

# W-LAN+Bluetooth Combo Module Data Sheet

**NXP 88W9098 Chipset**  
**for 802.11a/b/g/n/ac/ax 2x2 MIMO + Bluetooth 5.2**

**Design Name: Type1XL**  
**Module P/N : LBEE5ZZ1XL-774**  
**Sample P/N : LBEE5ZZ1XL-SMP**


## Revision History

Rev Code	Date	Description	Comments
-	Nov. 20 2020	First Issue	
A	Mar. 15 2021	5. Dimensions, Marking and Terminal Configurations 6.1. Pin Assignments	-Changed module size and pin function information.
B	Mar. 29 2021	5. Dimensions, Marking and Terminal Configurations 6.2. Pin Descriptions	-Changed module height and pin function information.
C	Apr. 5 2021	5. Dimensions, Marking and Terminal Configurations	-Corrected e5 value from 1.09 to 1.10mm.
D	Apr. 28 2021	5. Dimensions, Marking and Terminal Configurations 12. Reference Circuit	-Added Marking information. -Added reference circuit.
E	May 5 2021	6.2. Pin Descriptions	-Corrected pin description
F	Jun. 14, 2021	5. Dimensions, Marking and Terminal Configurations	-Modified Marking information.
G	Oct.18, 2021	1. Scope 2. Key Features 3. Part Number 6. Dimensions, Marking and Terminal Configurations 7.1 Pin Assignments 7.2 Pin Descriptions 7.3 Configuration Pins 7.4 Pin State 7.5 SDIO Pin Descriptions 12. Land patterns	-Updated Bluetooth version -Added a new section -Added MP part number -Updated terminal size and dimensions. -Updated a diagram and Pin 235-238 -Updated Pin 235-238 and Pin 68 -Added a new section -Added a new section -Added a new section -Added Land patter figure
H	Feb. 01, 2022	4. Block Diagram 9.1 Operating Conditions 7.4 Pin States 13. Reference Circuit	-Removed sleep clock input -Defined IO Current -Added PDn -Applied change of Pin 235-238 and Pin 68.

## TABLE OF CONTENTS

1. Scope .....	5
2. Key Features .....	5
3. Part Number .....	5
4. Block Diagram .....	5
5. Certification Information .....	6
5.1. Radio Certification .....	6
5.2. Bluetooth® Qualification .....	6
6. Dimensions, Marking and Terminal Configurations .....	7
7. Module Pin Descriptions .....	8
7.1. Pin Assignments .....	8
7.2. Pin Descriptions .....	10
7.3. Configuration Pins .....	13
7.4. Pin States .....	13
7.5. SDIO Pin Descriptions .....	14
8. Rating .....	15
9. Operating Condition .....	15
9.1. Operating condition .....	15
10. Power-Up / Power-Down Sequence .....	16
10.1. Power-Up Sequence .....	16
10.2. Power-Down Sequence .....	17
11. DC / RF Characteristics .....	18
11.1. DC/RF Characteristics for IEEE802.11b - 2.4GHz .....	18
11.1.1. High Rate Condition for IEEE802.11b – 2.4GHz .....	18
11.1.2. Low Rate Condition for IEEE802.11b – 2.4GHz .....	19
11.2. DC/RF Characteristics for IEEE802.11g - 2.4GHz .....	20
11.2.1. High Rate Condition for IEEE802.11g – 2.4GHz .....	20
11.2.2. Low Rate Condition for IEEE802.11g – 2.4GHz .....	21
11.3. DC/RF Characteristics for IEEE802.11n - 2.4GHz .....	22
11.3.1. High Rate Condition for IEEE802.11n – 2.4GHz .....	22
11.3.2. Low Rate Condition for IEEE802.11n – 2.4GHz .....	23
11.4. DC/RF Characteristics for IEEE802.11ax - 2.4GHz .....	24
11.4.1. High Rate Condition for IEEE802.11ax – 2.4GHz .....	24
11.4.2. Low Rate Condition for IEEE802.11ax – 2.4GHz .....	25
11.5. DC/RF Characteristics for IEEE802.11a - 5GHz .....	26
11.5.1. High Rate Condition for IEEE802.11a – 5GHz .....	26
11.5.2. Low Rate Condition for IEEE802.11a – 5GHz .....	27
11.6. DC/RF Characteristics for IEEE802.11n(HT20) - 5GHz .....	28
11.6.1. High Rate Condition for IEEE802.11n(HT20) – 5GHz .....	28
11.6.2. Low Rate Condition for IEEE802.11n(HT20) – 5GHz .....	29
11.7. DC/RF Characteristics for IEEE802.11ac(HT20) - 5GHz .....	30
11.7.1. High Rate Condition for IEEE802.11ac(VHT20) – 5GHz .....	30
11.7.2. Low Rate Condition for IEEE802.11ac(VHT20) – 5GHz .....	31
11.8. DC/RF Characteristics for IEEE802.11n(HT 40MHz) - 5GHz .....	32
11.8.1. High Rate Condition for IEEE802.11n(HT40) – 5GHz .....	32
11.8.2. Low Rate Condition for IEEE802.11n(HT40) – 5GHz .....	33
11.9. DC/RF Characteristics for IEEE802.11ac(VHT 40MHz) - 5GHz .....	34
11.9.1. High Rate Condition for IEEE802.11ac(VHT40) – 5GHz .....	34
11.9.2. Low Rate Condition for IEEE802.11ac(VHT40) – 5GHz .....	35
11.10. DC/RF Characteristics for IEEE802.11ac(VHT 80MHz)-5GHz .....	36
11.10.1. High Rate Condition for IEEE802.11ac(VHT80) – 5GHz .....	36
11.10.2. Low Rate Condition for IEEE802.11ac(VHT80) – 5GHz .....	37
11.11. DC/RF Characteristics for IEEE802.11ax(HE 20MHz)-5GHz .....	38
11.11.1. High Rate Condition for IEEE802.11ax(HE20) – 5GHz .....	38
11.11.2. Low Rate Condition for IEEE802.11ax(HE20) – 5GHz .....	39
11.12. DC/RF Characteristics for IEEE802.11ax(HE 40MHz)-5GHz .....	40
11.12.1. High Rate Condition for IEEE802.11ax(HE40) – 5GHz .....	40

11.12.2. Low Rate Condition for IEEE802.11ax(HE40) – 5GHz.....	41
11.13. DC/RF Characteristics for IEEE802.11ax(HE 80MHz)-5GHz .....	42
11.13.1. High Rate Condition for IEEE802.11ax(HE80) – 5GHz.....	42
11.13.2. Low Rate Condition for IEEE802.11ax(HE80) – 5GHz.....	43
11.14. DC/RF Characteristics for Bluetooth .....	44
11.14.1. Basic Data Rate Condition .....	44
11.14.2. Enhanced Data Rate Condition .....	45
11.15. DC/RF Characteristics for Bluetooth Low Energy .....	46
11.15.1. 1Mbps PHY Condition .....	46
11.15.2. 2Mbps PHY Condition .....	47
12. Land Patterns .....	48
13. Reference Circuit.....	49
14. Tape and Reel Packing .....	50
15. NOTICE .....	53
15.1. Storage Conditions: .....	53
15.2. Handling Conditions: .....	53
15.3. Standard PCB Design (Land Pattern and Dimensions):.....	53
15.4. Notice for Chip Placer:.....	53
15.5. Soldering Conditions: .....	54
15.6. Cleaning:.....	54
15.7. Operational Environment Conditions: .....	54
16. Precondition to use our products .....	55

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

## 1. Scope

This specification is applied to the IEEE802.11 a/b/g/n/ac/ax + Bluetooth 5.2 module.

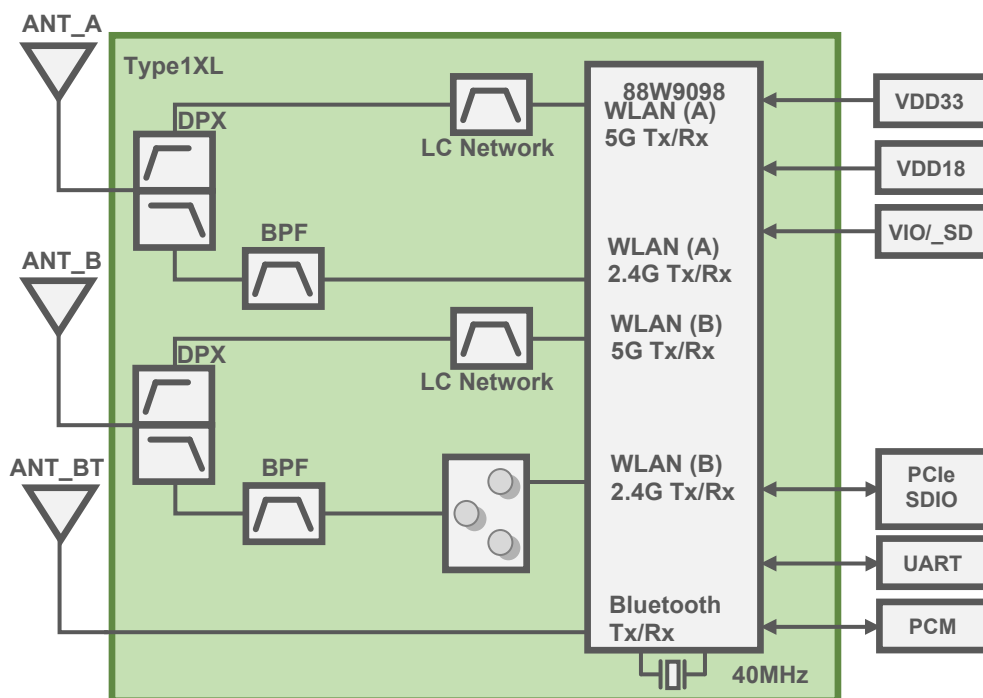
## 2. Key Features

- Module Size : 19.1mm x 16.5mm x 2.1(max.)mm
- Host Interface
  - WLAN : PCIe / SDIO
  - Bluetooth : UART
- IC P/N : NXP 88W9098
- Reference Clock : Reference clock embedded
- Weight : 1355 mg
- MSL : 3 (TBD)
- RoHS : This component can meet with RoHS compliance.

