

**To Be Discontinued**

## **W-LAN+Bluetooth Combo Module Data Sheet**

**Cypress Chipset**  
**for 802.11a/b/g/n/ac + Bluetooth 4.1**

**Tentative P/N : LBEE5ZZ1CK-TEMP**

## The revision history of the product specification

Revised No.	Date	Note
-	2014/03/28	First Issue
B	2015/02/11	p4:Adding tolerance p13~20:change output power
C	2016/4/14	P23 :correction output power setting
D	2017/3/3	Changed IC Part Number P3:Added Certification information P5:Added Label information P28:Added reference circuit P29:Added Packing information
E	2017/4/12	Revised BT version P3:1. SCOPE P27:11.10 DC/RF Characteristics for Bluetooth (LE)

**TABLE OF CONTENTS**

1. SCOPE.....	3
2. Part Number.....	3
3. Block Diagram .....	3
4. Certification Information .....	3
4.1. Radio Certification .....	3
5. Dimensions, Marking and Terminal Configuration.....	4
6. Rating.....	8
7. Operating Condition .....	8
7.1. Operating condition.....	8
7.2. Power Up Sequence.....	8
7.2.1 Power On Sequence for WLAN ON and BT ON .....	8
7.2.2 Power On Sequence for WLAN ON and BT Off .....	9
7.2.3 Power On Sequence for WLAN OFF and BT ON.....	9
7.2.4 Power On Sequence for WLAN OFF and BT OFF .....	9
8 External LPO Signal Requirement .....	10
9. Digital I/O Requirements .....	10
10 Interface timing.....	11
10.1 WLAN SDIO Timing .....	11
10.1.1 SDIO Timing(Default Mode).....	11
10.1.2 SDIO Timing(High Speed Mode).....	12
10.1.3 SDIO timing(SDR mode).....	12
10.1.4 SDIO Timing(DDR50 mode) .....	15
10.2 Bluetooth UART Timing .....	17
11 ELECTRICAL CHARACTERISTICS .....	18
11.1 DC/RF Characteristics for IEEE802.11b - 2.4G .....	18
11.2 DC/RF Characteristics for IEEE802.11g - 2.4G .....	19
11.3 DC/RF Characteristics for IEEE802.11n - 2.4GHz.....	20
11.4 DC/RF Characteristics for IEEE802.11a - 5GHz .....	21
11.5 DC/RF Characteristics for IEEE802.11n(HT 20MHz) - 5GHz .....	22
11.6 DC/RF Characteristics for IEEE802.11n(HT 40MHz) - 5GHz .....	23
11.7 DC/RF Characteristics for IEEE802.11ac(VHT 40MHz) - 5GHz .....	24
11.8 DC/RF Characteristics for IEEE802.11ac(VHT 80MHz)-5GHz .....	25
11.9 DC/RF Characteristics for Bluetooth .....	26
11.10 DC/RF Characteristics for Bluetooth (LE) .....	27
12 REFERENCE CIRCUIT.....	28
13 Packing Information.....	29
NOTICE .....	31
1. Storage Conditions : .....	31
2. Handling Conditions : .....	31
3. Cleaning : .....	31
4. Operational Environment Conditions : .....	31
5. Input Power Capacity : .....	31
PRECONDITION TO USE OUR PRODUCTS .....	32

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## 1. SCOPE

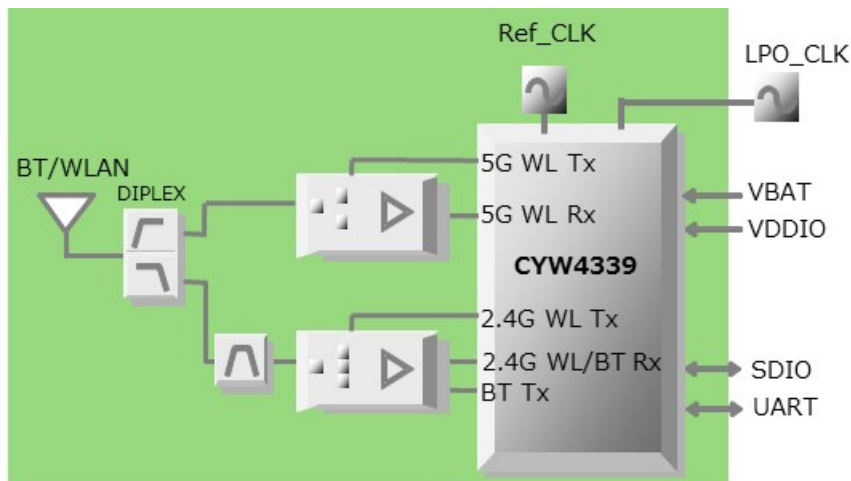
This specification is applied to the IEEE802.11a/b/g/n/ac W-LAN + Bluetooth 4.1 combo module.

- Module size : 33.0 x 18.0 mm typ., t = 7.55 mm max.
- IC/Firmware : Cypress CYW4339
- WLAN Host I/F : SDIO3.0
- Bluetooth Host I/F : UART
- Reference Clock : 37.4MHz Crystal Oscillator embedded
- ROM : Internal OTP
- Weight : 2.47g
- RoHS : This module is compliant with the RoHS directive.

