

W-LAN Module Data Sheet

Infineon Chipset
for 802.11b/g/n + Bluetooth® v5.1

Sample P/N : LBEE5KL1DX-TEMP

The revision history of the product specification

Issued Date	Revision Code	Revision Page	Changed Items	Change Reason
Oct 24, 2022	-	-	First Issue	

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1. Scope

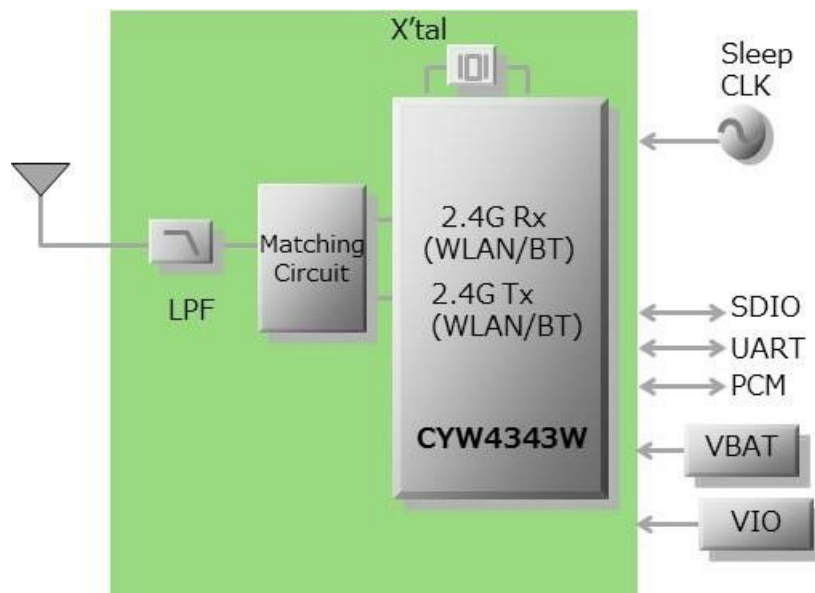
This specification is applied to the IEEE802.11b/g/n W-LAN + Bluetooth® v5.1 (BR/EDR/BLE) module for only Wi-Fi applications.

- Interface : SDIO (WLAN), UART (BT)
- IC/Firmware : Infineon/CYW4343W
- Reference Clock : Reference clock is embedded.
- MSL : Level 3

2. Part Number

Sample Part Number	LBEE5KL1DX-TEMP
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3. Block Diagram



4. Certification Information

4.1. Radio Certification USA

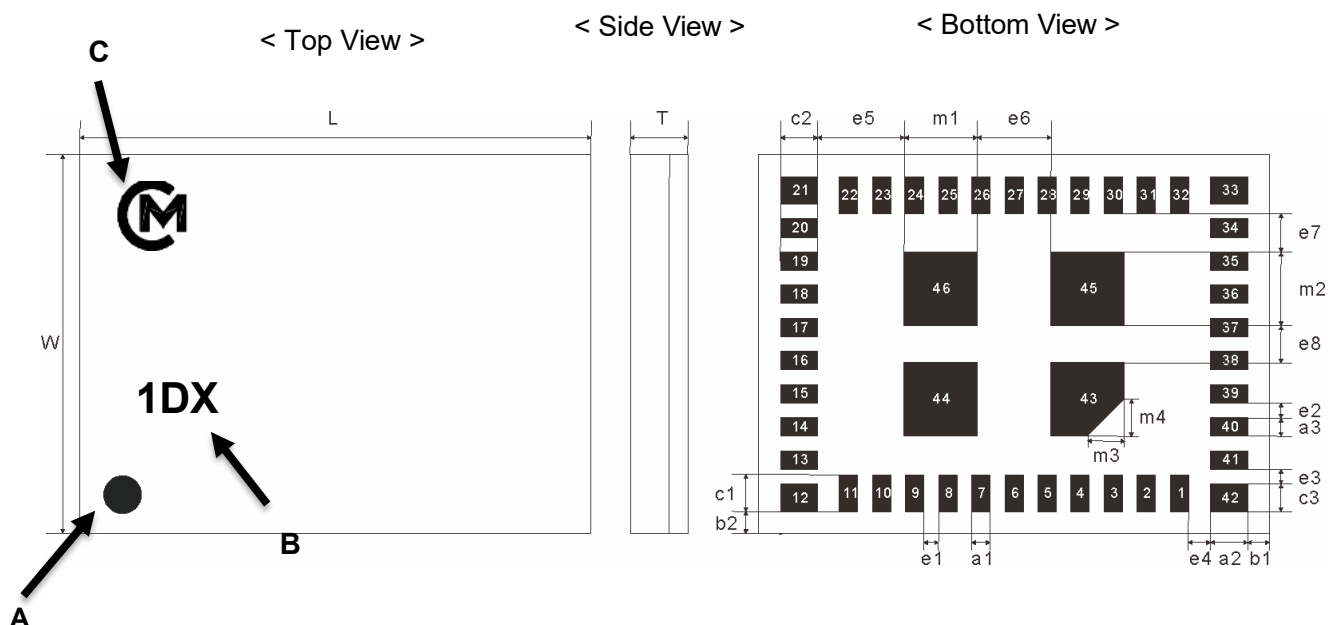
FCC ID:

2A83TWFASPD

*Please follow installation manual of Appendix

5. Dimensions, Marking and Terminal Configurations

5.1. Dimensions



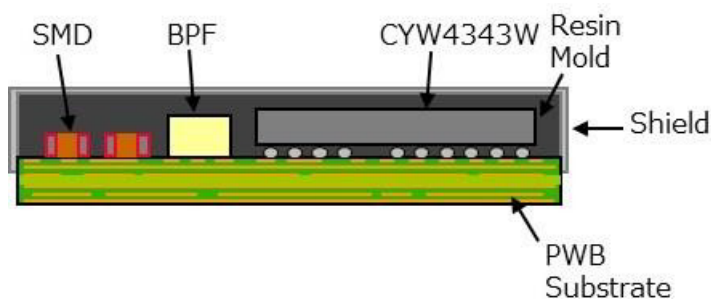
Marking	Meaning
A	Pin 1 Marking
B	Module Type
C	Logo

Dimensions

(unit : mm)

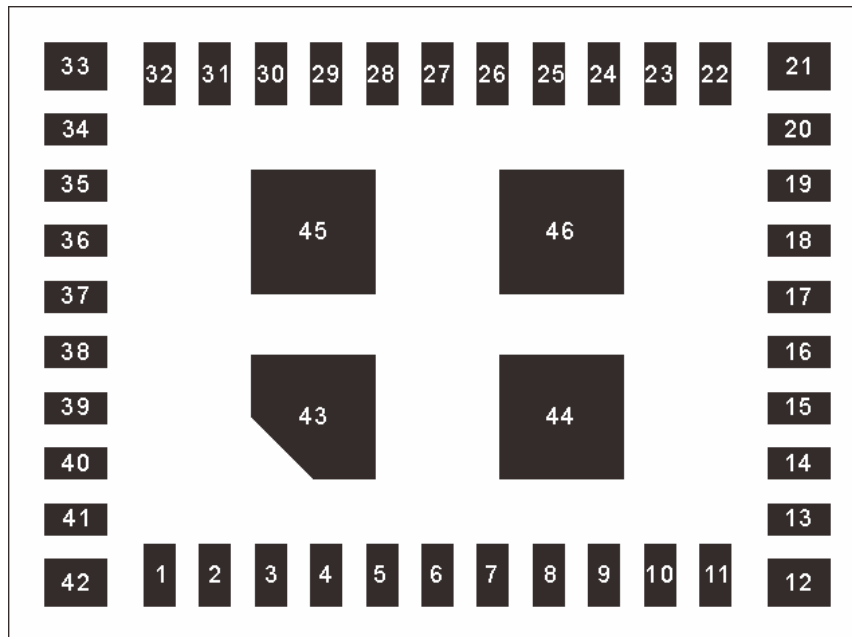
Mark	Dimensions	Mark	Dimensions	Mark	Dimensions
L	6.95 +/- 0.2	W	5.15 +/- 0.2	T	1.1 max.
a1	0.25 +/- 0.10	a2	0.5 +/- 0.1	a3	0.25 +/- 0.10
b1	0.30 +/- 0.2	b2	0.30 +/- 0.2	c1	0.50 +/- 0.1
c2	0.50 +/- 0.1	c3	0.375 +/- 0.100	e1	0.2 +/- 0.1
e2	0.2 +/- 0.1	e3	0.2 +/- 0.1	e4	0.3 +/- 0.1
e5	1.175 +/- 0.100	e6	1.0 +/- 0.1	e7	0.525 +/- 0.100
e8	0.50 +/- 0.10	m1	1.0 +/- 0.1	m2	1.0 +/- 0.1
m3	0.5 +/- 0.1	m4	0.5 +/- 0.1		