## 3. Part Number

Ordering Part Number	Description
LBEE5ZZ1XL-774	MP order
LBEE5ZZ1XL-SMP	In case of sample order

## 4. Block Diagram



## **5. Certification Information**

### **5.1. Radio Certification**

#### **USA/Canada**

FCC ID : TBD

IC : TBD

\*Please follow installation manual of Appendix

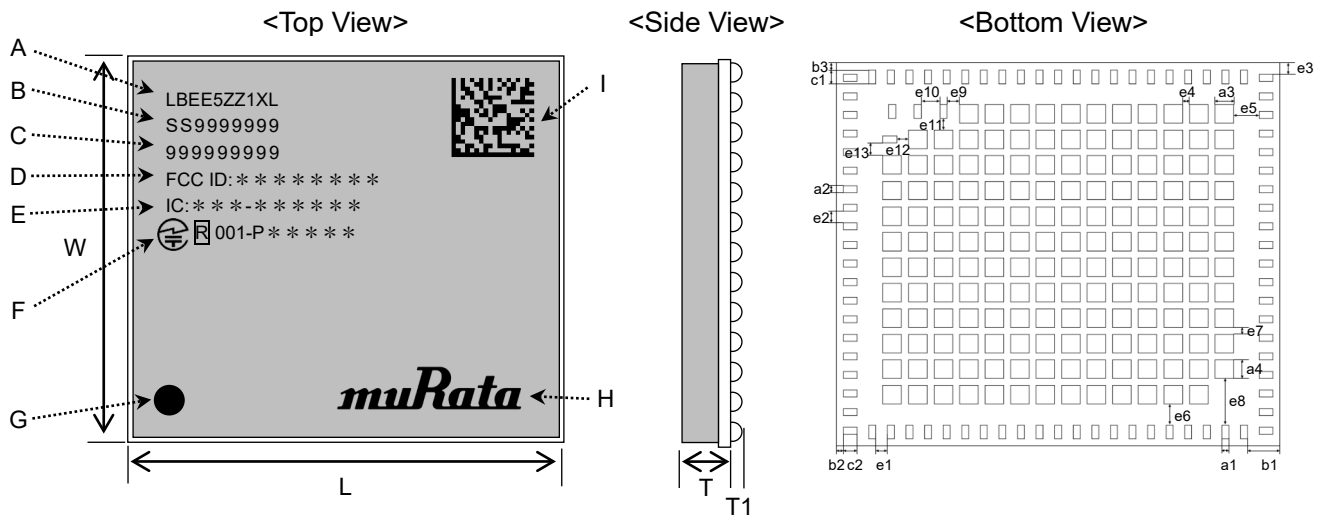
#### **Europe**

TBD

### **5.2. Bluetooth® Qualification**

TBD

## 6. Dimensions, Marking and Terminal Configurations



Marking	Meaning
A	Module Type
B	Production Process Number
C	Serial Number
D	FCC ID
E	ISED ID
F	Japan certification mark & ID
G	Pin-1 Marking
H	Murata Logo
I	2D code

Mark	Dimensions	Mark	Dimensions	Mark	Dimensions
L	19.1 +/- 0.2	W	16.5 +/- 0.2	T	2.1 max
T1	TBD	a1	0.3 +/- 0.1	a2	0.3 +/- 0.1
a3	0.8 +/- 0.1	a4	0.8 +/- 0.1	b1	1.4 +/- 0.2
b2	0.3 +/- 0.2	b3	0.5 +/- 0.2	c1	0.6 +/- 0.1
c2	0.6 +/- 0.1	e1	0.5 +/- 0.1	e2	0.5 +/- 0.1
e3	0.5 +/- 0.2	e4	0.3 +/- 0.1	e5	1.1 +/- 0.1
e6	0.9 +/- 0.1	e7	0.3 +/- 0.1	e8	2.0 +/- 0.1
e9	0.5 +/- 0.1	e10	0.8 +/- 0.1	e11	0.5 +/- 0.1
e12	0.5 +/- 0.1	e13	0.55 +/- 0.1	—	—

(unit : mm)





No.	Terminal Name	No.	Terminal Name	No.	Terminal Name
1	GND	31	GND	61	GPIO[26]
2	GND	32	NC	62	GPIO[27]
3	CONFIG_HOST[0]	33	NC	63	GND
4	CONFIG_HOST[1]	34	GND	64	GND
5	CONFIG_HOST[2]	35	VIO_SD	65	BT_RF_OUT
6	GPIO[1]	36	SD_CLK	66	GND
7	GPIO[0]	37	SD_CMD	67	GND
8	GPIO[14]	38	SD_D[0]	68	NC
9	GPIO[4]	39	SD_D[1]	69	GND
10	GPIO[6]	40	SD_D[2]	70	GPIO[22]
11	GPIO[5]	41	GND	71	GPIO[23]
12	GPIO[7]	42	SD_D[3]	72	GPIO[19]
13	GPIO[16]	43	PCIE_PERST_N	73	GPIO[18]
14	GPIO[15]	44	PCIE_CLKREQ_N	74	GPIO[17]
15	PDn	45	PCIE_WAKE_N	75	GND
16	GND	46	W_DISABLE1N	76	WL_B_ANT/ WL_B_BT_ANT
17	VDD33	47	GPIO[31]	77	GND
18	VDD33	48	GPIO[29]	78	GND
19	VIO	49	GPIO[30]	79	GND
20	VDD18	50	GPIO[28]	80	WL_A_ANT
21	VDD18	51	GPIO[3]	81	GND
22	GND	52	GPIO[2]	82	GND
23	PCIE_CLK_N	53	GPIO[11]	83-234	GND
24	PCIE_CLK_P	54	GPIO[10]	235	RF_CNTL0_N
25	GND	55	GPIO[9]	236	RF_CNTL3_P
26	PCIE_TX_P	56	GPIO[8]	237	RF_CNTL2_N
27	PCIE_TX_N	57	GPIO[12]	238	RF_CNTL1_P
28	GND	58	GPIO[13]	239-248	GND
29	PCIE_RX_N	59	GPIO[24]	249	NC
30	PCIE_RX_P	60	GPIO[25]	-	-

## 7.2. Pin Descriptions

No.	Terminal Name	Type	Power Supply	Description
(1)	GND	GND	-	Ground
(2)	GND	GND	-	Ground
(3)	CONFIG_HOST[0]	I	VDD18	Host configuration options. Selects the host interface used for Wi-Fi and Bluetooth. See section 7.3. Internal pull-up
(4)	CONFIG_HOST[1]	I	VDD18	Host configuration options. Selects the host interface used for Wi-Fi and Bluetooth. See section 7.3. Internal pull-up
(5)	CONFIG_HOST[2]	I	VDD18	Host configuration options. Selects the host interface used for Wi-Fi and Bluetooth. See section 7.3. Internal pull-down(51k ohm) on this pin
(6)	GPIO[1]	I/O	VIO	GPIO[1]
(7)	GPIO[0]	I/O	VIO	GPIO[0]
(8)	GPIO[14]	I/O	VIO	CONFIG_AUTO_REF_DET GPIO[14] Internal pull-down(51k ohm) on this pin Keep open or input level high until finished power up sequence.
(9)	GPIO[4]	I/O	VIO	PCM Mode: Receive PCM input. I2S Mode: Receive I2S input. GPIO[4]
(10)	GPIO[6]	I/O	VIO	PCM Mode: PCM Clock I2S Mode: I2S bit clock. - Output if master - Input if slave GPIO[6]
(11)	GPIO[5]	I/O	VIO	PCM Mode: Transmit PCM output. I2S Mode: Transmit I2S output. GPIO[5]
(12)	GPIO[7]	I/O	VIO	PCM Mode: PCM frame sync. I2S Mode: I2S left-right clock. - Output if master - Input if slave GPIO[7]
(13)	GPIO[16]	I/O	VIO	GPIO[16] Keep open or input level high until finished power up sequence.
(14)	GPIO[15]	I/O	VIO	GPIO[15] Keep open or input level high until finished power up sequence.
(15)	PDn	I	VDD18	Full power-down (input) (active low) · 0 = full power-down mode · 1 = normal operation mode - PDn can accept an input of 1.8V to 4.5V - PDn may be driven by the host - PDn must be high for normal operation No internal pull-up on this pin. Connect to power down pin (GPIO) of host or tie to power rail. External host required to drive this pin high for normal operation mode.
(16)	GND	GND	-	Ground
(17)	VDD33	P	-	3.3V Voltage Input
(18)	VDD33	P	-	3.3V Voltage Input
(19)	VIO	P	-	1.8V/3.3V Digital I/O Power Supply
(20)	VDD18	P	-	1.8V Voltage Input
(21)	VDD18	P	-	1.8V Voltage Input
(22)	GND	GND	-	Ground
(23)	PCIE_CLK_N	I	VDD18	PCI Express Differential Clock Input—Negative
(24)	PCIE_CLK_P	I	VDD18	PCI Express Differential Clock Input—Positive
(25)	GND	GND	-	Ground
(26)	PCIE_TX_P	O	VDD18	PCI Express Transmit Data—Positive
(27)	PCIE_TX_N	O	VDD18	PCI Express Transmit Data—Negative
(28)	GND	GND	-	Ground
(29)	PCIE_RX_N	I	VDD18	PCI Express Receive Data—Negative

(30)	PCIE_RX_P	I	VDD18	PCI Express Receive Data—Positive
(31)	GND	GND	-	Ground
(32)	NC	-	-	No Connection
(33)	NC	-	-	No Connection
(34)	GND	GND	-	Ground
(35)	VIO_SD	P	-	1.8V/3.3V Digital I/O SDIO power supply • For SDIO ultra-high speed mode (25 to 208 MHz), VIO_SD must be 1.8V. • For SDIO default mode (up to 25 MHz) and high-speed mode (up to 50 MHz), VIO_SD must be 1.8V or 3.3V.
(36)	SD_CLK	I	VIO_SD	<b>SDIO 4-bit Mode:</b> Clock input <b>SDIO 1-bit Mode:</b> Clock input Internal pull-up
(37)	SD_CMD	I/O	VIO_SD	<b>SDIO 4-bit Mode:</b> Command/response (input/output) <b>SDIO 1-bit Mode:</b> Command line Internal pull-up
(38)	SD_D[0]	I/O	VIO_SD	<b>SDIO 4-bit Mode:</b> Data line Bit[0] <b>SDIO 1-bit Mode:</b> Data line Internal pull-up
(39)	SD_D[1]	I/O	VIO_SD	<b>SDIO 4-bit Mode:</b> Data line Bit[1] <b>SDIO 1-bit Mode:</b> Interrupt Internal pull-up
(40)	SD_D[2]	I/O	VIO_SD	<b>SDIO 4-bit Mode:</b> Data line Bit[2] or read wait (optional) <b>SDIO 1-bit Mode:</b> Read wait (optional) Internal pull-up
(41)	GND	GND	-	Ground
(42)	SD_D[3]	I/O	VIO_SD	<b>SDIO 4-bit Mode:</b> Data line Bit[3] <b>SDIO 1-bit Mode:</b> Reserved Internal pull-up
(43)	PCIE_PERST_N	I	VIO	PCIe host indication to reset the device (input)(active low) <b>Note:</b> Muxed with GPIO[20].(input/output) Internal pull-up
(44)	PCIE_CLKREQ_N	I/O	VIO	PCIe clock request (input/output) (active low) <b>Note:</b> An external pull-up (on host side) is required.
(45)	PCIE_WAKE_N	I/O	VIO	PCIe wake signal (input/output) (active low) <b>Note:</b> An external pull-up (on host side) is required.
(46)	W_DISABLE1N	I	VIO	<b>GPIO Mode:</b> GPIO[21] (input/output) <b>Default Mode:</b> W_DISABLE1n (input) (active low) Host indication to disable the Wi-Fi function of the device. See GPIO[12] for W_DISABLE2n (input) (active low).
(47)	GPIO[31]	I/O	VIO	<b>GPIO Mode:</b> GPIO[31] (input/output) <b>JTAG Mode:</b> JTAG_TDO, JTAG test data (output) <b>Coexistence Mode:</b> UART_LTE_SOUT (LTE coexistence data output signal)
(48)	GPIO[29]	I/O	VIO	<b>GPIO Mode:</b> GPIO[29] (input/output) <b>JTAG Mode:</b> JTAG_TMS, JTAG controller select (input)
(49)	GPIO[30]	I/O	VIO	<b>GPIO Mode:</b> GPIO[30] (input/output) <b>JTAG Mode:</b> JTAG_TDI, JTAG test data (input) <b>Coexistence Mode:</b> UART_LTE_SIN (LTE coexistence data input signal)
(50)	GPIO[28]	I/O	VIO	<b>GPIO Mode:</b> GPIO[28] (input/output) <b>JTAG Mode:</b> JTAG_TCK, JTAG test clock (input)
(51)	GPIO[3]	I/O	VIO	<b>GPIO Mode:</b> GPIO[3] (input/output) <b>LED Mode:</b> LED_OUT_BT (output) <b>I2S Mode:</b> I2S_CCLK (output, optional) <b>PCM Mode:</b> PCM_MCLK (output, optional)
(52)	GPIO[2]	I/O	VIO	<b>GPIO Mode:</b> GPIO[2] (input/output) <b>LED Mode:</b> LED_OUT_WLAN (output)
(53)	GPIO[11]	I/O	VIO	<b>GPIO Mode:</b> GPIO[11] (input/output) <b>UART Mode:</b> UART_RTSn (output) (active low)
(54)	GPIO[10]	I/O	VIO	<b>GPIO Mode:</b> GPIO[10] (input/output) <b>UART Mode:</b> UART_CTSn (input) (active low)
(55)	GPIO[9]	I/O	VIO	<b>GPIO Mode:</b> GPIO[9] (input/output) <b>UART Mode:</b> UART_SIN (input)
(56)	GPIO[8]			
(57)	GPIO[12]	I/O	VIO	<b>GPIO Mode:</b> GPIO[12] (input/output) <b>UART Mode:</b> UART_DSRRn (input) (active low) <b>Default Mode:</b> W_DISABLE2n (input) (active low) Host indication to disable the Wi-Fi function of the device. See GPIO[21] for W_DISABLE1n (input) (active low).
(58)	GPIO[13]	I/O	VIO	<b>GPIO Mode:</b> GPIO[13] (input/output) <b>UART Mode:</b> UART_DTRn (output) (active low)
(59)	GPIO[24]	I/O	VIO	<b>GPIO Mode:</b> GPIO[24] (input/output)
(60)	GPIO[25]	I/O	VIO	<b>GPIO Mode:</b> GPIO[25] (input/output)
(61)	GPIO[26]	I/O	VIO	<b>GPIO Mode:</b> GPIO[26] (input/output)