## 2. Part Number

Sample Part Number
LBEE5ZZ1CK-TEMP

## 3. Block Diagram



## 4. Certification Information

### 4.1. Radio Certification

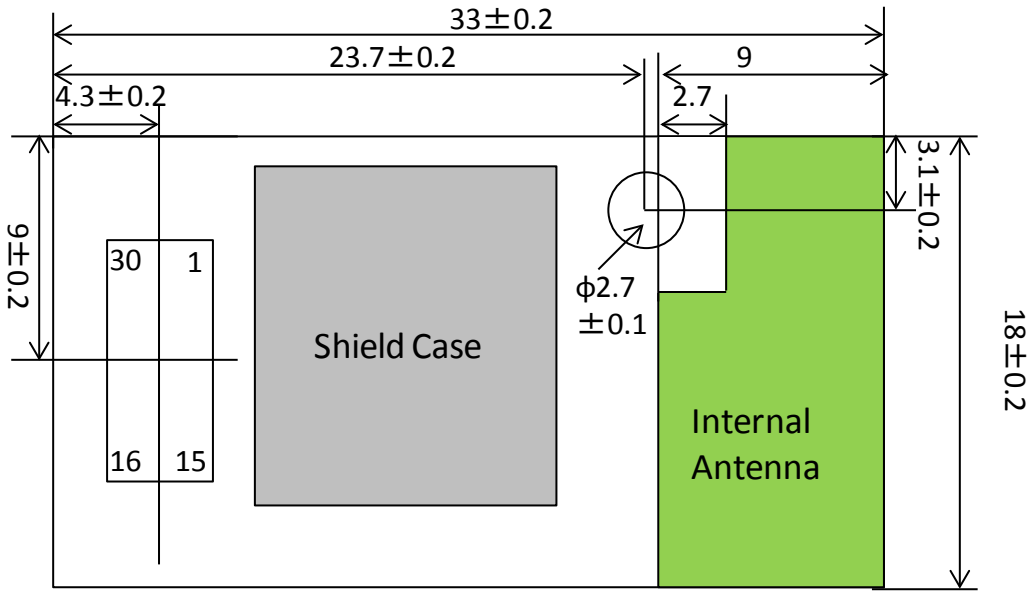
#### USA/Canada

FCC ID : VPYLB1CK982

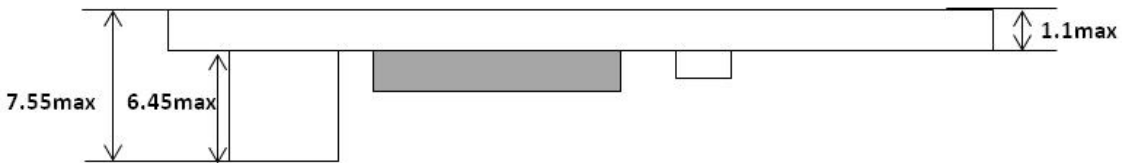
IC : 772C-LB1CK982

**5. Dimensions, Marking and Terminal Configuration**

Dimensions



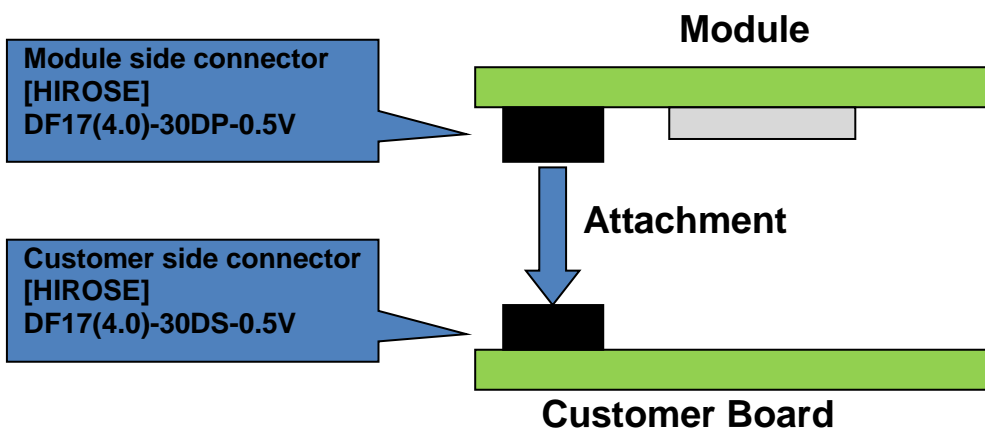
Unit:mm



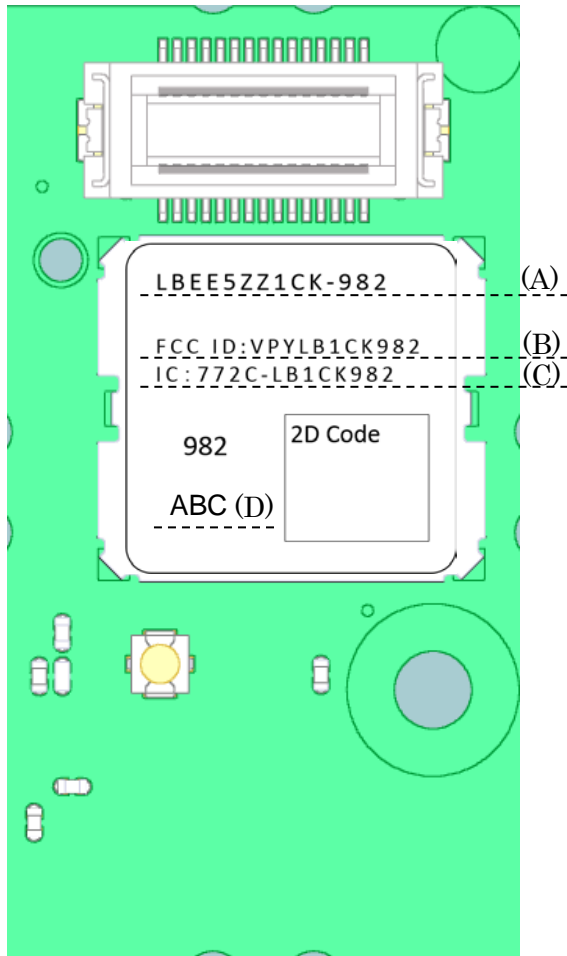
Indication

< connector >

- P/N: DF17(4.0)-30DP-0.5V (mounted on Murata module)
- P/N: DF17(4.0)-30DS-0.5V (need to place on Customer board)
- Maker: HIROSE Electric



Marking  
<Top side>



Marking	Meaning
(A)	Part Number
(B)	FCC ID
(C)	IC ID
(D)	Trace Number

Terminal Configurations

No.	Terminal Name	Type	Connection to IC Terminal	Description
1	VBAT	PI	SR_VDDBATP5V LDO_VDDBAT5V	Power VBAT
2	VBAT	PI	SR_VDDBATP5V LDO_VDDBAT5V	Power VBAT
3	GND	-	-	-
4	VIO	PI	PMU_VDDIO VDDIO VDDIO_SD	I/O supply for PMU, WLAN, SDIO
5	GND	-	-	-
6	WLAN_REG_ON	I	WL_REG_ON	Used by PMU to power up or power down the internal CYW4339 regulators used by the WLAN section. Also, when deasserted, this pin holds the WLAN section in reset. This pin has an internal 200k ohm pull-down resistor that is enabled by default. It can be disabled through programming.
7	BT_REG_ON	I	BT_REG_ON	Used by PMU to power up, or power down the internal CYW4339 regulators used by BT section. Also when deasserted, this pin holds the BT/FM section in reset. This pin has an internal 200kohm pull-down resistor that is enabled by default. It can be disabled by programming.
8	WLAN_HOST_WAKE	I/O	GPIO_0	This pin can be programmed by S/W to be a GPIO, or WLAN_HOST_WAKE output indicating that host wake-up should be performed.
9	GND	-	-	-
10	BT_UART_RTS_N	O	BT_UART_RTS_N	UART request-to-send. Active-low request to send signal for HCI UART I/F
11	BT_UART_TXD	O	BT_UART_TXD	UART signal output. Serial data output for the HCI UART I/F
12	BT_UART_RXD	I	BT_UART_RXD	UART signal input. Serial data input for the HCI UART I/F
13	BT_UART_CTS_N	I	BT_UART_CTS_N	UART clear_to_send. Active low. Clear to send signal for HCI UART I/F
14	GND	-	-	-
15	SLEEP_CLK	I	LPO_IN	External Sleep clock input(32.768kHz)
16	GND	-	-	-
17	BT_DEV_WAKE	I/O	BT_DEV_WAKE	DEV_WAKE of general purpose I/O signal
18	BT_HOST_WAKE	I/O	BT_HOST_WAKE	HOST_WAKE of general purpose I/O signal
19	GND	-	-	-
20	SDIO_D2	I/O	SDIO_DATA2	SDIO Data Line 2
21	GND	-	-	-
22	SDIO_D3	I/O	SDIO_DATA3	SDIO Data Line 3
23	GND	-	-	-
24	SDIO_CMD	I/O	SDIO_CMD	SDIO Command Line
25	GND	-	-	-
26	SDIO_CLK	I	SDIO_CLK	SDIO Clock Input
No.	Terminal Name	Type	Connection to IC Terminal	Description

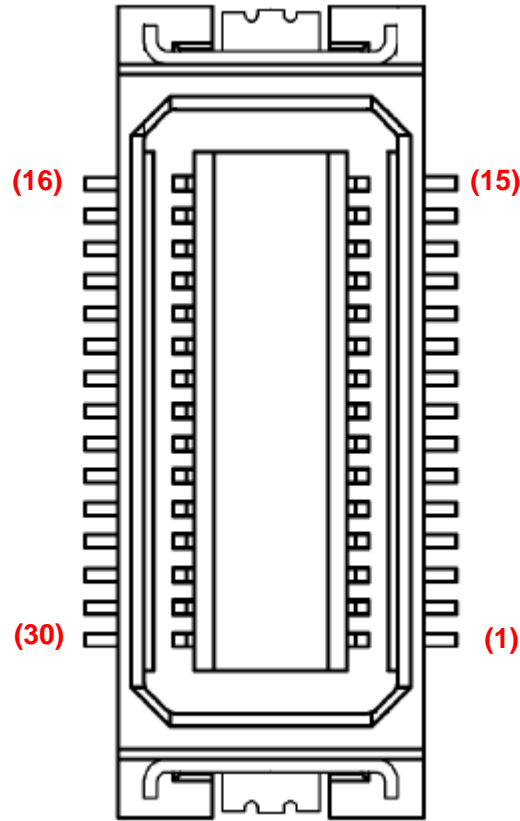
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27	GND	-	-	-
28	SDIO_D0	I/O	SDIO_DATA0	SDIO Data Line 0
29	GND	-	-	-
30	SDIO_D1	I/O	SDIO_DATA1	SDIO Data Line 1

Terminal Configuration looked from a board implementation side of the customer





## 6. Rating

Parameter		min.	max.	Unit
Storage Temperature		-40	85	deg.C
Supply Voltage	VBAT	0	+5	V
	VIO	0	+3.9	V

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

## 7. Operating Condition

### 7.1. Operating condition

Parameter		min.	typ.	max.	unit
Operating Temperature <sup>*1</sup>		-20	25	80	deg.C
Supply Voltage	VBAT	3.2	3.6	4.4	V
	VIO	1.71	1.8	1.89	V