Structure



5.2. Pin Layout

Top View



No.	Terminal Name	No.	Terminal Name	No.	Terminal Name
1	GND	15	WL_GPIO_4	29	GND
2	BT_UART_RXD	16	BT_I2S_dO	30	VBAT
3	BT_UART_TXD	17	WL_GPIO_2	31	VIN_LDO
4	BT_UART_CTS_N	18	WL_GPIO_1	32	GND (SR_PVSS)
5	BT_UART_RTS_N	19	GND	33	GND (SR_PVSS)
6	BT_GPIO_3	20	SDIO_CLK	34	SR_VLX
7	BT_GPIO_4	21	GND	35	GND
8	BT_PCM_SYNC	22	SDIO_CMD	36	VIO
9	BT_PCM_IN	23	SDIO_DATA_2	37	LPO_IN (32kHz)
10	BT_PCM_OUT	24	SDIO_DATA_0	38	BT_HOST_WAKE
11	BT_PCM_CLK	25	SDIO_DATA_3	39	BT_DEV_WAKE
12	GND	26	SDIO_DATA_1	40	GND
13	BT_GPIO_5	27	WL_GPIO_0_HOST_WAKE	41	ANT
14	BT_REG_ON	28	WL_REG_ON	42~46	GND

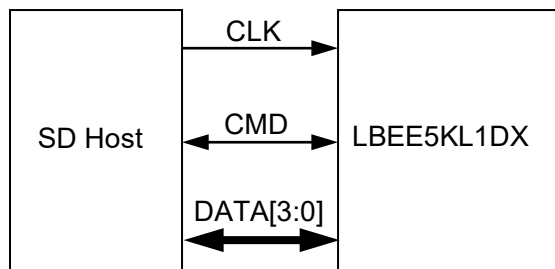
5.3. Module PIN Descriptions

No.	Terminal Name	Type	Connection to IC Terminal	Description
(1)	GND			
(2)	BT_UART_RXD	I	BT_UART_RXD	UART serial input. Serial data input for the HCI UART interface.
(3)	BT_UART_TXD	O	BT_UART_TXD	UART serial output. Serial data output for the HCI UART interface.
(4)	BT_UART_CTS_N	I	BT_UART_CTS_N	UART clear-to-send. Active-low clear-to-send signal for the HCI UART interface.
(5)	BT_UART_RTS_N	O	BT_UART_RTS_N	UART request-to-send. Active-low request-to-send signal for the HCI UART interface.
(6)	BT_GPIO_3		BT_GPIO_3	
(7)	BT_GPIO_4		BT_GPIO_4	
(8)	BT_PCM_SYNC	I/O	BT_PCM_SYNC	PCM sync; can be master (output) or slave (input)
(9)	BT_PCM_IN	I	BT_PCM_IN	PCM data input sensing
(10)	BT_PCM_OUT	O	BT_PCM_OUT	PCM data output
(11)	BT_PCM_CLK	I/O	BT_PCM_CLK	PCM clock; can be master (output) or slave (input)
(12)	GND			
(13)	BT_GPIO_5		BT_GPIO_5	
(14)	BT_REG_ON	I	BT_REG_ON	Used by PMU to power up or power down the internal regulators used by the Bluetooth section. Also, when deasserted, this pin holds the Bluetooth section in reset. This pin has an internal 200kΩ pull-down resistor that is enabled by default. It can be disabled through programming.
(15)	WL_GPIO_4		GPIO_4	
(16)	BT_I2S_dO			
(17)	WL_GPIO_2		GPIO_2	
(18)	WL_GPIO_1		GPIO_1	
(19)	GND			
(20)	SDIO_CLK	I		SDIO clock input
(21)	GND			