(62)	GPIO[27]	I/O	VIO	<b>GPIO Mode:</b> GPIO[27] (input/output)
(63)	GND	GND	-	Ground
(64)	GND	GND	-	Ground
(65)	BT_RF_OUT	RF	-	<b>2-ANT Mode:</b> Connect to BT_RF_IN <b>3-ANT Mode:</b> Bluetooth Transmit/Receive
(66)	GND	GND	-	Ground
(67)	GND	GND	-	Ground
(68)	NC	NC	-	NC
(69)	GND	GND	-	Ground
(70)	GPIO[22]	I/O	VIO	GPIO[22]
(71)	GPIO[23]	I/O	VIO	GPIO[23]
(72)	GPIO[19]	I/O	VIO	GPIO[19]
(73)	GPIO[18]	I/O	VIO	GPIO[18]
(74)	GPIO[17]	I/O	VIO	GPIO[17]
(75)	GND	GND	-	Ground
(76)	WL_B_ANT/ WL_B_BT_ANT	RF	-	<b>2-ANT Mode:</b> WLAN Transmit/Receive - Path B + Bluetooth <b>3-ANT Mode:</b> WLAN Transmit/Receive - Path B
(77)	GND	GND	-	Ground
(78)	GND	GND	-	Ground
(79)	GND	GND	-	Ground
(80)	WL_A_ANT	RF		WLAN Transmit/Receive – Path A
(81)	GND	GND	-	Ground
(82)	GND	GND	-	Ground
(83)-(234)	GND	GND	-	Ground
(235)	RF_CNTL0_N	O	VIO_RF	RF Control 0—RF Control Output Low (output)
(236)	RF_CNTL3_P	O	VIO_RF	RF Control 3—RF Control Output High (output)
(237)	RF_CNTL2_N	O	VIO_RF	RF Control 2—RF Control Output Low (output)
(238)	RF_CNTL1_P	O	VIO_RF	RF Control 1—RF Control Output High (output)
(239)- (248)	GND	GND	-	Ground
(249)	NC	GND	-	No Connection

### 7.3. Configuration Pins

Strap Value			WLAN	Bluetooth/LE
CONFIG_HOST[2]	CONFIG_HOST[1]	CONFIG_HOST[0]		
0	0	0	SDIO	UART
0	0	1	reserved	reserved
0	1	0	reserved	reserved
0	1	1	PCIe	UART
1	0	0	reserved	reserved
1	0	1	reserved	reserved
1	1	0	reserved	reserved
1	1	1	reserved	reserved

### 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

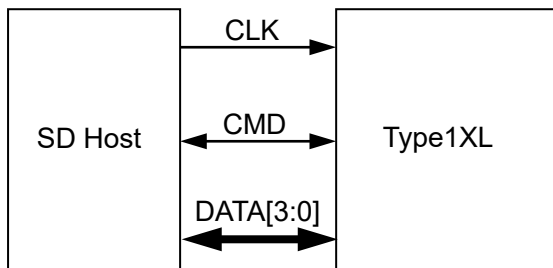
Pin Name	Supply	No Pad Power State <sup>[1]</sup>	Reset State	HW State	PD State	PD Prog	Internal PU/PD	Int'l Pull Value[Ω]
GPIO[0]	VIO	tristate	output	output	drive low	yes	nominal PU	100K
GPIO[1]	VIO	tristate	input	input	tristate	yes	weak PU	800K
GPIO[2]	VIO	tristate	input	input	tristate	yes	nominal PU	100K
GPIO[3]	VIO	tristate	input	input	tristate	yes	nominal PU	100K
GPIO[4]	VIO	tristate	input	input	tristate	yes	weak PU	800K
GPIO[5]	VIO	tristate	input	input	tristate	yes	weak PU	800K
GPIO[6]	VIO	tristate	input	input	tristate	yes	weak PU	800K
GPIO[7]	VIO	tristate	input	input	tristate	yes	nominal PU	100K
GPIO[8]	VIO	tristate	input	input	drive low	yes	nominal PU	100K
GPIO[9]	VIO	tristate	input	input	tristate	yes	nominal PU	100K
GPIO[10]	VIO	tristate	input	input	tristate	yes	nominal PU	100K
GPIO[11]	VIO	tristate	input	input	drive high	yes	nominal PU	100K
GPIO[12]	VIO	tristate	input	input	tristate	yes	nominal PD	100K
GPIO[13]	VIO	tristate	input	input	drive high	yes	nominal PU	100K
GPIO[14]	VIO	tristate	input	input	tristate	yes	weak PU	800K
GPIO[15]	VIO	tristate	input	input	drive high	yes	weak PU	800K
GPIO[16]	VIO	tristate	input	input	tristate	yes	weak PD	800K
GPIO[17]	VIO	tristate	input	input	tristate	yes	weak PD	800K
GPIO[18]	VIO	tristate	input	input	tristate	yes	weak PD	800K
GPIO[19]	VIO	tristate	input	input	tristate	yes	weak PU	800K
GPIO[20]	VIO	tristate	input	input	drive high	yes	nominal PU	100K
GPIO[21]	VIO	tristate	input	input	tristate	yes	nominal PU	100K
GPIO[22]	VIO	tristate	input	input	drive high	yes	weak PU	800K
GPIO[23]	VIO	tristate	input	input	drive low	yes	weak PU	800K
GPIO[24]	VIO	tristate	input	input	tristate	yes	nominal PU	100K
GPIO[25]	VIO	tristate	input	input	drive high	yes	nominal PU	100K
GPIO[26]	VIO	tristate	input	input	tristate	yes	nominal PU	100K
GPIO[27]	VIO	tristate	input	input	tristate	yes	nominal PU	100K
GPIO[28]	VIO	tristate	input	input	tristate	yes	nominal PU	100K
GPIO[29]	VIO	tristate	input	input	tristate	yes	nominal PD	100K
GPIO[30]	VIO	tristate	input	input	tristate	yes	nominal PU	100K
GPIO[31]	VIO	tristate	input	input	tristate	yes	nominal PU	100K
SD_CLK	VIO	tristate	input	input	tristate	no	nominal PU	100K
SD_CMD	VIO	tristate	input	input	tristate	no	nominal PU	100K
SD_D[0]	VIO	tristate	input	input	tristate	no	nominal PU	100K
SD_D[1]	VIO	tristate	input	input	tristate	no	nominal PU	100K
SD_D[2]	VIO	tristate	input	input	tristate	no	nominal PU	100K

SD_D[3]	VIO	tristate	input	input	tristate	no	nominal PU	100K
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	-
PCIE_PERST_N	VIO	tristate	input	input	drive high	yes	nominal PU	100K
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
RF_CNTL0_N	VIO_RF	tristate	input	output	drive low	yes	nominal PU	100K
RF_CNTL1_P	VIO_RF	tristate	input	output	drive low	yes	weak PU	800K
RF_CNTL2_N	VIO_RF	tristate	input	output	drive low	yes	weak PU	800K
RF_CNTL3_P	VIO_RF	tristate	input	output	drive low	yes	weak PU	800K
PDn	AVDD18	-	-	-	-	-	-	-

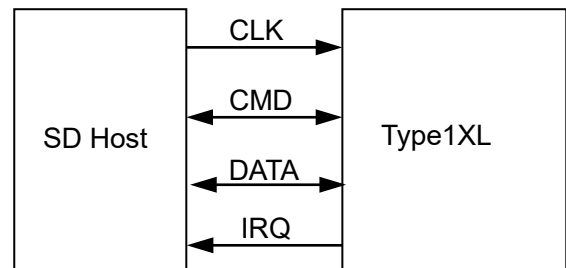
[1] Maximum input voltage is 0.4V when VIO has no power (or in uncertain situations).