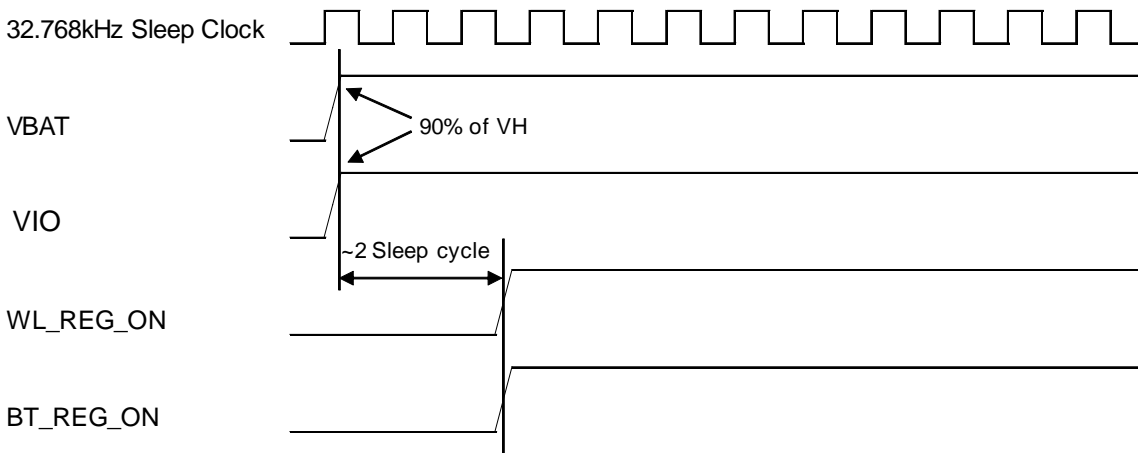
\* Surface temperature of shield case

### 7.2. Power Up Sequence

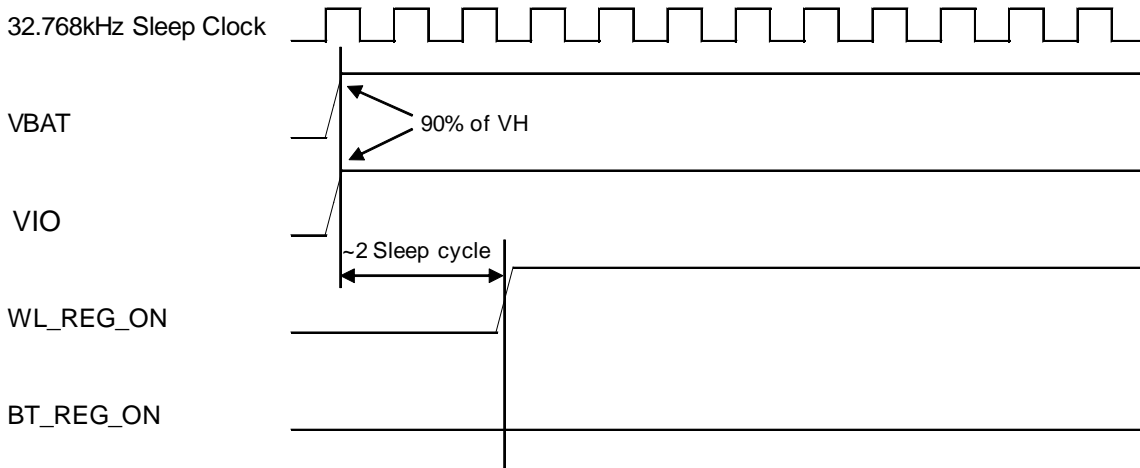
-VBAT should not rise 10%-90% faster than 40 microsecond.

-VBAT should be up before or at the same time as VIO. VIO should NOT be present fast or be held high before VBAT is high.

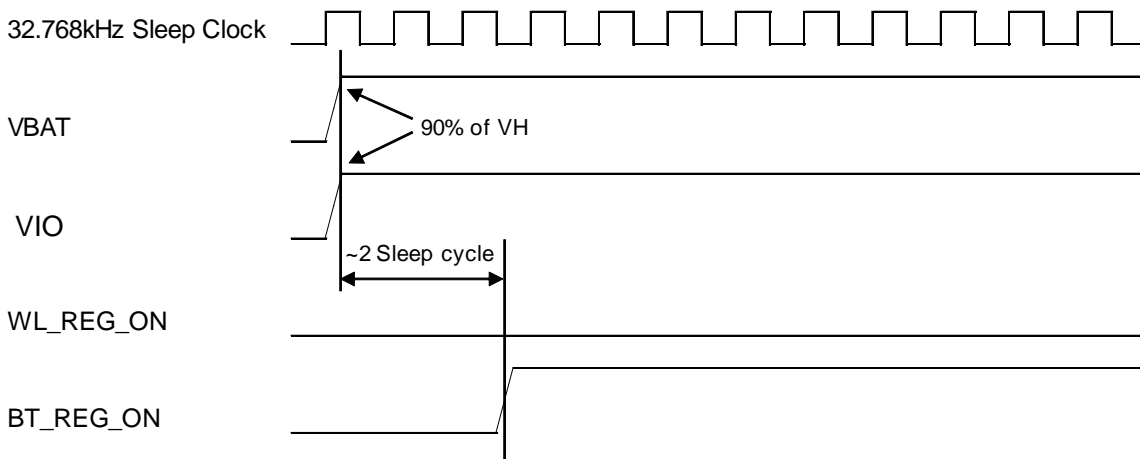
#### 7.2.1 Power On Sequence for WLAN ON and BT ON



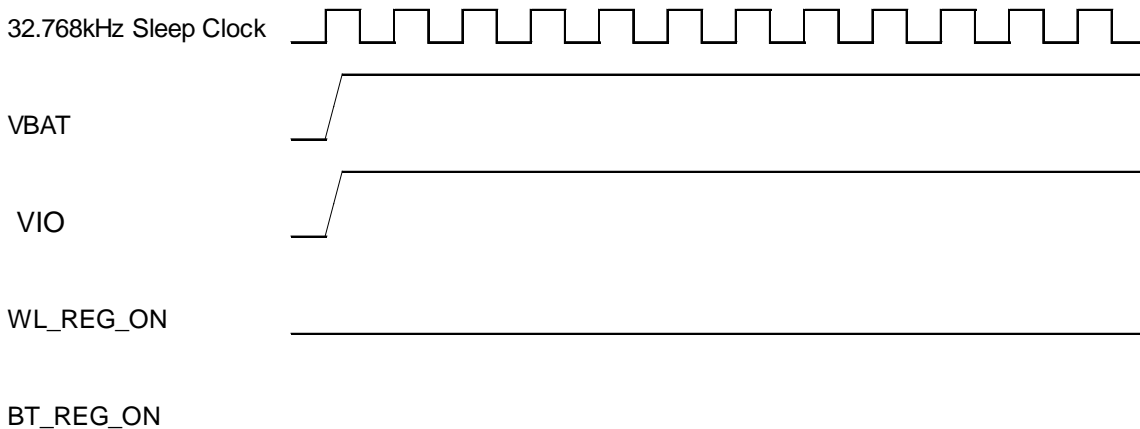
**7.2.2 Power On Sequence for WLAN ON and BT OFF**



**7.2.3 Power On Sequence for WLAN OFF and BT ON**



**7.2.4 Power On Sequence for WLAN OFF and BT OFF**



## 8 External LPO Signal Requirement

Parameter	External LPO Clock	Unit
Nominal input frequency	32.768	kHz
Frequency accuracy	+/-200	ppm
Duty cycle	30-70	%
Input signal amplitude	200 - 1800	mVp-p
Signal type	Square-wave or sine-wave	-
Input impedance <sup>a</sup>	> 100k < 5	ohm pF
Clock jitter (during initial start-up)	<10,000	ppm

a)When power is applied or switch off.

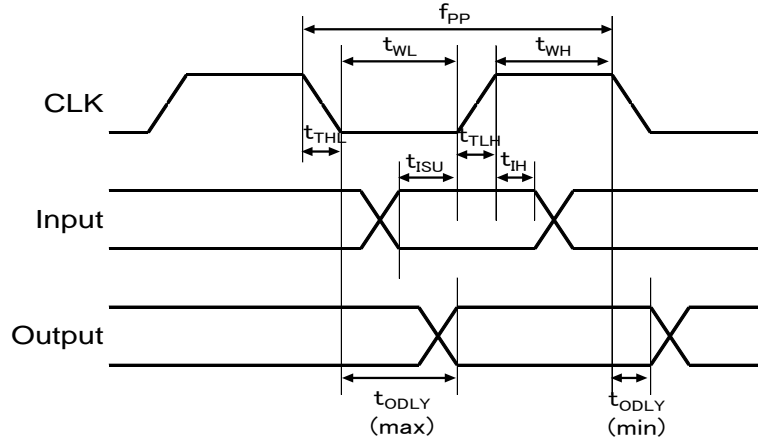
## 9. Digital I/O Requirements

Digital I/O Pins	Sym	min.	typ.	max.	unit
SDIO Interface I/O Pins@1.8V					
Input high voltage	VIH	1.27	-	-	V
Input low voltage	VIL	-	-	0.58	V
Output high voltage@2mA	VOH	1.40	-	-	V
Output low voltage@2mA	VOL	-	-	0.45	V
Other Digital I/O Pins@1.8V					
Input high voltage	VIH	0.65 x VIO	-	-	V
Input low voltage	VIL	-	-	0.35 x VIO	V
Output high voltage@2mA	VOH	VIO-0.45	-	-	V
Output low voltage@2mA	VOL	-	-	0.45	V

## 10 Interface timing

### 10.1 WLAN SDIO Timing

#### 10.1.1 SDIO Timing(Default Mode)



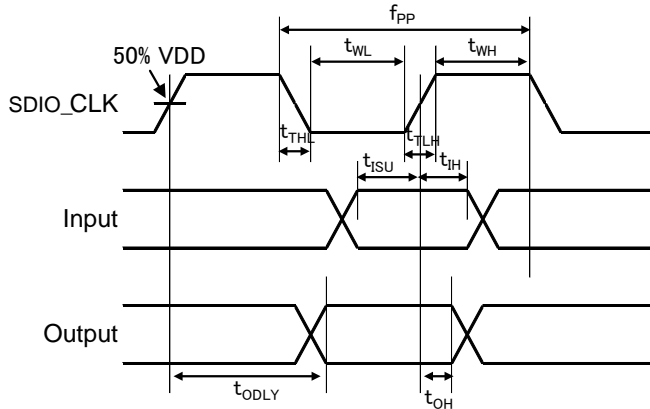
SDIO Bus Timing<sup>(a)</sup> parameters (default Mode)

Parameter	Symbol	Min	Typ	Max	Unit
SDIO CLK (All values are referred to minimum $V_{IH}$ and maximum $V_{IL}$ <sup>(b)</sup> )					
Frequency-Data Transfer Mode	$f_{PP}$	0	-	25	MHz
Frequency-Identification Mode	$f_{OD}$	0	-	400	kHz
Clock Low Time	$t_{WL}$	10	-	-	ns
Clock High Time	$t_{WH}$	10	-	-	ns
Clock Rise Time	$t_{TLH}$	-	-	10	ns
Clock low Time	$t_{THL}$	-	-	10	ns
Inputs: CMD, DAT (referenced to CLK)					
Input Setup Time	$t_{ISU}$	5	-	-	ns
Input Hold Time	$t_{IH}$	5	-	-	ns
Outputs: CMD, DAT (referenced to CLK)					
Output Delay time-Data Transfer Mode	$t_{ODLY}$	0	-	14	ns
Output Delay time-Identification Mode	$t_{ODLY}$	0	-	50	ns

(a). Timing is based on  $CL \leq 40pF$  load on CMD and Data.