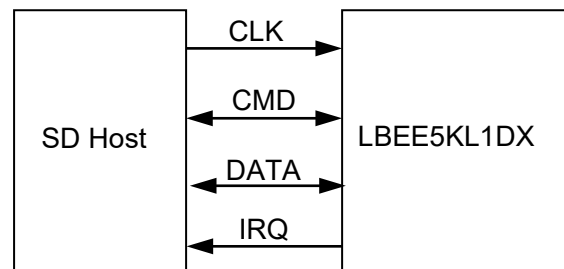
(22)	SDIO_CMD	I/O	SDIO_CMD	SDIO command line
(23)	SDIO_DATA_2	I/O	SDIO_DATA_2	SDIO data line 2
(24)	SDIO_DATA_0	I/O	SDIO_DATA_0	SDIO data line 0
(25)	SDIO_DATA_3	I/O	SDIO_DATA_3	SDIO data line 3
(26)	SDIO_DATA_1	I/O	SDIO_DATA_1	SDIO data line 1
(27)	WL_GPIO_0_HOST_WAKE		GPIO_0	
(28)	WL_REG_ON	I	WL_REG_ON	Used by PMU to power up or power down the internal regulators used by the WLAN section. Also, when deasserted, this pin holds the WLAN section in reset. This pin has an internal 200kΩ pull-down resistor that is enabled by default. It can be disabled through programming.
(29)	GND			
(30)	VBAT		LDO_VDDBAT5V, SR_VDDBAT5V	
(31)	VIN_LDO		LDO_VDD1P5, WLR_F_VDD_1P35	
(32)	GND (SR_PVSS)			
(33)	GND (SR_PVSS)			
(34)	SR_VLX		SR_VLX	CBUCK switching regulator output.
(35)	GND			
(36)	VIO		SCC_VDDIO, SYS_VDDIO	
(37)	LPO_IN (32kHz)	I	LPO_IN	External sleep clock input (32.768kHz).
(38)	BT_HOST_WAKE	I/O	BT_HOST_WAKE	HOST_WAKE or general-purpose I/O signal
(39)	BT_DEV_WAKE	I/O	BT_DEV_WAKE	DEV_WAKE or general-purpose I/O signal
(40)	GND			
(41)	ANT			
(42) ~ (46)	GND			

SDIO Pin Description

No.	Pin Name	(i) SD 4-bit Mode		(ii) SD 1-bit Mode	
20	SDIO_CLK	CLK	Clock	CLK	Clock
24	SDIO_D0	DATA0	Data line 0	DATA	Data line
26	SDIO_D1	DATA1	Data line 1 /Interrupt	IRQ	Interrupt
23	SDIO_D2	DATA2	Data line 2	NC	Not used
25	SDIO_D3	DATA3	Data line 3	NC	Not used
22	SDIO_CMD	CMD	Command line	CMD	Command line



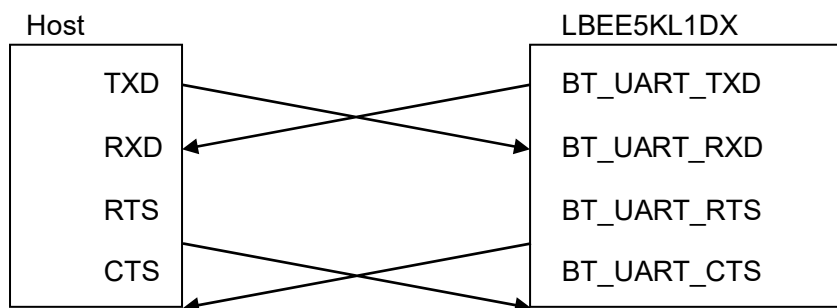
(i) SD 4-bit Mode



(ii) SD 1-bit Mode

Note : 10 to 100kΩ pull-ups are required on the four DATA lines and the CMD line. This requirement must be met during all operating states by using external pull-up resistors or properly programming internal SDIO host pull-ups.