## 7.5. SDIO Pin Descriptions

No.	Pin Name	(i) SD 4-bit Mode		(ii) SD 1-bit Mode	
55	SD_CLK	CLK	Clock	CLK	Clock
59	SD_D[0]	DATA0	Data line 0	DATA	Data line
61	SD_D[1]	DATA1	Data line 1 /Interrupt	IRQ	Interrupt
63	SD_D[2]	DATA2	Data line 2	NC	Not used
65	SD_D[3]	DATA3	Data line 3	NC	Not used
57	SD_CMD	CMD	Command line	CMD	Command line



(i) SD 4-bit Mode



(ii) SD 1-bit Mode

## 8. Rating

Parameter		Min	Max	Unit
Storage Temperature		-40	+85	deg.C
Supply Voltage	VDD33	-	3.63	V
	VDD18	-	2.16	V
	VIO (1.8V)	-	1.98	V
	VIO(3.3V)	-	3.63	V
	VIO_SD(1.8V)	-	1.98	V
	VIO_SD(3.3V)	-	3.63	V

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

## 9. Operating Condition

### 9.1. Operating condition

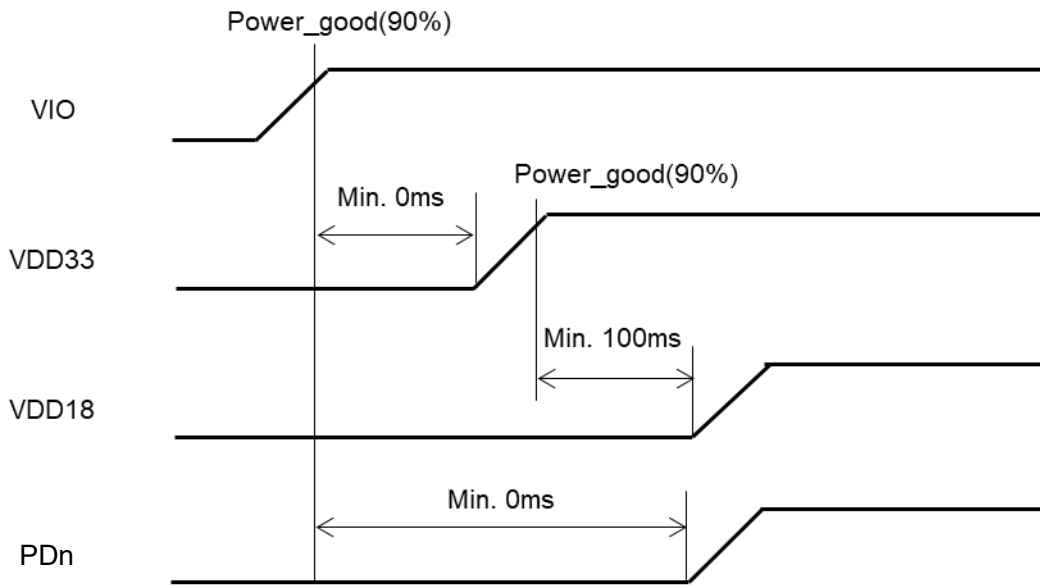
Parameter		Min	Typ	Max	Unit
Operating Temperature Range <sup>1</sup>		-40	+25	+85	deg.C
Specification Temperature Range		TBD	+25	TBD	deg.C
Supply Voltage	VDD33	3.14	3.3	3.46	V
	VDD18	1.71	1.8	1.89	V
	VIO	1.71	1.8	1.89	V
		3.14	3.3	3.46	V
	VIO_SD	1.71	1.8	1.89	V
		3.14	3.3	3.46	V
IO Current	VIO&VIO_SD	-	0.1	0.5	mA
Peak current	VDD33	-	1150 (TBD)	TBD	mA
	VDD18	-	1873 (TBD)	TBD	mA

<sup>1</sup> Functionality is guaranteed but specifications require derating at extreme temperatures

## 10. Power-Up / Power-Down Sequence

### 10.1. Power-Up Sequence

(1) VIO=3.3V

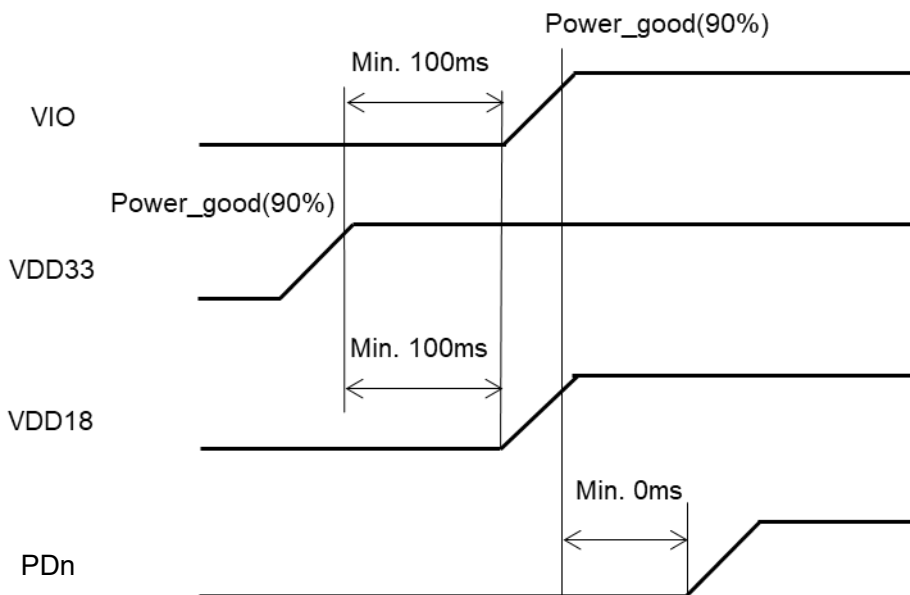


Ramp-up time of VIO must be <100ms.

Ramp-up time of VDD33 must be <100ms.

Ramp-up time of VDD18 must be <100ms.

(2) VIO=1.8V



Ramp-up time of VIO must be <100ms.

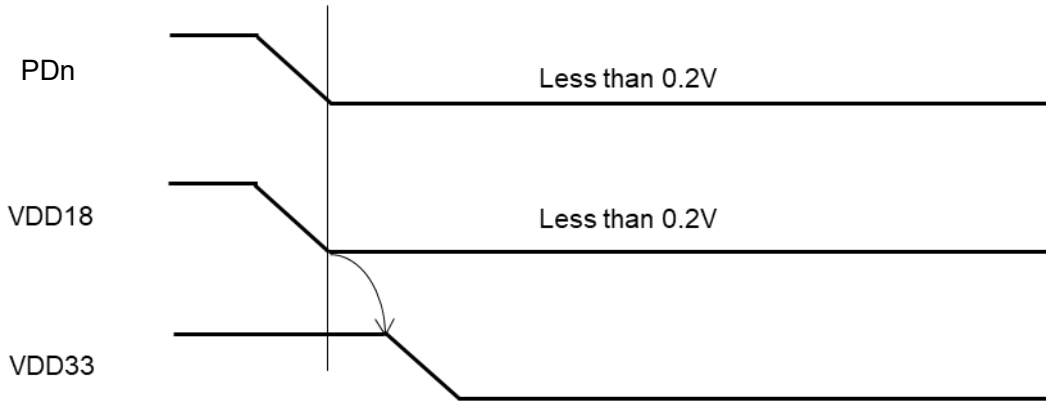
Ramp-up time of VDD33 must be <100ms.

Ramp-up time of VDD18 must be <100ms.

VIO should be the same as VDD18 or earlier. After power\_good state of VDD33, then VIO can ramp up. At that time VDD18 can be the same or later than VIO.



## 10.2. Power-Down Sequence



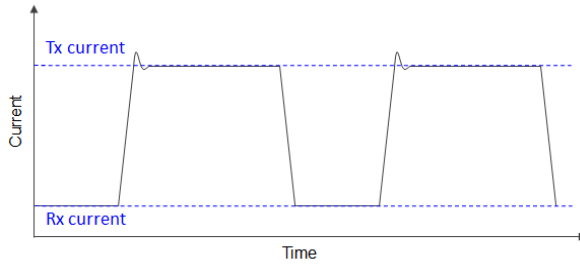
To reduce leakage, ramp down VDD18 before VDD33 when powering down the SoC. It is not required specific timing for VIO for its power-down.

## 11. DC / RF Characteristics

- ALL DC/RF characteristics are defined by following file.

TBD	TBD
TBD	TBD

- Burst current definition



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

Specification	IEEE802.11b
Mode	DSSS / CCK
Channel Frequency	2412 - 2472MHz
Data rate	1, 2, 5.5, 11Mbps

#### 11.1.1. High Rate Condition for IEEE802.11b – 2.4GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, 11Mbps mode

Items		Contents			
		Min.	Typ.	Max.	Unit
- DC Characteristics -					
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -					
		Min.	Typ.	Max.	Unit
2. Output Power					
		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 1st side lobes		0	-	-	dB
2) 2nd side lobes		0	-	-	dB
4. Power-on/off ramp					
		-	-	2.0	Usec
5. RF Carrier Suppression					
		15	-	-	dB
6. Modulation Accuracy					
		-	-	35	%
7. Frequency tolerance					
		-20		20	ppm
8. 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
9. Minimum Input Level (FER≤ 8%)					
		-	-	-76	dBm
10. Maximum Input Level (FER ≤ 8%)					
		-10	-	-	dBm
11. Adjacent Channel Rejection (FER< 8%)					
		35	-	-	dB

### 11.1.2. Low Rate Condition for IEEE802.11b – 2.4GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, 1Mbps mode

Items		Contents			
- DC Characteristics -		Min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		Min.	Typ.	Max.	Unit
2. Output Power					
		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 1st side lobes		0	-	-	dB
2) 2nd side lobes		0	-	-	dB
4. Power-on/off ramp					
		-	-	2.0	Usec
5. RF Carrier Suppression					
		15	-	-	dB
6. Modulation Accuracy					
		-	-	35	%
7. Frequency tolerance					
		-20		20	ppm
8. 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
9. Minimum Input Level (FER≤ 8%)					
		-	-	-80	dBm
10. Maximum Input Level (FER ≤ 8%)					
		-10	-	-	dBm
11. Adjacent Channel Rejection (FER< 8%)					
		35	-	-	dB

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

Specification	IEEE802.11g
Mode	OFDM
Channel Frequency	2412 - 2472MHz
Data rate	6, 9, 12, 18, 24, 36, 48, 54Mbps

### 11.2.1. High Rate Condition for IEEE802.11g – 2.4GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, 54Mbps mode

Items		Contents			
		Min.	Typ.	Max.	Unit
- DC Characteristics -					
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		Min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 9MHz to 11MHz (0~ -20dBr)		0	-	-	dB
2) 11MHz to 20MHz (-20~ -28dBr)		0	-	-	dB
3) 20MHz to 30MHz (-28~ -40dBr)		0	-	-	dB
4) 30MHz to 33MHz (-40dBr)		0	-	-	dB
4. Constellation Error(EVM)		-	-	-25	dB
5. Frequency tolerance		-20		20	ppm
6. 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
7. Minimum Input Level (PER < 10%)		-	-	-65	dBm
8. Maximum Input Level (PER < 10%)		-20	-	-	dBm
9. Adjacent Channel Rejection(PER< 10%)		-1	-	-	dB

### 11.2.2. Low Rate Condition for IEEE802.11g – 2.4GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, 6Mbps mode

Items		Contents				
- DC Characteristics -		Min.	Typ.	Max.	Unit	
1. DC current						
1) Tx mode	VDD18	-	TBD	TBD	mA	
	VDD33	-	TBD	TBD	mA	
2) Rx mode	VDD18(CDW)	-	TBD	TBD	mA	
	VDD33(CDW)	-	TBD	TBD	mA	
	VDD18	-	TBD	TBD	mA	
	VDD33	-	TBD	TBD	mA	
	VDD18(CDW)	-	TBD	TBD	mA	
	VDD33(CDW)	-	TBD	TBD	mA	
	- Tx Characteristics -		Min.	Typ.	Max.	Unit
	2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin						
1) 9MHz to 11MHz (0~ -20dB)		0	-	-	dB	
2) 11MHz to 20MHz (-20~ -28dB)		0	-	-	dB	
3) 20MHz to 30MHz (-28~ -40dB)		0	-	-	dB	
4) 30MHz to 33MHz (-40dB)		0	-	-	dB	
4. Constellation Error(EVM)		-	-	-25	dB	
5. Frequency tolerance		-20		20	ppm	
6. 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	
7. Minimum Input Level (PER < 10%)		-	-	-82	dBm	
8. Maximum Input Level (PER < 10%)		-20	-	-	dBm	
9. Adjacent Channel Rejection(PER< 10%)		-1	-	-	dB	

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

Specification	IEEE802.11n
Mode	OFDM
Channel Frequency	2412 - 2472MHz
Data rate	MCS0-MCS7