(b). Min ( $V_{ih}$ ) =  $0.7 \cdot V_{IO}$  and max ( $V_{il}$ ) =  $0.2 \cdot V_{IO}$ .

**10.1.2 SDIO Timing(High Speed Mode)**



SDIO Bus Timing<sup>(a)</sup> parameters (High-Speed Mode)

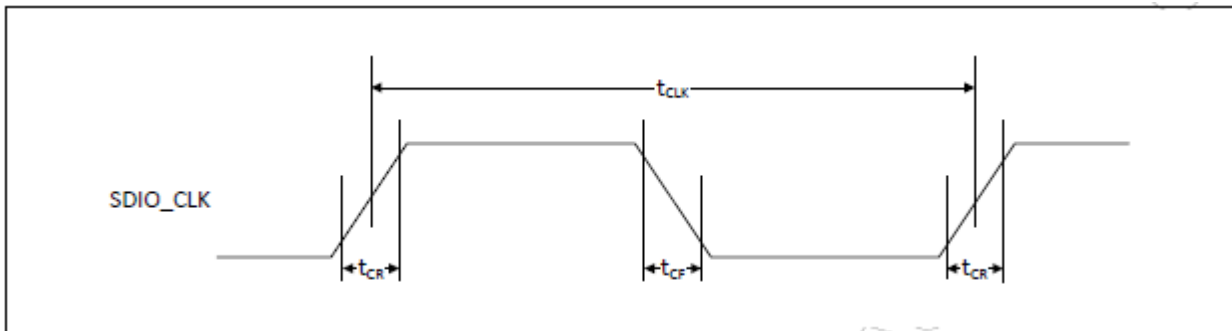
Parameter	Symbol	Min	Typ	Max	Unit
SDIO CLK (All values are referred to minimum VIH and maximum VIL <sup>(b)</sup> )					
Frequency-Data Transfer Mode	f <sub>PP</sub>	0	-	50	MHz
Frequency-Identification Mode	f <sub>OD</sub>	0	-	400	kHz
Clock Low Time	t <sub>WL</sub>	7	-	-	ns
Clock High Time	t <sub>WH</sub>	7	-	-	ns
Clock Rise Time	t <sub>TLH</sub>	-	-	3	ns
Clock low Time	t <sub>TLL</sub>	-	-	3	ns
Inputs: CMD, DAT (referenced to CLK)					
Input Setup Time	t <sub>ISU</sub>	6	-	-	ns
Input Hold Time	t <sub>IH</sub>	2	-	-	ns
Outputs: CMD, DAT (referenced to CLK)					
Output Delay time-Data Transfer Mode	t <sub>ODLY</sub>	-	-	14	ns
Output Hold time	t <sub>OH</sub>	2.5	-	-	ns
Total System Capacitance (each line)	CL	-	-	40	pF

(a). Timing is based on CL ≤ 40pF load on CMD and Data.

(b). Min (V<sub>Ih</sub>) = 0.7\*V<sub>IO</sub> and max (V<sub>Il</sub>) = 0.2\*V<sub>IO</sub>.

**10.1.3 SDIO timing(SDR mode)**

**Clock Timing**



SDIO Bus Clock Timing Parameters(SDR Modes)

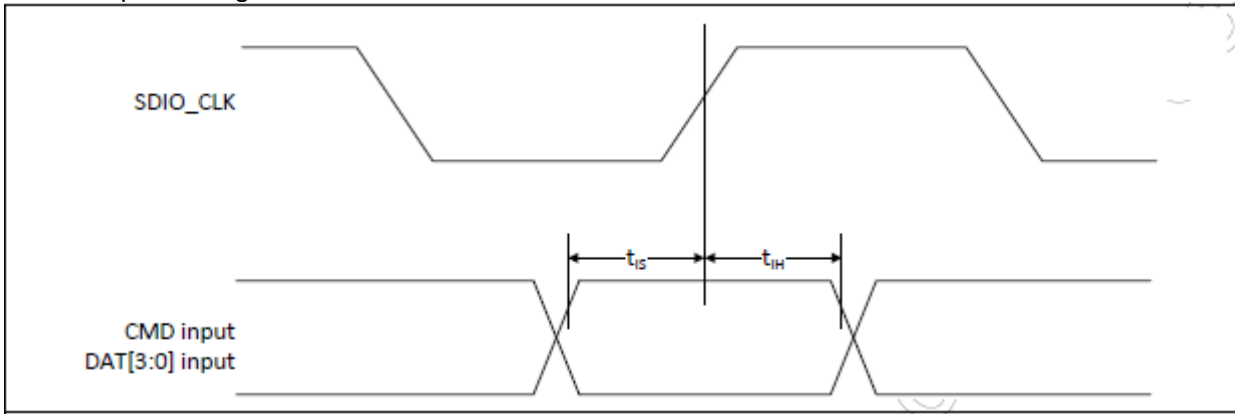
Parameter	Symbol	Min	Max	Unit	Comments
-	t <sub>clk</sub>	40	-	ns	SDR12 mode
		20	-	ns	SDR25 mode
		10	-	ns	SDR50 mode
		4.8	-	ns	SDR104 mode
-	t <sub>cr</sub> , t <sub>cf</sub>	-	0.2xt <sub>clk</sub>	ns	t <sub>cr</sub> , t <sub>cf</sub> < 2.00ns(max) @ 100MHz, C <sub>card</sub> = 10pF t <sub>cr</sub> , t <sub>cf</sub> < 0.96ns(max) @ 208MHz, C <sub>card</sub> = 10pF
Clock duty cycle	-	30	70	%	ns

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Device Input Timing

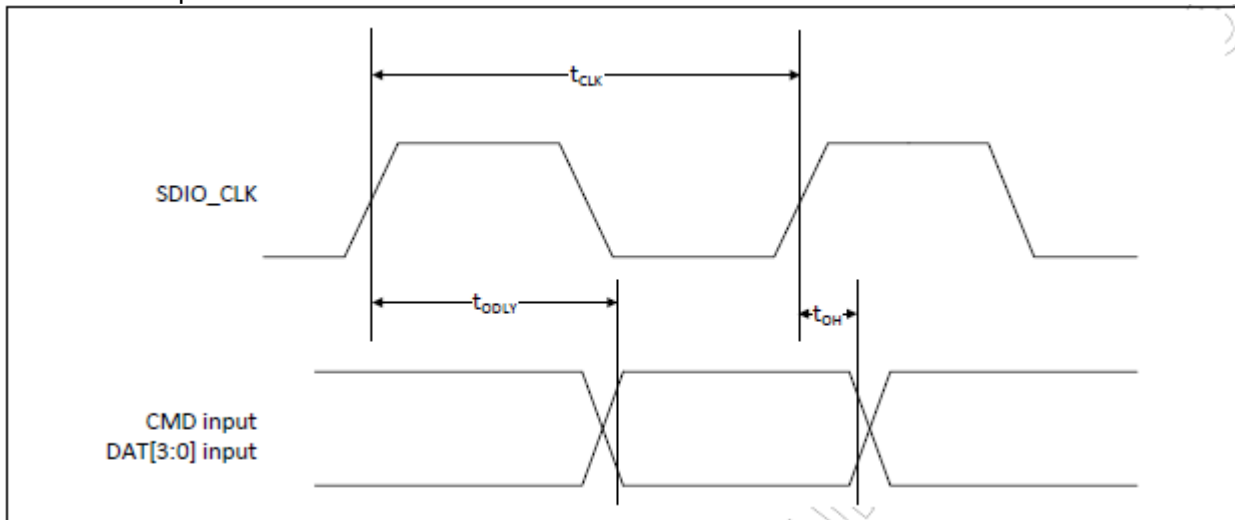


SDIO Bus Input Timing Parameters(SDR Modes)

Symbol	Min	Max	Unit	CommentsUnit
<b>SDR104 Mode</b>				
$t_{IS}$	1.4	-	ns	Ccard=10pF, VCT=0.975V
$t_{IH}$	0.8	-	ns	Ccard=5pF, VCT=0.975v
<b>SDR50 Mode</b>				
$t_{IS}$	3.0	-	ns	Ccard=10pF, VCT=0.975V
$t_{IH}$	0.8	-	ns	Ccard=5pF, VCT=0.975V

