			MCS3~MCS7	11.0 ± 2.0
		64	All Rate	10.0 ± 2.0
	W56	100	All Rate	9.0 ± 2.0
		104~136, 144 Not include 120~128	MCS0~MCS2	14.0 ± 2.0
			MCS3~MCS7	11.0 ± 2.0
		140	All Rate	7.0 ± 2.0
	W58	149~165	MCS0~MCS2	15.0 ± 2.0
			MCS3~MCS7	11.0 ± 2.0

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11n(HT40)	W52	38	All Rate	7.0 ± 2.0
		46	All Rate	10.0 ± 2.0
	W53	54	MCS0~MCS2	13.0 ± 2.0
			MCS3~MCS7	11.0 ± 2.0
		62	All rate	7.0 ± 2.0
	W56	102	All Rate	7.0 ± 2.0
		110,142	MCS0~MCS2	13.0 ± 2.0
			MCS3~MCS7	11.0 ± 2.0
		134	All Rate	10.0 ± 2.0
	W58	151	MCS0~MCS2	13.0 ± 2.0
		159	MCS3~MCS7	14.0 ± 2.0
		151~159	All Rate	11.0 ± 2.0

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11ac(VHT20)	W52	36~48	All Rate	8.0 ± 2.0
	W53	52~60	VHT_SS1_MCS0~VHT_SS1_MCS2	14.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8	10.0 ± 2.0
		64	All Rate	9.0 ± 2.0
	W56	100	All Rate	9.0 ± 2.0
		104~144 Not include 120~128	VHT_SS1_MCS0~VHT_SS1_MCS2	14.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8	10.0 ± 2.0
	W58	149~165	VHT_SS1_MCS0~VHT_SS1_MCS2	15.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8	10.0 ± 2.0

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11ac(VHT40)	W52	38	All Rate	7.0 ± 2.0
		46	All Rate	10.0 ± 2.0
	W53	54	VHT_SS1_MCS0~VHT_SS1_MCS2	13.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8, VHT_SS1_MCS9	10.0 ± 2.0
		62	All rate	7.0 ± 2.0
	W56	102	All Rate	7.0 ± 2.0
		110,134,142	VHT_SS1_MCS0~VHT_SS1_MCS2	13.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8, VHT_SS1_MCS9	10.0 ± 2.0
	W58	151~159	VHT_SS1_MCS0~VHT_SS1_MCS2	13.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8, VHT_SS1_MCS9	10.0 ± 2.0

mode	Band	Channel	Rate	MAXIMUM TUNE UP TOLERANCE [dBm]
IEEE 802.11ac(VHT80)	W52	42	All Rate	5.0 ± 2.0
	W53	58	All rate	5.0 ± 2.0
	W56	106	All Rate	5.0 ± 2.0
		138	VHT_SS1_MCS0~VHT_SS1_MCS2	12.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8, VHT_SS1_MCS9	10.0 ± 2.0
	W58	155	VHT_SS1_MCS0~VHT_SS1_MCS2	13.0 ± 2.0
			VHT_SS1_MCS3~VHT_SS1_MCS7	11.0 ± 2.0
			VHT_SS1_MCS8, VHT_SS1_MCS9	10.0 ± 2.0

Theory of Operation

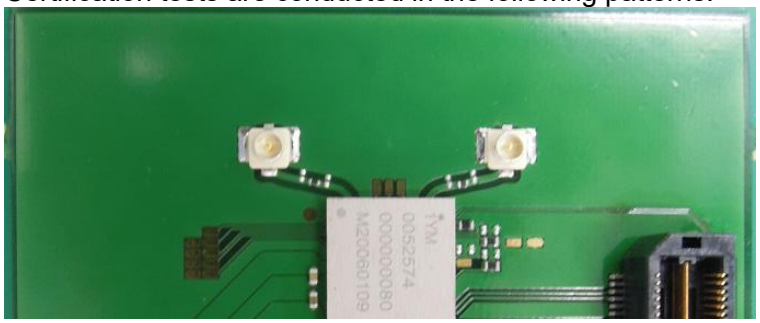
Frequency of Operation			Scan	Ad-hoc mode
2.4GHz	11b/g/n (HT20)/ac(VHT20)	2412-2462MHz	Active	Yes
W52	11a/n/ac ((V)HT20)	5180-5240MHz	Active	Yes
	11n/ac ((V)HT40)	5190-5230MHz	Active	Yes
	11ac (VHT80)	5210MHz	Active	Yes
W53	11a/n/ac ((V)HT20)	5260-5320MHz	Passive	No
	11n/ac ((V)HT40)	5270-5310MHz	Passive	No
	11ac (VHT80)	5290MHz	Passive	No
W56	11a/n/ac ((V)HT20)	5500-5720MHz (*ISED:5600-5650MHz disable)	Passive	No
	11n/ac ((V)HT40)	5510-5710MHz (*ISED:5600-5650MHz disable)	Passive	No
	11ac (VHT80)	5530-5690MHz (*ISED:5600-5650MHz disable)	Passive	No
W58	11a/n/ac ((V)HT20)	5745-5825MHz	Active	Yes
	11n/ac ((V)HT40)	5755-5795MHz	Active	Yes
	11ac (VHT80)	5775MHz	Active	Yes

Antenna

No.	Maker	Support Antenna						
		P/N	Form factor	Type	Gain		Size	Detail
					2.4GHz	5GHz		
1	Molex	146153	u.FL/flexible	Dipole	3.2	4.25	35x9x0.1mm	Flexible//horizontal
2	Molex	146187	u.FL/flexible	Dipole	3.4	4.75	40.95x9x0.7mm	Rigid//horizontal

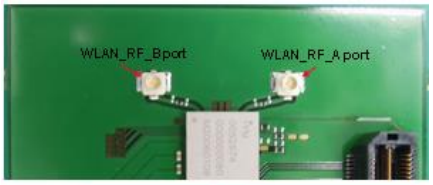
Do not mix two antenna ports with the P/N of another antenna.
There is only one set of trace line patterns between the U.FL connector and the module RF OUT PIN.

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



The 50ohm microstrip line needs to be copied
when module is installed in the End product.
Murata provides set makers with Gerber data or something similar.

Port Name



JIG ANT port name	Function
WLAN_RF_A port	WLAN
WLAN_RF_B port	WLAN and BT(LE)