#### 11.3.1. High Rate Condition for IEEE802.11n – 2.4GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS7 mode

Items		Contents			
- DC Characteristics -		Min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
2) Rx mode	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		Min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 9MHz to 11MHz (0~ -20dBr)		0	-	-	dB
2) 11MHz to 20MHz (-20~ -28dBr)		0	-	-	dB
3) 20MHz to 30MHz (-28~ -45dBr)		0	-	-	dB
4) 30MHz to 33MHz (-45dBr)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-27	dB
5. Frequency tolerance		-20		20	ppm
6. 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
7. Minimum Input Level (PER ≤ 10%)		-	-	-64	dBm
8. Maximum Input Level (PER < 10%)		-20	-	-	dBm
9. Adjacent Channel Rejection(PER≤ 10%)		-2	-	-	dB

### 11.3.2. Low Rate Condition for IEEE802.11n – 2.4GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS0 mode

Items		Contents				
- DC Characteristics -		Min.	Typ.	Max.	Unit	
1. DC current						
1) Tx mode	VDD18	-	TBD	TBD	mA	
	VDD33	-	TBD	TBD	mA	
2) Rx mode	VDD18(CDW)	-	TBD	TBD	mA	
	VDD33(CDW)	-	TBD	TBD	mA	
	VDD18	-	TBD	TBD	mA	
	VDD33	-	TBD	TBD	mA	
	VDD18(CDW)	-	TBD	TBD	mA	
	VDD33(CDW)	-	TBD	TBD	mA	
	- Tx Characteristics -		Min.	Typ.	Max.	Unit
	2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin						
1) 9MHz to 11MHz (0~ -20dBr)		0	-	-	dB	
2) 11MHz to 20MHz (-20~ -28dBr)		0	-	-	dB	
3) 20MHz to 30MHz (-28~ -45dBr)		0	-	-	dB	
4) 30MHz to 33MHz (-45dBr)		0	-	-	dB	
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-27	dB	
5. Frequency tolerance		-20		20	ppm	
6. 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	
7. Minimum Input Level (PER ≤ 10%)		-	-	-82	dBm	
8. Maximum Input Level (PER < 10%)		-20	-	-	dBm	
9. Adjacent Channel Rejection(PER ≤ 10%)		-2	-	-	dB	

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

Specification	IEEE802.11ax
Mode	OFDM
Channel Frequency	2412 - 2472MHz
Data rate	MCS0-MCS11

##### 11.4.1. High Rate Condition for IEEE802.11ax – 2.4GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS11 mode

Items		Contents			
		Min.	Typ.	Max.	Unit
- DC Characteristics -					
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
2) Rx mode	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
	- Tx Characteristics -				
	<b>Min.      Typ.      Max.      Unit</b>				
2. Output Power					
		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 9MHz to 11MHz (0~ -20dBr)		0	-	-	dB
2) 11MHz to 20MHz (-20~ -28dBr)		0	-	-	dB
3) 20MHz to 30MHz (-28~ -45dBr)		0	-	-	dB
4) 30MHz to 33MHz (-45dBr)		0	-	-	dB
4. Constellation Error (EVM)					
(measured at enhanced mode)		-	-	-35	dB
5. Frequency tolerance					
		-20		20	ppm
6. 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 -					
		<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
7. Minimum Input Level (PER ≤ 10%)					
		-	-	-69	dBm
8. Maximum Input Level (PER < 10%)					
		TBD	-	-	dBm
9. Adjacent Channel Rejection(PER≤ 10%)					
		-2	-	-	dB



### 11.4.2. Low Rate Condition for IEEE802.11ax – 2.4GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS0 mode

Items		Contents			
- DC Characteristics -		Min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		Min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1)	9MHz to 11MHz (0~ -20dBr)	0	-	-	dB
2)	11MHz to 20MHz (-20~ -28dBr)	0	-	-	dB
3)	20MHz to 30MHz (-28~ -45dBr)	0	-	-	dB
4)	30MHz to 33MHz (-45dBr)	0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-19	dB
5. Frequency tolerance		-20		20	ppm
6. 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
7. Minimum Input Level (PER ≤ 10%)		-	-	-69	dBm
8. Maximum Input Level (PER < 10%)		TBD	-	-	dBm
9. Adjacent Channel Rejection(PER ≤ 10%)		-2	-	-	dB

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

Specification	IEEE802.11a
Mode	OFDM
Channel Frequency	5180 to 5240MHz, 5260 to 5320MHz, 5500 to 5720MHz, 5745 to 5825MHz
Data rate	6, 9, 12, 18, 24, 36, 48, 54Mbps

#### 11.5.1. High Rate Condition for IEEE802.11a – 5GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD,  
54Mbps mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 9MHz to 11MHz (0~ -20dBr)		0	-	-	dB
2) 11MHz to 20MHz (-20~ -28dBr)		0	-	-	dB
3) 20MHz to 30MHz (-28~ -45dBr)		0	-	-	dB
4) 30MHz to 33MHz (-45dBr)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-25	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
7. Minimum Input Level (PER ≤ 10%)		-	-	-65	dBm
8. Maximum Input Level (PER < 10%)		-30	-	-	dBm
9. Adjacent Channel Rejection (PER ≤ 10%)		-1	-	-	dB

### 11.5.2. Low Rate Condition for IEEE802.11a – 5GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, 6Mbps mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode*	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 9MHz to 11MHz (0~ -20dBr)		0	-	-	dB
2) 11MHz to 20MHz (-20~ -28dBr)		0	-	-	dB
3) 20MHz to 30MHz (-28~ -45dBr)		0	-	-	dB
4) 30MHz to 33MHz (-45dBr)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-25	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
7. Minimum Input Level (PER ≤ 10%)		-	-	-82	dBm
8. Maximum Input Level (PER < 10%)		-30	-	-	dBm
9. Adjacent Channel Rejection (PER ≤ 10%)		-1	-	-	dB

## 11.6. DC/RF Characteristics for IEEE802.11n(HT20) - 5GHz

Specification	IEEE802.11n
Mode	OFDM
Channel Frequency	5180 to 5240MHz, 5260 to 5320MHz, 5500 to 5720MHz, 5745 to 5825MHz
Data rate	MCS0-MCS7

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

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS7 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 9MHz to 11MHz (0~ -20dBr)		0	-	-	dB
2) 11MHz to 20MHz (-20~ -28dBr)		0	-	-	dB
3) 20MHz to 30MHz (-28~ -45dBr)		0	-	-	dB
4) 30MHz to 33MHz (-45dBr)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-27	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
7. Minimum Input Level (PER ≤ 10%)		-	-	-64	dBm
8. Maximum Input Level (PER < 10%)		-30	-	-	dBm
9. Adjacent Channel Rejection (PER ≤ 10%)		-2	-	-	dB

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

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS0 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1)	9MHz to 11MHz (0~ -20dBr)	0	-	-	dB
2)	11MHz to 20MHz (-20~ -28dBr)	0	-	-	dB
3)	20MHz to 30MHz (-28~ -45dBr)	0	-	-	dB
4)	30MHz to 33MHz (-45dBr)	0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-27	dB
5. Frequency tolerance		-20		20	ppm
6. 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)	1000-5150MHz (BW=1MHz)	-	-	-30	dBm
11)	5350-5470MHz (BW=1MHz)	-	-	-30	dBm
12)	5725-26000MHz (BW=1MHz)	-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
7. Minimum Input Level (PER ≤ 10%)		-	-	-82	dBm
8. Maximum Input Level (PER < 10%)		-30	-	-	dBm
9. Adjacent Channel Rejection (PER ≤ 10%)		-2	-	-	dB

### 11.7. DC/RF Characteristics for IEEE802.11ac(HT20) - 5GHz

Specification	IEEE802.11ac
Mode	OFDM
Channel Frequency	5180 to 5240MHz, 5260 to 5320MHz, 5500 to 5720MHz, 5745 to 5825MHz
Data rate	MCS0-MCS8

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

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS8 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 9MHz to 11MHz (0~ -20dBr)		0	-	-	dB
2) 11MHz to 20MHz (-20~ -28dBr)		0	-	-	dB
3) 20MHz to 30MHz (-28~ -45dBr)		0	-	-	dB
4) 30MHz to 33MHz (-45dBr)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-30	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
7. Minimum Input Level (PER ≤ 10%)		-	-	-59	dBm
8. Maximum Input Level (PER < 10%)		-30	-	-	dBm
9. Adjacent Channel Rejection (PER ≤ 10%)		-7	-	-	dB

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

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS0 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
2) Rx mode	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 9MHz to 11MHz (0~ -20dBr)		0	-	-	dB
2) 11MHz to 20MHz (-20~ -28dBr)		0	-	-	dB
3) 20MHz to 30MHz (-28~ -45dBr)		0	-	-	dB
4) 30MHz to 33MHz (-45dBr)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-30	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
7. Minimum Input Level (PER ≤ 10%)		-	-	-82	dBm
8. Maximum Input Level (PER < 10%)		-30	-	-	dBm
9. Adjacent Channel Rejection (PER ≤ 10%)		-7	-	-	dB

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

Specification	IEEE802.11n
Mode	OFDM
Frequency	5190 to 5795MHz
Data rate	MCS0-MCS7

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

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS7 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1)	19MHz to 21MHz (0~ -20dB)	0	-	-	dB
2)	21MHz to 40MHz (-20~ -28dB)	0	-	-	dB
3)	40MHz to 60MHz (-28~ -45dB)	0	-	-	dB
4)	60MHz to 80MHz (-45dB)	0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-27	dB
5. Frequency tolerance		-20		20	ppm
6. 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)	1000-5150MHz (BW=1MHz)	-	-	-30	dBm
11)	5350-5470MHz (BW=1MHz)	-	-	-30	dBm
12)	5725-26000MHz (BW=1MHz)	-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
7. Minimum Input Level (PER ≤ 10%)		-	-	-61	dBm
8. Maximum Input Level (PER ≤ 10%)		-30	-	-	dBm
9. Adjacent Channel Rejection (PER ≤ 10%)		-2	-	-	dB



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

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS0 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
2) Rx mode	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 19MHz to 21MHz (0~ -20dB)		0	-	-	dB
2) 21MHz to 40MHz (-20~ -28dB)		0	-	-	dB
3) 40MHz to 60MHz (-28~ -45dB)		0	-	-	dB
4) 60MHz to 80MHz (-45dB)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-27	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
7. Minimum Input Level (PER ≤ 10%)		-	-	-79	dBm
8. Maximum Input Level (PER ≤ 10%)		-30	-	-	dBm
9. Adjacent Channel Rejection (PER ≤ 10%)		-2	-	-	dB

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

Specification	IEEE802.11ac
Mode	OFDM
Frequency	5190 to 5795MHz
Data rate	MCS0-MCS9

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

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS9 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1)	19MHz to 21MHz (0~ -20dB)	0	-	-	dB
2)	21MHz to 40MHz (-20~ -28dB)	0	-	-	dB
3)	40MHz to 60MHz (-28~ -45dB)	0	-	-	dB
4)	60MHz to 80MHz (-45dB)	0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-32	dB
5. Frequency tolerance		-20		20	ppm
6. 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)	1000-5150MHz (BW=1MHz)	-	-	-30	dBm
11)	5350-5470MHz (BW=1MHz)	-	-	-30	dBm
12)	5725-26000MHz (BW=1MHz)	-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
7. Minimum Input Level (PER ≤ 10%)		-	-	-54	dBm
8. Maximum Input Level (PER ≤ 10%)		-30	-	-	dBm
9. Adjacent Channel Rejection (PER ≤ 10%)		-9	-	-	dB