Device Output Timing

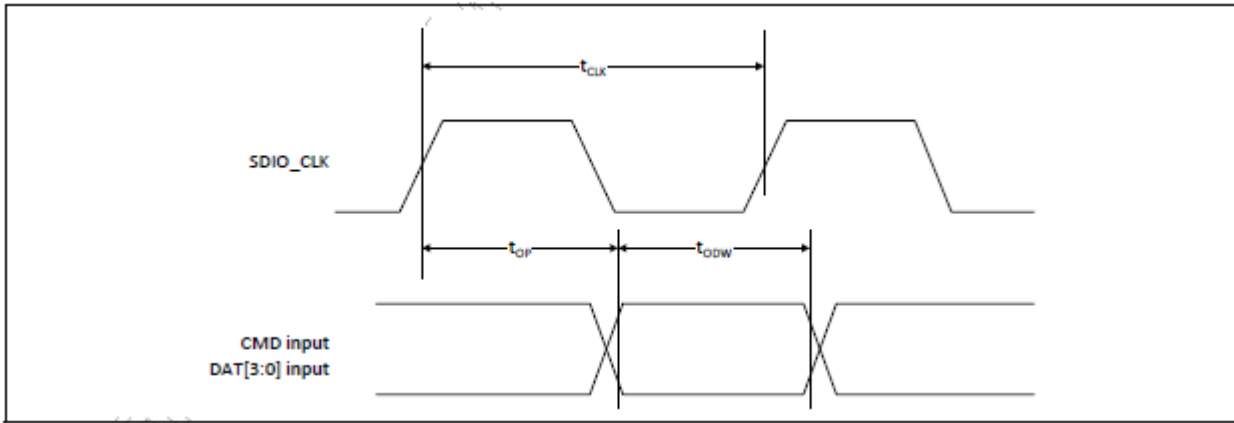
SDR Modes up to 100MHz



SDIO Bus Output Timing Parameters(SDR Modes up to 100MHz)

Symbol	Min	Max	Unit	CommentsUnit
$t_{ODLY}$	-	7.5	ns	$t_{CLK} > 10ns$ CI=30pF using driver tyoe B for SDR50
$t_{ODLY}$	-	14.0	ns	$t_{CLK} > 20ns$ CI=40pF using for SDR12, SDR25
$t_{OH}$	1.5	-	ns	Hold time at the $t_{ODLY}(\min)$ CI=15pF

SDR Modes 100MHz to 208MHz



SDIO Bus Output Timing Parameters(SDR Modes 100MHz up to 208MHz)

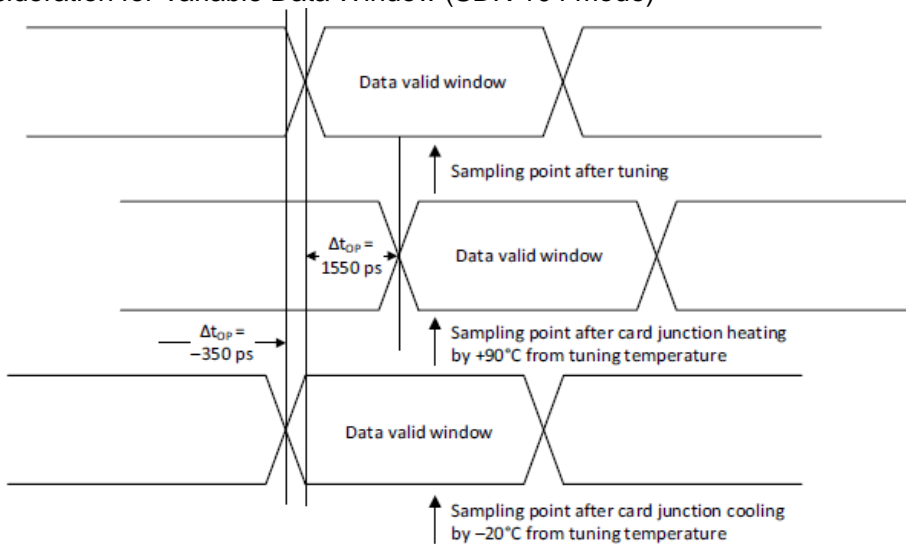
Symbol	Min	Max	Unit	Comments
$t_{OP}$	0	2	UI	Card output phase
$\Delta t_{OP}$	-350	+1550	ps	Delay variation due to temp change after tuning
$t_{ODW}$	0.60	-	UI	$t_{ODW}=2.88ns@208MHz$

$\Delta t_{OP}=+1550$  ps for junction temperature of  $\Delta t_{OP}=90$  degrees during operation

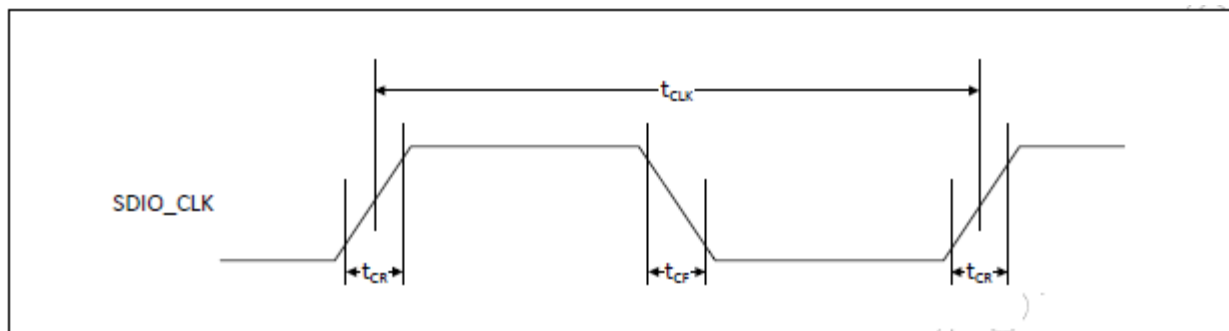
$\Delta t_{OP}=-350$  ps for junction temperature of  $\Delta t_{OP}=-20$  degrees during operation

$\Delta t_{OP}=+2600$  ps for junction temperature of  $\Delta t_{OP}=-20$  to  $+125$  degrees during operation

$\Delta t_{OP}$  Consideration for Variable Data Window (SDR 104 mode)



**10.1.4 SDIO Timing(DDR50 mode)**

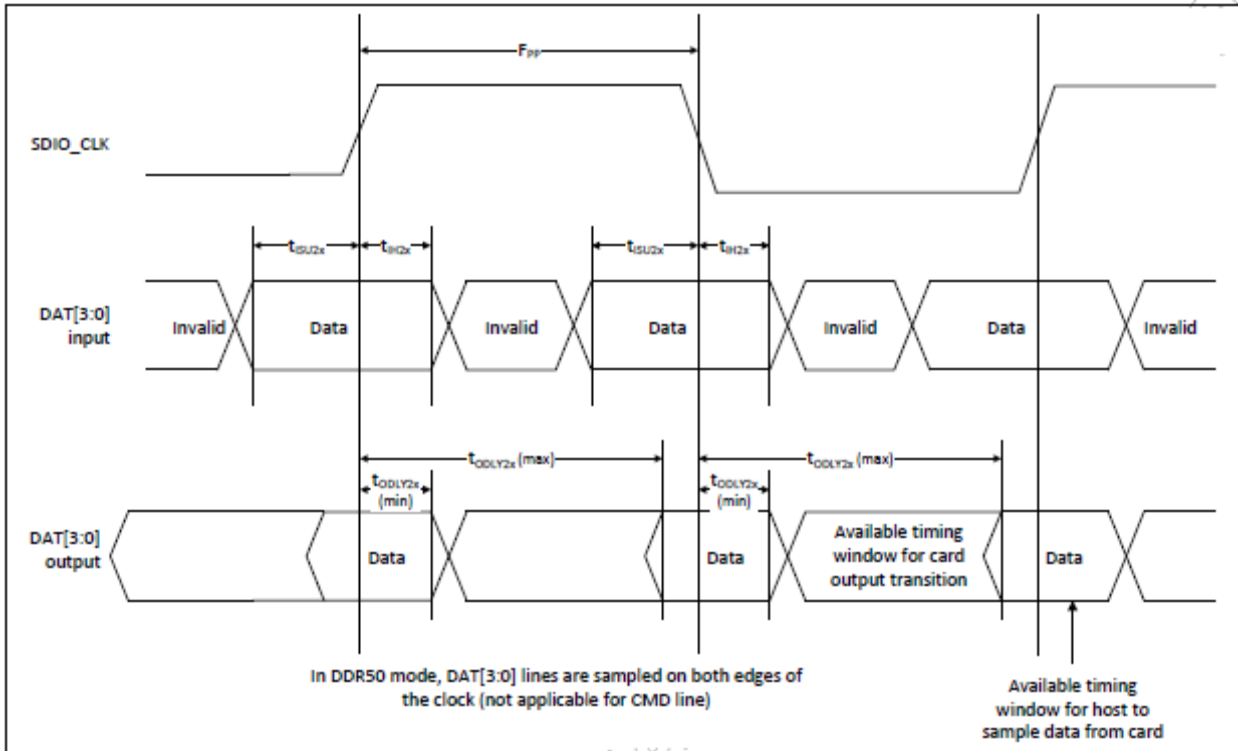


SDIO Bus Clock Timing Parameters(DDR50 Mode)

parameter	Symbol	Min	Max	Unit	Comments
-	tclk	20	-	ns	DDR50 mode
-	tcr, tcf	-	0.2xtclk	ns	tcr, tcf<4.00ns(max)@50MHz, Ccard=10pF
Clock duty cycle	-	45	55	%	-



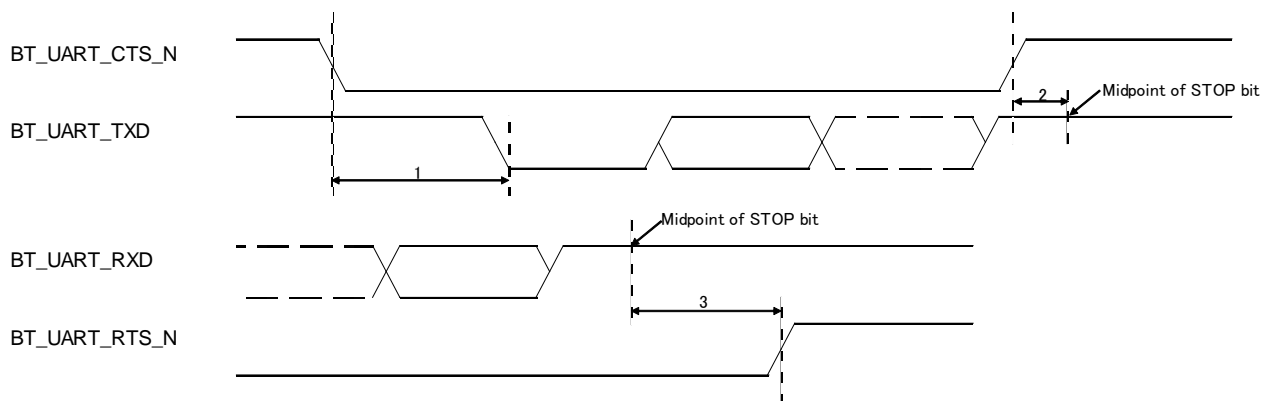
Data Timing, DDR50 Mode



SDIO Bus Timing Parameters(DDR50 Mode)

parameter	Symbol	Min	Max	unit	Comments
<b>Input CMD</b>					
Input setup time	tisu	6	-	ns	Ccard<10pF(1 Card)
Input hold time	tih	0.8	-	ns	Ccard<10pF(1 Card)
<b>Output CMD</b>					
Output delay time	todly	-	13.7	ns	Ccard<30pF(1 Card)
Output hold time	toh	1.5	-	ns	Ccard<15pF(1 Card)
<b>Input DAT</b>					
Input setup time	tisu2x	3	-	ns	Ccard<10pF(1 Card)
Input hold time	tihu2x	0.8	-	ns	Ccard<10pF(1 Card)
<b>Output DAT</b>					
Output delay time	todly2x	-	7.0	ns	Ccard<25pF(1 Card)
Output hold time	todly2x	1.5	-	ns	Ccard<15pF(1 Card)

## 10.2 Bluetooth UART Timing



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

## 11 ELECTORICAL CHARACTERISTICS

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

Normal Condition : 25deg.C, VBAT=3.6V.

11Mbps mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11b-2.4GHz			
Mode	DSSS / CCK			
Channel frequency	2412 to 2472 MHz			
Data rate	1, 2, 5.5, 11Mbps			
Power setting (Tx power, in dBm)	17			
<b>Current Consumption</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>unit</b>
(a) Tx mode (99% Tx mode)	-	-	350	mA
(b) Rx mode	-	-	100	mA
<b>Transmitter</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
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	%
Spurious Emissions (BW=100kHz)				
(a) $10\text{MHz} \leq f < 2387\text{MHz}$	-	-	-36	dBm
(b) $2387\text{MHz} \leq f < 2400\text{MHz}$	-	-	-30	dBm
(c) $2483.5\text{MHz} < f \leq 2496.5\text{MHz}$	-	-	-47	dBm
(d) $2496.5\text{MHz} < f \leq 8\text{GHz}$	-	-	-47	dBm
<b>Receiver</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Minimum Input Level (FER <sub>≤</sub> 8%)	-	-	-76	dBm
Maximum Input Level (FER <sub>≤</sub> 8%)	-10	-	-	dBm
Adjacent Channel Rejection (FER <sub>≤</sub> 8%)	35	-	-	dB

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

Normal Condition : 25deg.C, VBAT =3.6V.

54Mbps mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11g-2.4GHz			
Mode	OFDM			
Channel frequency	2412 to 2472 MHz			
Data rate	6, 9, 12, 18, 24, 36, 48, 54Mbps			
Power setting (Tx power, in dBm)	14			
<b>Current Consumption</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
(a) Tx mode (99% Tx mode)	-	-	300	mA
(b) Rx mode	-	-	100	mA
<b>Transmitter</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Power Levels	12	14	16	dBm
Spectrum Mask				
(a) at $f_c \pm 11\text{MHz}$	-	-	-20	dBr
(b) at $f_c \pm 20\text{MHz}$	-	-	-28	dBr
(c) at $f_c \geq \pm 30\text{MHz}$	-	-	-40	dBr
Constellation Error	-	-	-25	dB
Spurious Emissions (BW=100kHz)				
(a) $10\text{MHz} \leq f < 2387\text{MHz}$	-	-	-36	dBm
(b) $2387\text{MHz} \leq f < 2400\text{MHz}$	-	-	-30	dBm
(c) $2483.5\text{MHz} < f \leq 2496.5\text{MHz}$	-	-	-47	dBm
(d) $2496.5\text{MHz} < f \leq 8\text{GHz}$	-	-	-47	dBm
<b>Receiver</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Minimum Input Level (PER $\leq 10\%$ )	-	-	-65	dBm
Maximum Input Level (PER $\leq 10\%$ )	-20	-	-	dBm
Adjacent Channel Rejection (FER $\leq 10\%$ )	-1	-	-	dB

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

Normal Condition : 25deg.C, VBAT =3.6V.

65Mbps (MCS7) mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11n-2.4GHz			
Mode	OFDM			
Channel frequency	2412 to 2472 MHz			
Data rate	6.5, 13, 19.5, 26, 39, 52, 58.5, 65Mbps			
Power setting (Tx power, in dBm)	13			
<b>Current Consumption</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
(a) Tx mode (99% Tx mode)	-	-	300	mA
(b) Rx mode	-	-	100	mA
<b>Transmitter</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Power Levels	11	13	15	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc $\geq$ +/-30MHz	-	-	-45	dBr
Constellation Error	-	-	-27	dB
Spurious Emissions (BW=100kHz)				
(a) 10MHz $\leq$ f < 2387MHz	-	-	-36	dBm
(b) 2387MHz $\leq$ f < 2400MHz	-	-	-30	dBm
(c) 2483.5MHz < f $\leq$ 2496.5MHz	-	-	-47	dBm
(d) 2496.5MHz < f $\leq$ 8GHz	-	-	-47	dBm
<b>Receiver</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Minimum Input Level (PER $\leq$ 10%)	-	-	-64	dBm
Adjacent Channel Rejection (FER $\leq$ 10%)	-1	-	-	dB

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

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

Items	Contents			
Specification	IEEE802.11a-5GHz			
Mode	OFDM			
Channel frequency	5180 - 5825MHz			
Data rate	6, 9, 12, 18, 24, 36, 48, 54Mbps			
Power setting (Tx power, in dBm)	12			
<b>Current Consumption</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
(a) Tx mode (99% Tx mode)	-	-	350	mA
(b) Rx mode	-	-	110	mA
<b>Transmitter</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Power Levels	10	12	14	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc $\geq$ +/-30MHz	-	-	-40	dBr
Constellation Error	-	-	-25	dB
Spurious Emissions (BW=100kHz)				
(a) 10MHz $\leq$ f < 2387MHz	-	-	-36	dBm
(b) 2387MHz $\leq$ f < 2400MHz	-	-	-30	dBm
(c) 2483.5MHz < f $\leq$ 2496.5MHz	-	-	-47	dBm
(d) 2496.5MHz < f $\leq$ 8GHz	-	-	-47	dBm
<b>Receiver</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Minimum Input Level (PER $\leq$ 10%)	-	-	-65	dBm
Adjacent Channel Rejection (FER $\leq$ 10%)	-1	-	-	dB

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

Normal Condition : 25deg.C, VBAT =3.6V.

65Mbps (MCS7 – HT 20MHz) mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11n-5GHz			
Mode	OFDM			
Channel frequency	5180 - 5825MHz			
Data rate	6.5, 13, 19.5, 26, 39, 52, 58.5, 65Mbps			
Power setting (Tx power, in dBm)	12			
<b>Current Consumption</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
(a) Tx mode (99% Tx mode)	-	-	350	mA
(b) Rx mode	-	-	110	mA
<b>Transmitter</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Power Levels	10	12	14	dBm
Spectrum Mask				
(a) at $f_c \pm 11\text{MHz}$	-	-	-20	dBr
(b) at $f_c \pm 20\text{MHz}$	-	-	-28	dBr
(c) at $f_c \geq \pm 30\text{MHz}$	-	-	-40	dBr
Constellation Error (measured at enhanced mode)	-	-	-27	dB
Spurious Emissions (BW=100kHz)				
(a) $10\text{MHz} \leq f < 2387\text{MHz}$	-	-	-36	dBm
(b) $2387\text{MHz} \leq f < 2400\text{MHz}$	-	-	-30	dBm
(c) $2483.5\text{MHz} < f \leq 2496.5\text{MHz}$	-	-	-47	dBm
(d) $2496.5\text{MHz} < f \leq 8\text{GHz}$	-	-	-47	dBm
<b>Receiver</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Minimum Input Level (PER $\leq 10\%$ )	-	-	-64	dBm
Adjacent Channel Rejection (FER $\leq 10\%$ )	-1	-	-	dB

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

Normal Condition : 25deg.C, VBAT =3.6V.