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

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS0 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
2) Rx mode	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 19MHz to 21MHz (0~ -20dB)		0	-	-	dB
2) 21MHz to 40MHz (-20~ -28dB)		0	-	-	dB
3) 40MHz to 60MHz (-28~ -45dB)		0	-	-	dB
4) 60MHz to 80MHz (-45dB)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-32	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
7. Minimum Input Level (PER ≤ 10%)		-	-	-79	dBm
8. Maximum Input Level (PER ≤ 10%)		-30	-	-	dBm
9. Adjacent Channel Rejection (PER ≤ 10%)		-9	-	-	dB

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

Specification	IEEE802.11ac
Mode	OFDM
Channel Frequency	5210 - 5775MHz
Data rate	MCS0-MCS9

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

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS9 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 39MHz to 41MHz (0~ -20dB)		0	-	-	dB
2) 41MHz to 80MHz (-20~ -28dB)		0	-	-	dB
3) 80MHz to 120MHz (-28~ -40dB)		0	-	-	dB
4) 120MHz to 140MHz (-40dB)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-32	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
6. Minimum Input Level (PER ≤ 10%)		-	-	-51	dBm
7. Maximum Input Level (PER ≤ 10%)		-30	-	-	dBm
8. Adjacent Channel Rejection (PER ≤ 10%)		-9	-	-	dB

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

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS0 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
2) Rx mode	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
	- Tx Characteristics -				
			min.	Typ.	Max.
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 39MHz to 41MHz (0~ -20dB)		0	-	-	dB
2) 41MHz to 80MHz (-20~ -28dB)		0	-	-	dB
3) 80MHz to 120MHz (-28~ -40dB)		0	-	-	dB
4) 120MHz to 140MHz (-40dB)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-19	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
		Min.	Typ.	Max.	Unit
6. Minimum Input Level (PER ≤ 10%)		-	-	-76	dBm
7. Maximum Input Level (PER ≤ 10%)		-30	-	-	dBm
8. Adjacent Channel Rejection (PER ≤ 10%)		-9	-	-	dB

### 11.11. DC/RF Characteristics for IEEE802.11ax(HE 20MHz)-5GHz

Specification	IEEE802.11ax
Mode	OFDM
Channel Frequency	5180 to 5240MHz, 5260 to 5320MHz, 5500 to 5720MHz, 5745 to 5825MHz
Data rate	MCS0-MCS11

#### 11.11.1. High Rate Condition for IEEE802.11ax(HE20) – 5GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS11 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 39MHz to 41MHz (0~ -20dBr)		0	-	-	dB
2) 41MHz to 80MHz (-20~ -28dBr)		0	-	-	dB
3) 80MHz to 120MHz (-28~ -40dBr)		0	-	-	dB
4) 120MHz to 140MHz (-40dBr)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-32	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
6. Minimum Input Level (PER ≤ 10%)		-	-	-51	dBm
7. Maximum Input Level (PER ≤ 10%)		-30	-	-	dBm
8. Adjacent Channel Rejection (PER ≤ 10%)		-9	-	-	dB

### 11.11.2. Low Rate Condition for IEEE802.11ax(HE20) – 5GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS0 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
2) Rx mode	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 39MHz to 41MHz (0~ -20dB)		0	-	-	dB
2) 41MHz to 80MHz (-20~ -28dB)		0	-	-	dB
3) 80MHz to 120MHz (-28~ -40dB)		0	-	-	dB
4) 120MHz to 140MHz (-40dB)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-19	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
6. Minimum Input Level (PER ≤ 10%)		-	-	-76	dBm
7. Maximum Input Level (PER ≤ 10%)		-30	-	-	dBm
8. Adjacent Channel Rejection (PER ≤ 10%)		-9	-	-	dB

### 11.12. DC/RF Characteristics for IEEE802.11ax(HE 40MHz)-5GHz

Specification	IEEE802.11ax
Mode	OFDM
Channel Frequency	5210 - 5775MHz
Data rate	MCS0-MCS11

#### 11.12.1. High Rate Condition for IEEE802.11ax(HE40) – 5GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS11 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 39MHz to 41MHz (0~ -20dB)		0	-	-	dB
2) 41MHz to 80MHz (-20~ -28dB)		0	-	-	dB
3) 80MHz to 120MHz (-28~ -40dB)		0	-	-	dB
4) 120MHz to 140MHz (-40dB)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-32	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
6. Minimum Input Level (PER ≤ 10%)		-	-	-51	dBm
7. Maximum Input Level (PER ≤ 10%)		-30	-	-	dBm
8. Adjacent Channel Rejection (PER ≤ 10%)		-9	-	-	dB



### 11.12.2. Low Rate Condition for IEEE802.11ax(HE40) – 5GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS0 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
2) Rx mode	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 39MHz to 41MHz (0~ -20dB)		0	-	-	dB
2) 41MHz to 80MHz (-20~ -28dB)		0	-	-	dB
3) 80MHz to 120MHz (-28~ -40dB)		0	-	-	dB
4) 120MHz to 140MHz (-40dB)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-32	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
6. Minimum Input Level (PER ≤ 10%)		-	-	-76	dBm
7. Maximum Input Level (PER ≤ 10%)		-30	-	-	dBm
8. Adjacent Channel Rejection (PER ≤ 10%)		-9	-	-	dB

### 11.13. DC/RF Characteristics for IEEE802.11ax(HE 80MHz)-5GHz

Specification	IEEE802.11ax
Mode	OFDM
Channel Frequency	5210 - 5775MHz
Data rate	MCS0-MCS11

#### 11.13.1. High Rate Condition for IEEE802.11ax(HE80) – 5GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS11 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
2) Rx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1)	39MHz to 41MHz (0~ -20dB)	0	-	-	dB
2)	41MHz to 80MHz (-20~ -28dB)	0	-	-	dB
3)	80MHz to 120MHz (-28~ -40dB)	0	-	-	dB
4)	120MHz to 140MHz (-40dB)	0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-32	dB
5. Frequency tolerance		-20		20	ppm
6. 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)	1000-5150MHz (BW=1MHz)	-	-	-30	dBm
11)	5350-5470MHz (BW=1MHz)	-	-	-30	dBm
12)	5725-26000MHz (BW=1MHz)	-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
6. Minimum Input Level (PER ≤ 10%)		-	-	-51	dBm
7. Maximum Input Level (PER ≤ 10%)		-30	-	-	dBm
8. Adjacent Channel Rejection (PER ≤ 10%)		-9	-	-	dB

### 11.13.2. Low Rate Condition for IEEE802.11ax(HE80) – 5GHz

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V, Output power setting=TBD, MCS0 mode

Items		Contents			
- DC Characteristics -		min.	Typ.	Max.	Unit
1. DC current					
1) Tx mode	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
2) Rx mode	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
	VDD18	-	TBD	TBD	mA
	VDD33	-	TBD	TBD	mA
	VDD18(CDW)	-	TBD	TBD	mA
	VDD33(CDW)	-	TBD	TBD	mA
- Tx Characteristics -		min.	Typ.	Max.	Unit
2. Output Power		TBD	TBD	TBD	dBm
3. Spectrum Mask Margin					
1) 39MHz to 41MHz (0~ -20dB)		0	-	-	dB
2) 41MHz to 80MHz (-20~ -28dB)		0	-	-	dB
3) 80MHz to 120MHz (-28~ -40dB)		0	-	-	dB
4) 120MHz to 140MHz (-40dB)		0	-	-	dB
4. Constellation Error (EVM) (measured at enhanced mode)		-	-	-32	dB
5. Frequency tolerance		-20		20	ppm
6. 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) 1000-5150MHz (BW=1MHz)		-	-	-30	dBm
11) 5350-5470MHz (BW=1MHz)		-	-	-30	dBm
12) 5725-26000MHz (BW=1MHz)		-	-	-30	dBm
- Rx Characteristics -		Min.	Typ.	Max.	Unit
6. Minimum Input Level (PER ≤ 10%)		-	-	-76	dBm
7. Maximum Input Level (PER ≤ 10%)		-30	-	-	dBm
8. Adjacent Channel Rejection (PER ≤ 10%)		-9	-	-	dB

## 11.14. DC/RF Characteristics for Bluetooth

### 11.14.1. Basic Data Rate Condition

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V,

Items	Contents			
Bluetooth specification (power class)	Version 5.1			
Channel frequency (spacing)	2402 to 2480 MHz (1MHz)			
Current Consumption	Min.	Typ.	Max.	unit
1) Tx mode DH5	-	TBD	TBD	mA
2) Rx mode DH5	-	TBD	TBD	mA
- Tx Characteristics -	Min.	Typ.	Max.	Unit
Output Power@DH5	TBD	TBD	TBD	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%)	-	-91	-86	dBm
C/I Performance (BER≤0.1%) *2				
1) co-channel	-	-	11	dB
2) 1MHz	-	-	0	dB
3) 2MHz	-	-	-30	dB
4) 3MHz	-	-	-40	dB
5) image (+4MHz)	-	-	-9	dB
6) image +/- 1MHz	-	-	-20	dB
Maximum Input Level (BER≤0.1%)	-20	-	-	dBm

\*1: Up to three spurious responses within Bluetooth limits are allowed.

\*2: Up to five spurious responses within Bluetooth limits are allowed.

### 11.14.2. Enhanced Data Rate Condition

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V,

Items	Contents			
Bluetooth specification (power class)	Version 5.1			
Channel frequency (spacing)	2402 to 2480 MHz (1MHz)			
Current Consumption	Min.	Typ.	Max.	unit
1) Tx mode 2DH5	-	TBD	TBD	mA
2) Rx mode 2DH5	-	TBD	TBD	mA
3) Tx mode 3DH5	-	TBD	TBD	mA
4) Rx mode 3DH5	-	TBD	TBD	mA
- Tx Characteristics -	Min.	Typ.	Max.	Unit
Output Power@2DH5/3DH5	TBD	TBD	TBD	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	-82	dBm
C/I Performance (BER≤0.1%) *2				
1) co-channel	-	-	11	dB
2) 1MHz	-	-	0	dB
3) 2MHz	-	-	-30	dB
4) 3MHz	-	-	-40	dB
5) image (+4MHz)	-	-	-9	dB
6) image +/- 1MHz	-	-	-20	dB
Maximum Input Level (BER≤0.1%)	-20	-	-	dBm

\*1: Up to three spurious responses within Bluetooth limits are allowed.

\*2: Up to five spurious responses within Bluetooth limits are allowed.

## 11.15. DC/RF Characteristics for Bluetooth Low Energy

### 11.15.1. 1Mbps PHY Condition

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V,

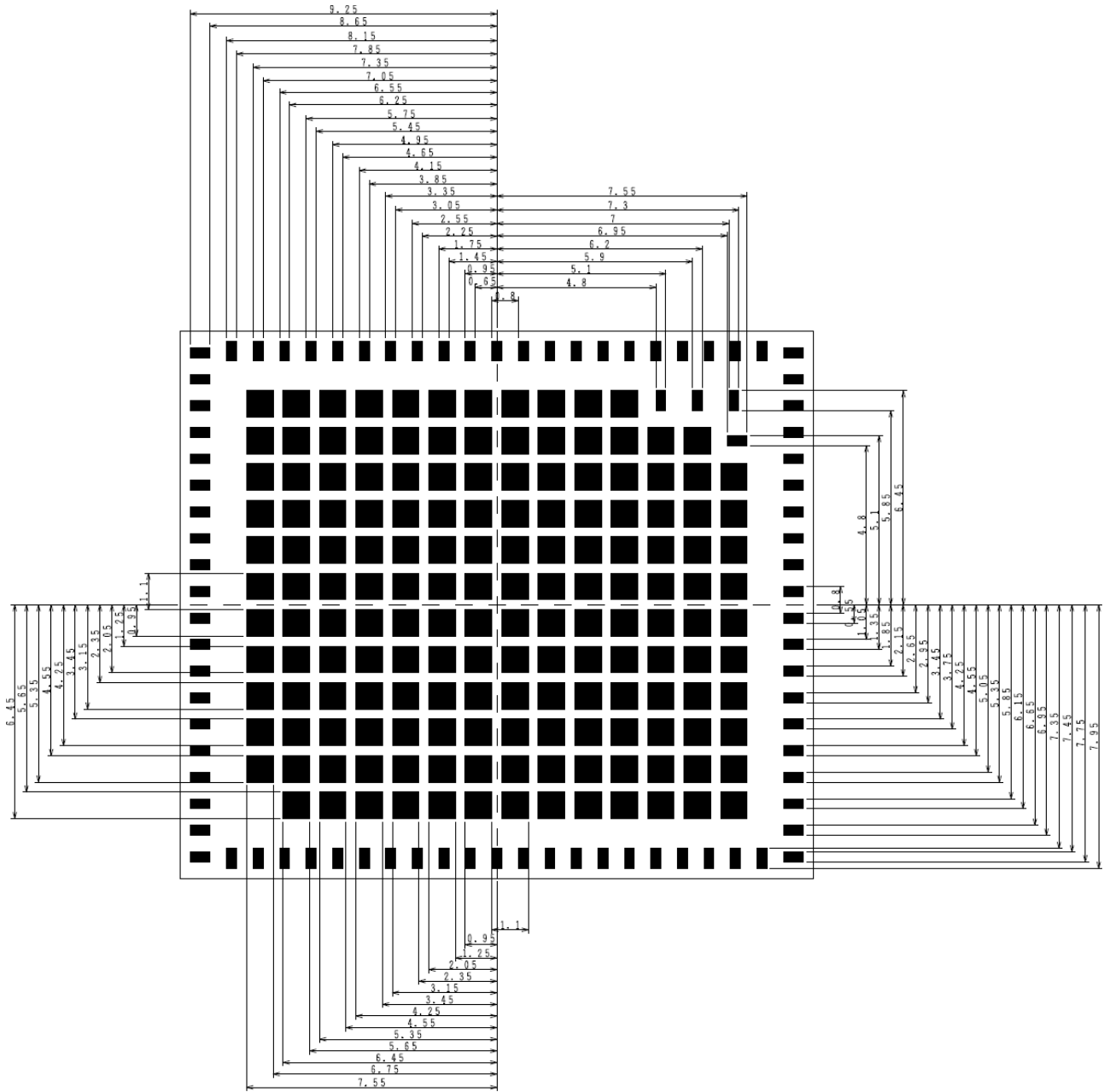
Items	Contents			
Bluetooth specification (power class)	Version 5.1			
Channel frequency (spacing)	2402 to 2480 MHz (2MHz)			
Number of RF Channel	40			
Current Consumption	Min.	Typ.	Max.	Unit
1) Tx mode	-	TBD	TBD	mA
2) Rx mode	-	TBD	TBD	mA
- Tx Characteristics -	Min.	Typ.	Max.	Unit
Center Frequency	2402	-	2480	MHz
Channel Spacing	-	2	-	MHz
Number of RF channel	-	40	-	-
Output power	TBD	TBD	TBD	dBm
Modulation Characteristics				
1) $\Delta f_{1\text{avg}}$	225	-	275	kHz
2) $\Delta f_{2\text{max}}$ (at 99.9%)	185	-	-	kHz
3) $\Delta f_{2\text{avg}} / \Delta f_{1\text{avg}}$	0.8	-	-	-
Carrier frequency offset and drift				
1) Frequency offset	-	-	150	kHz
2) Frequency drift	-	-	50	kHz
3) Drift rate	-	-	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	-90	dBm
Maximum input signal level (PER < 30.8%)	-10	-	-	dBm
PER Report Integrity (-30dBm input)	50	-	65.4	%

### 11.15.2. 2Mbps PHY Condition

Conditions : 25deg.C, VDD33=3.3V, VDD18=1.8V VIO=1.8V,

Items	Contents			
Bluetooth specification (power class)	Version 5.1			
Channel frequency (spacing)	2402 to 2480 MHz (2MHz)			
Number of RF Channel	40			
Current Consumption	Min.	Typ.	Max.	Unit
1) Tx mode	-	TBD	TBD	mA
2) Rx mode	-	TBD	TBD	mA
- Tx Characteristics -	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Center Frequency	2402	-	2480	MHz
Channel Spacing	-	2	-	MHz
Number of RF channel	-	40	-	-
Output power	0	3	6	dBm
Modulation Characteristics				
1) $\Delta f_{1\text{avg}}$	225	-	275	kHz
2) $\Delta f_{2\text{max}}$ (at 99.9%)	185	-	-	kHz
3) $\Delta f_{2\text{avg}} / \Delta f_{1\text{avg}}$	0.8	-	-	-
Carrier frequency offset and drift				
1) Frequency offset	-	-	150	kHz
2) Frequency drift	-	-	50	kHz
3) Drift rate	-	-	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 -	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>unit</b>
Receiver sensitivity (PER < 30.8%)	-	-95	-90	dBm
Maximum input signal level (PER < 30.8%)	-10	-	-	dBm
PER Report Integrity (-30dBm input)	50	-	65.4	%

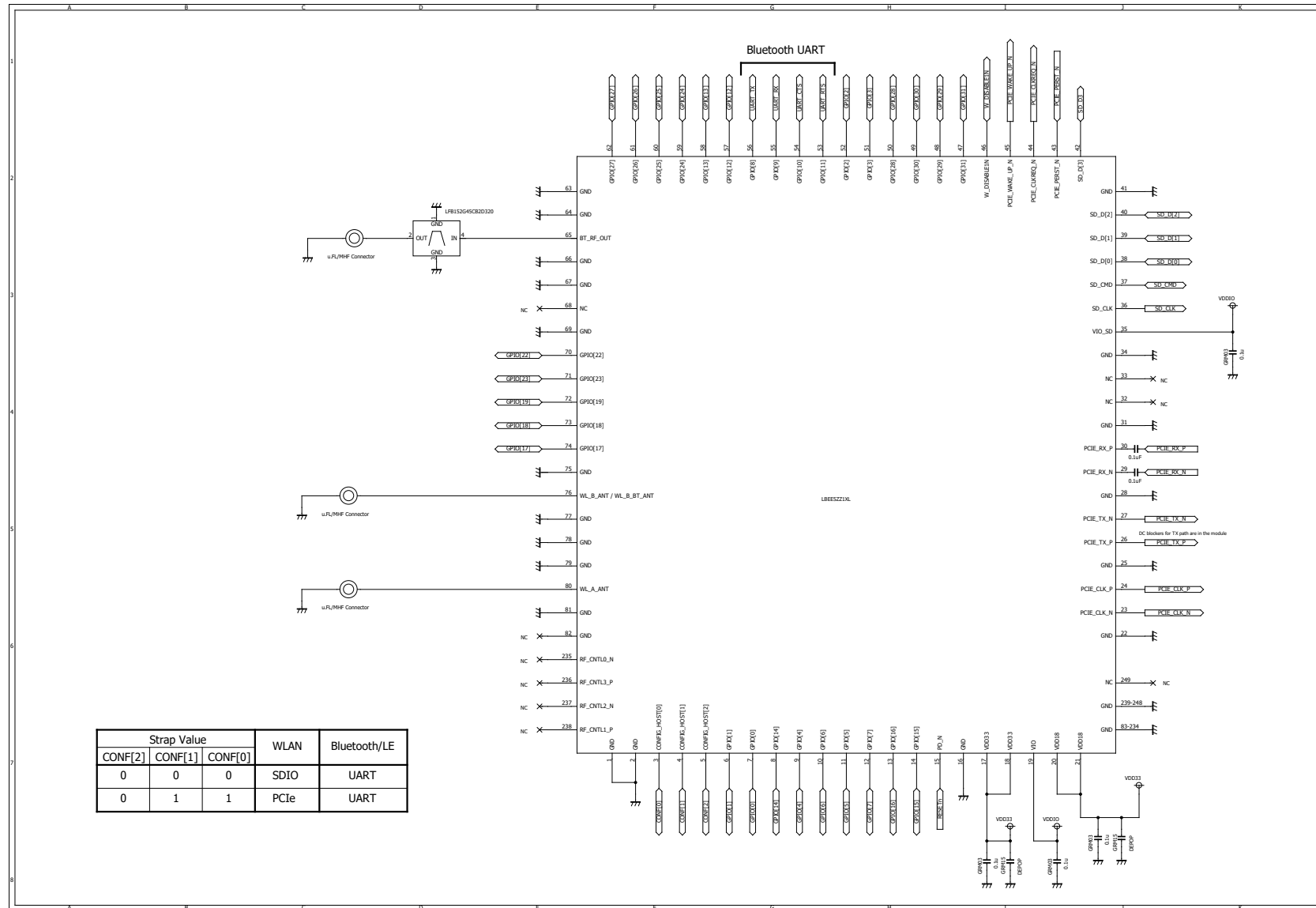
**12. Land Patterns**



(unit : mm)