135Mbps (MCS7 – HT 40MHz) mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11n-5GHz			
Mode	OFDM			
Channel frequency	5190 - 5795MHz			
Data rate	13.5, 27, 40.5, 54, 81, 108, 121.5, 135Mbps			
Power setting (Tx power, in dBm)	11.5			
<b>Current Consumption</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
(a) Tx mode (99% Tx mode)	-	-	350	mA
(b) Rx mode	-	-	110	mA
<b>Transmitter</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Power Levels	9.5	11.5	13.5	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
Spurious Emissions (BW=100kHz)				
(a) 10MHz ≤ f < 2387MHz	-	-	-36	dBm
(b) 2387MHz ≤ f < 2400MHz	-	-	-30	dBm
(c) 2483.5MHz < f ≤ 2496.5MHz	-	-	-47	dBm
(d) 2496.5MHz < f ≤ 8GHz	-	-	-47	dBm
<b>Receiver</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Minimum Input Level (PER ≤ 10%)	-	-	-61	dBm
Adjacent Channel Rejection (FER ≤ 10%)	-1	-	-	dB



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

Normal Condition : 25deg.C, VBAT =3.6V.

180Mbps (MCS9 – VHT 40MHz) mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11ac-5GHz			
Mode	OFDM			
Channel frequency	5190 - 5795MHz			
Data rate	13.5,27,40.5,54,81,108,121.5,135,160,180Mbps			
Power setting (Tx power, in dBm)	11.5			
<b>Current Consumption</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
(a) Tx mode (99% Tx mode)	-	-	350	mA
(b) Rx mode	-	-	130	mA
<b>Transmitter</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Power Levels	9.5	11.5	13.5	dBm
<b>Spectrum Mask</b>				
(a) at $f_c \pm 21\text{MHz}$	-	-	-20	dBr
(b) at $f_c \pm 40\text{MHz}$	-	-	-28	dBr
(c) at $f_c \geq \pm 60\text{MHz}$	-	-	-40	dBr
Constellation Error (measured at enhanced mode)	-	-	-32	dB
<b>Spurious Emissions (BW=100kHz)</b>				
(a) $10\text{MHz} \leq f < 2387\text{MHz}$	-	-	-36	dBm
(b) $2387\text{MHz} \leq f < 2400\text{MHz}$	-	-	-30	dBm
(c) $2483.5\text{MHz} < f \leq 2496.5\text{MHz}$	-	-	-47	dBm
(d) $2496.5\text{MHz} < f \leq 8\text{GHz}$	-	-	-47	dBm
<b>Receiver</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Minimum Input Level (PER $\leq 10\%$ )	-	-	-54	dBm
Adjacent Channel Rejection (FER $\leq 10\%$ )	-1	-	-	dB

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

Normal Condition : 25deg.C, VBAT =3.6V.

390Mbps (MCS9 – VHT 80MHz) mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11ac-5GHz			
Mode	OFDM			
Channel frequency	5210 - 5775MHz			
Data rate	29.3,58.5,87.8,117,175.5,234,263.3,292.5,351,390Mbps			
Power setting (Tx power, in dBm)	11			
<b>Current Consumption</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
(a) Tx mode (99% Tx mode)	-	-	350	mA
(b) Rx mode	-	-	160	mA
<b>Transmitter</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Power Levels	9	11	13	dBm
<b>Spectrum Mask</b>				
(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
<b>Spurious Emissions (BW=100kHz)</b>				
(a) 10MHz ≤ f < 2387MHz	-	-	-36	dBm
(b) 2387MHz ≤ f < 2400MHz	-	-	-30	dBm
(c) 2483.5MHz < f ≤ 2496.5MHz	-	-	-47	dBm
(d) 2496.5MHz < f ≤ 8GHz	-	-	-47	dBm
<b>Receiver</b>	<b>min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Minimum Input Level (PER ≤ 10%)	-	-	-51	dBm
Adjacent Channel Rejection (FER ≤ 10%)	-1	-	-	dB

### 11.9 DC/RF Characteristics for Bluetooth

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

Items	Contents			
Bluetooth specification (power class)	Version 2.1+EDR (Class1)			
Channel frequency (spacing)	2402 to 2480 MHz (1MHz)			
<b>Current Consumption</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
(a) DH5 Packet 50% Rx/Tx slot duty cycle	-	-	90	mA
(b) 2DH5 Packet 50% Rx/Tx slot duty cycle	-	-	80	mA
(c) 3DH5 Packet 50% Rx/Tx slot duty cycle	-	-	80	mA
<b>Transmitter</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Output Power *1	7	11	15	dBm
Frequency range	2400	-	2483.5	MHz
20dB bandwidth	-	-	1	MHz
Adjacent Channel Power *2				
(a) [M-N] =2	-	-	-20	dBm
(b) [M-N] ≥3	-	-	-40	dBm
Modulation characteristics				
(a) Modulation Δf1avg	140	-	175	kHz
(b) Modulation Δf2max	115	-	-	kHz
(c) Modulation Δf2avg / Δf1avg	0.8	-	-	
Carrier Frequency Drift				
(a) 1slot	-25	-	+25	kHz
(b) 3slot / 5slot	-40	-	+40	kHz
(c) Maximum drift rate	-20	-	+20	kHz/50us
EDR Relative Power	-4	-	+1	dB
EDR Carrier Frequency Stability and Modulation Accuracy				
(a) ωi	-75	-	+75	kHz
(b) ωi+ωo	-75	-	+75	kHz
(c) ωo	-10	-	+10	kHz
(d) RMS DEVM (DQPSK)	-	-	20	%
(e) Peak DEVM (DQPSK)	-	-	35	%
(f) 99% DEVM (DQPSK)	-	-	30	%
(g) RMS DEVM (8DPSK)	-	-	13	%
(h) Peak DEVM (8DPSK)	-	-	25	%
(i) 99% DEVM (8DPSK)	-	-	20	%
Spurious Emissions (BW=100kHz)				
(a) 10MHz ≤ f < 2387MHz	-	-	-36	dBm
(b) 2387MHz ≤ f < 2400MHz	-	-	-30	dBm
(c) 2483.5MHz < f ≤ 2496.5MHz	-	-	-47	dBm
(d) 2496.5MHz < f ≤ 8GHz	-	-	-47	dBm
<b>Receiver</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Sensitivity (BER≤0.1%)	-	-	-80	dBm
C/I Performance (BER≤0.1%) *3				
(a) co-channel	-	-	11	dB
(b) 1MHz	-	-	0	dB
(c) 2MHz	-	-	-30	dB
(d) 3MHz	-	-	-40	dB
(e) image (+4MHz)	-	-	-9	dB
(f) image +/- 1MHz	-	-	-20	dB
Maximum Input Level (BER≤0.1%)	-20	-	-	dBm
EDR Sensitivity (BER≤0.007%)				
(a) 8DPSK	-	-	-77	dBm

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

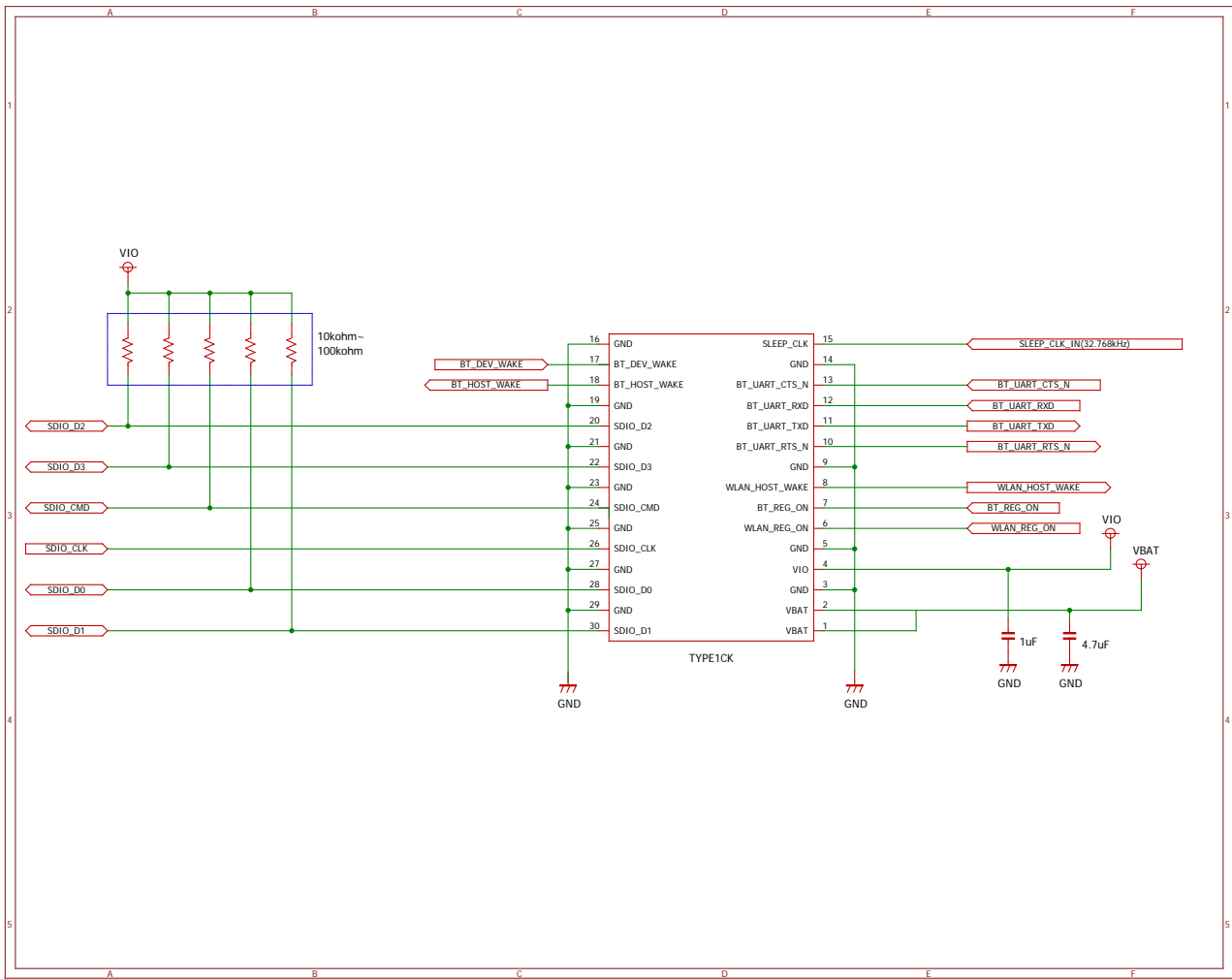
\*2: Up to five spurious responses within Bluetooth limits are allowed.