### 13. Reference Circuit



**14. Tape and Reel Packing**



(2) Dimensions of Reel



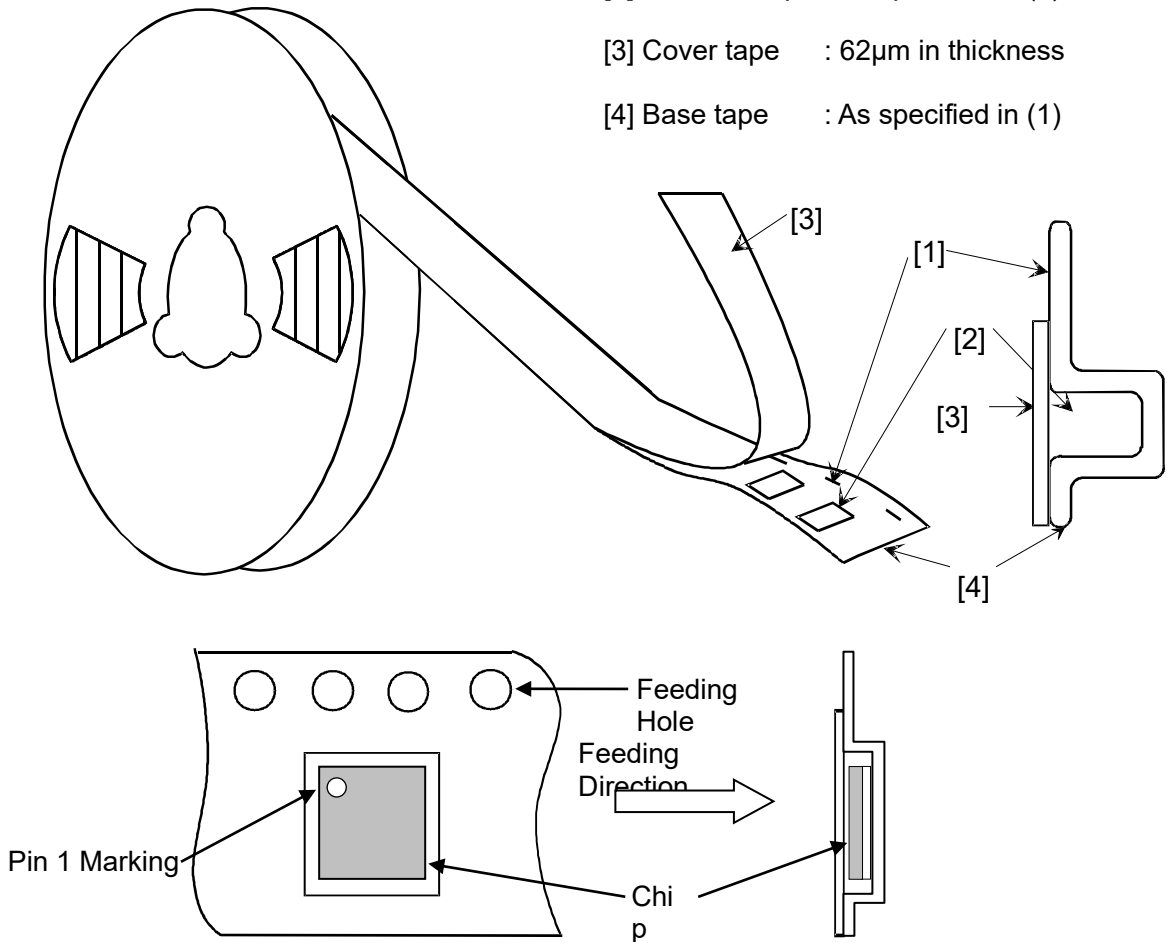
(3) Taping Diagrams

[1] Feeding Hole : As specified in (1)

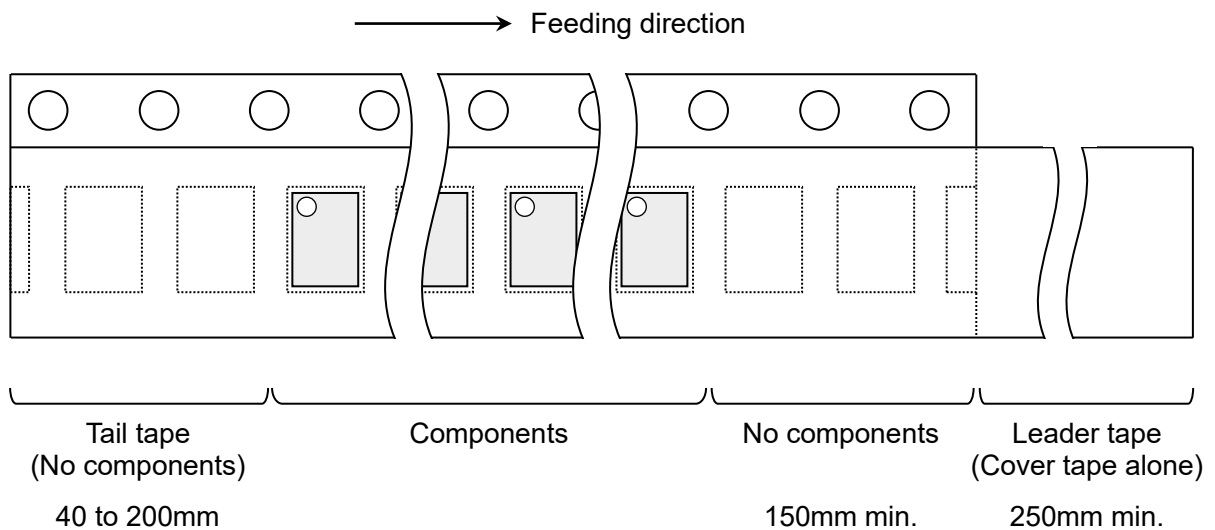
[2] Hole for chip : As specified in (1)

[3] Cover tape : 62μm in thickness

[4] Base tape : As specified in (1)

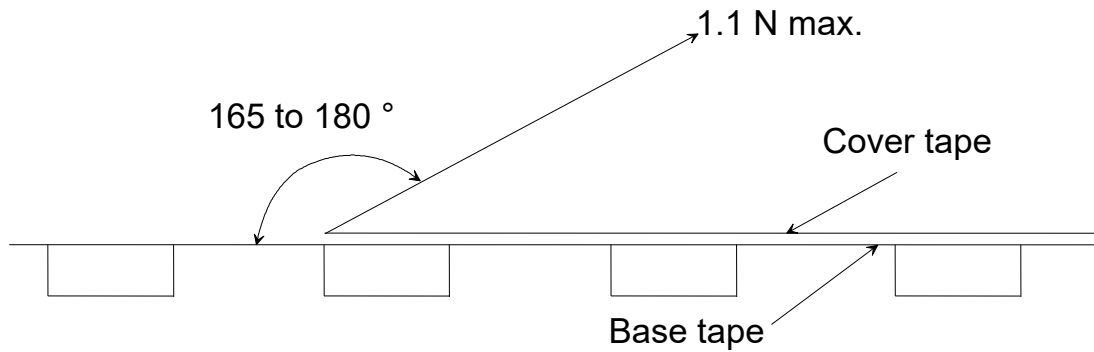


(4) Leader and Tail tape

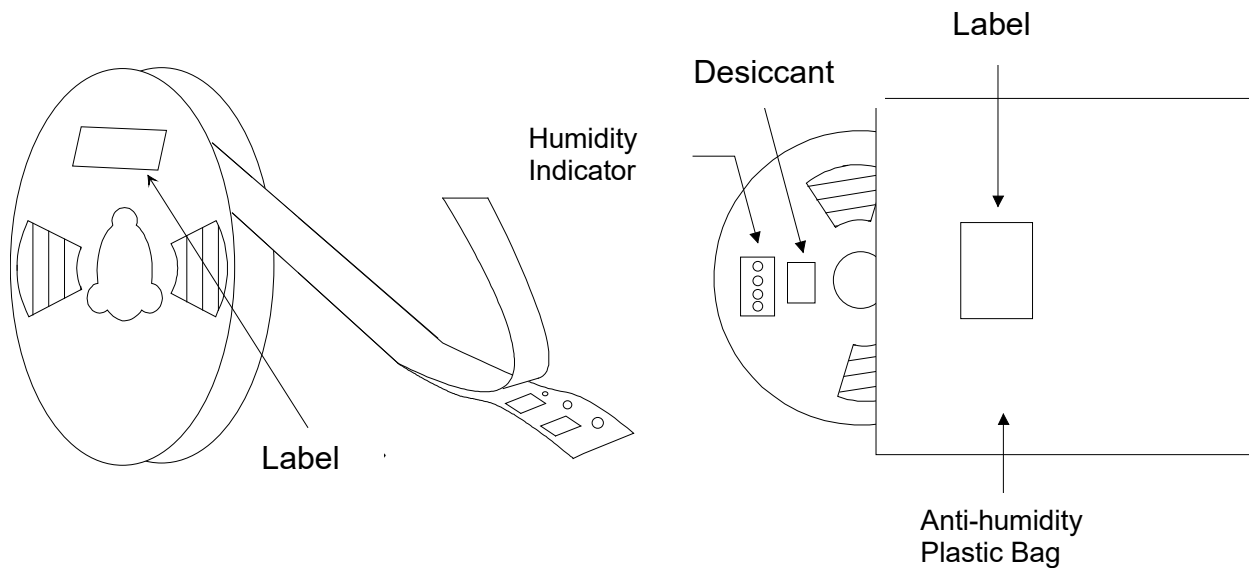


(5) The tape for chips are wound clockwise, the feeding holes to the right side as the tape is pulled toward the user.

- (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 : 1,000 pcs./ reel
- (9) material : Base tape : Plastic  
Real : 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) Packaging (Humidity proof Packing)



Tape and reel must be sealed with the anti-humidity plastic bag. The bag contains the desiccant and the humidity indicator.

## **15. NOTICE**

### **15.1. 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 35 °C and humidity from 20 ~ 70 %RH.  
(Packing materials, in particular, may be deformed at the temperature over 40 °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<sub>2</sub>, NH<sub>3</sub>, SO<sub>2</sub>, Nox, 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 IPC/JEDEC J-STD-020)

- After the packing opened, the product shall be stored at <30 °C / <60 %RH and the product shall be used within 168 hours.
- When the color of the indicator in the packing changed, the product shall be baked before soldering.

Baking condition : 125 +5/-0 °C, 24 hours, 1 time

The products shall be baked on the heat-resistant tray because the material (Base Tape, Reel Tape and Cover Tape) are not heat-resistant.

### **15.2. 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 bare hands that may result in poor solder ability and destroy by static electrical charge.

### **15.3. 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.

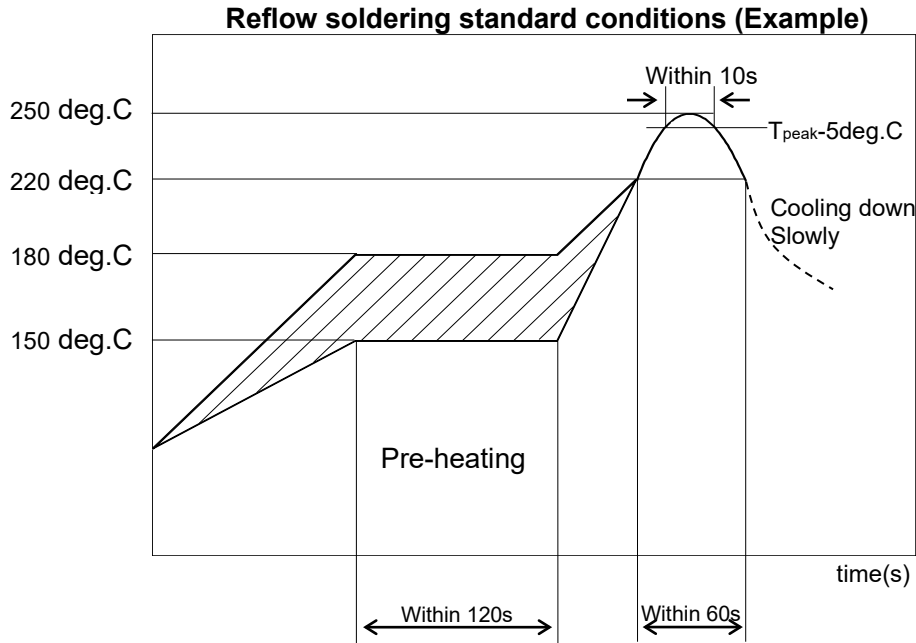
### **15.4. Notice for Chip Placer:**

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.

### 15.5. 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.



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.

### 15.6. 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.

### 15.7. 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<sub>2</sub>, NH<sub>3</sub>, SO<sub>x</sub>, NO<sub>x</sub> 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. Precondition to use our products

PLEASE READ THIS NOTICE BEFORE USING OUR PRODUCTS.

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

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

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

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

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

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

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

- Aircraft equipment.
- Aerospace equipment
- Undersea equipment.
- Power plant control equipment
- Medical equipment.
- 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.