### 11.10 DC/RF Characteristics for Bluetooth (LE)

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

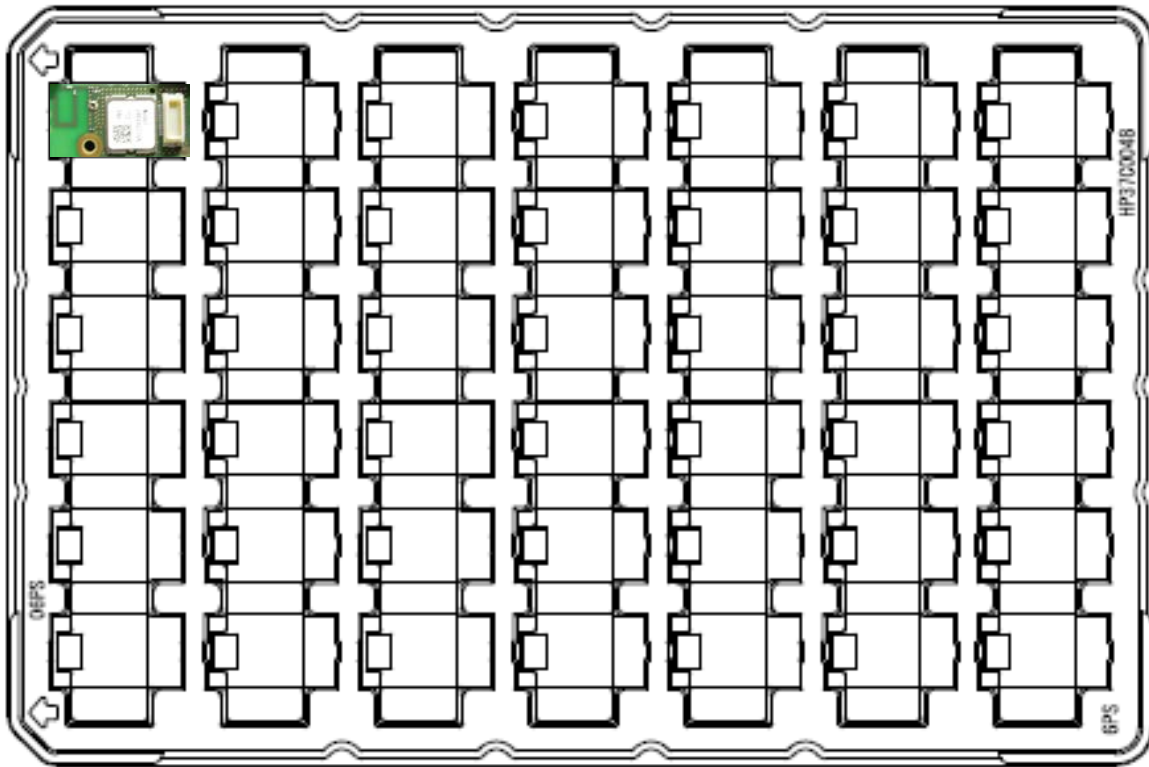
Items	Contents			
Bluetooth specification (power class)	Version 4.1(LE)			
Channel frequency (spacing)	2402 to 2480 MHz (2MHz)			
Number of RF Channel	40			
Item / Condition	Min.	Typ.	Max.	Unit
Center Frequency	2402	-	2480	MHz
Channel Spacing	-	2	-	MHz
Number of RF channel	-	40	-	-
Output power *1	-	-	10	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
Receiver sensitivity (PER < 30.8%)	-	-	-70	dBm
Maximum input signal level (PER < 30.8%)	-10	-	-	dBm
PER Report Integrity (-30dBm input)	50	-	65.4	%

**12 REFERENCE CIRCUIT**



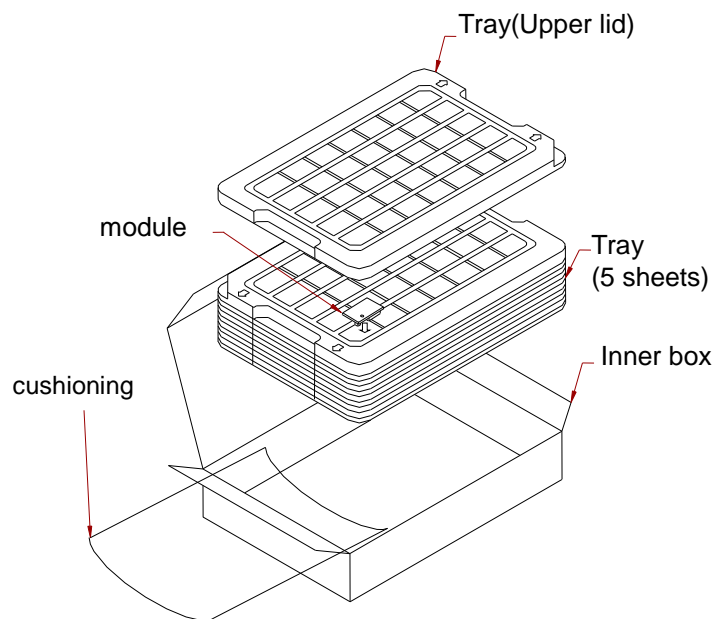
### 13 Packing Information

The products shall be packed in the below tray.

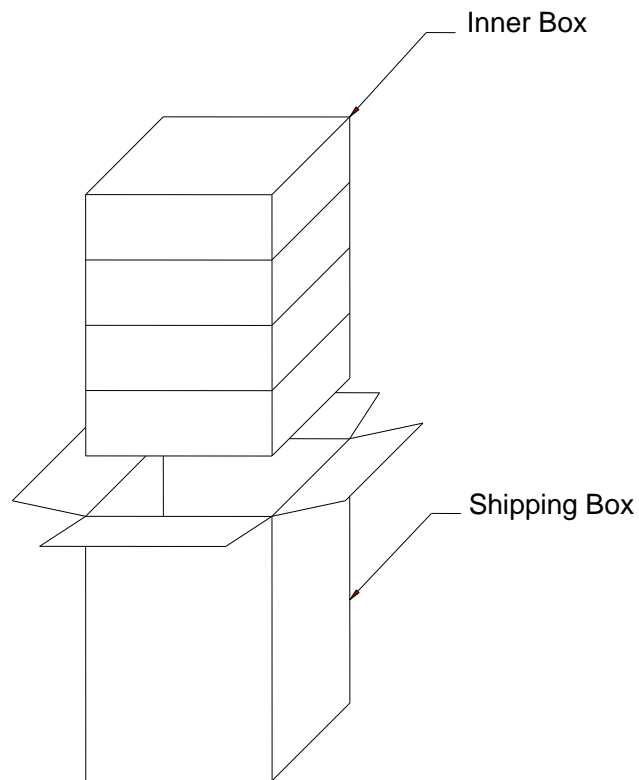


Number of the products in the carton is 210pcs.  
There is the 42pcs per tray and 5pile number of the tray which stored the product.  
Finally, a dummy tray is put on the topmost part of trays.

Packing in a inner box



Shipping box



- Please keep any packaging below 40 deg.C until using it up, because a tray is potentially deformed with storage over the temperature.
- Please don't stack the shipping box over 1.5m height to avoid any physical problem.
- Four inner boxes is general number in a shipping box, but it may be dummy for some of inner boxes.
- One inner box has 210pcs as standard q'ty.
- MOQ is 840pcs, which are constructed two inner boxes.

## **NOTICE**

### **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<sub>2</sub>, NH<sub>3</sub>, SO<sub>2</sub>, NO<sub>x</sub>, 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.

### **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 destroy by static electrical charge.

### **3. Cleaning :**

Since this Product is Moisture Sensitive, any cleaning is not permitted.

### **4. 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.

### **5. 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.