UART connection



UART Connection

6. Rating

		min.	max.	unit
Storage Temperature		-40	+85	deg.C
Supply Voltage	VBAT	-0.5	5.0	V
	VDDIO	-0.5	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

		min.	typ.	max.	unit
Operating Temperature Range		-30	+25	+70	deg.C
Specification Temperature Range		-10	+25	+55	deg.C
Operating Voltage	VBAT	3.0	3.6	4.8	V
	VDDIO	1.71	1.8 or 3.3	3.63	V
Specification Voltage	VBAT	3.2	3.6	4.2	V
	VDDIO	1.71	1.8 or 3.3	3.63	V

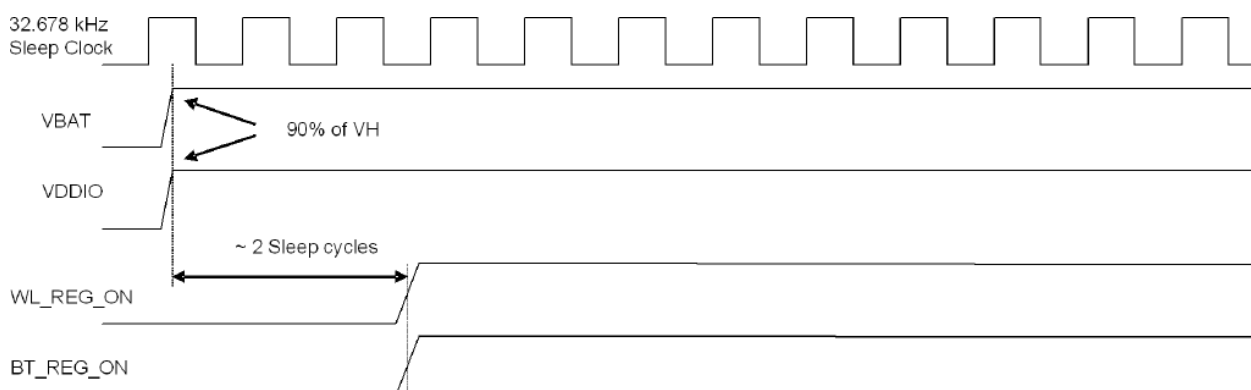
[Note] All RF characteristics in this datasheet are defined by Specification Temperature Range and Specification Voltage.

7.2. Power Up Sequence

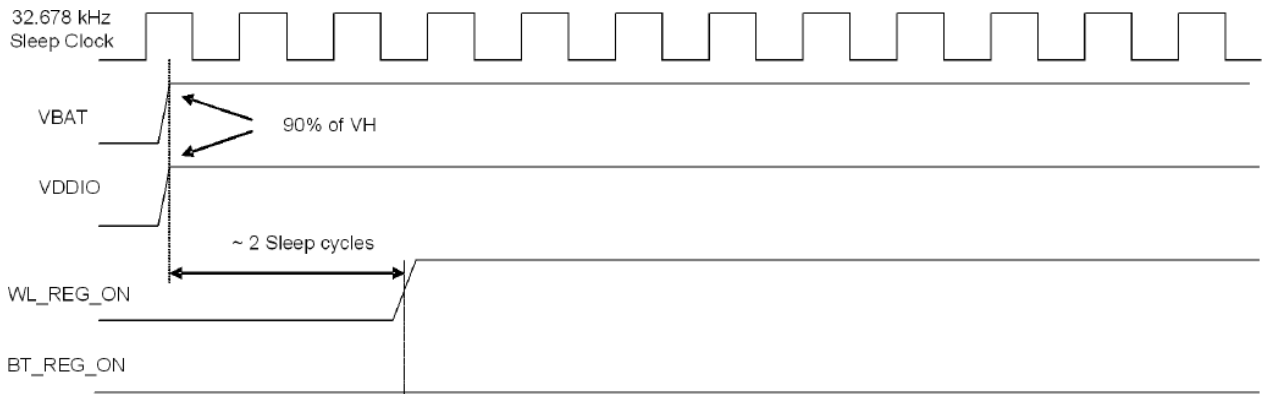
-VBAT should not rise 10%-90% faster than 40 microsecond.

-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.

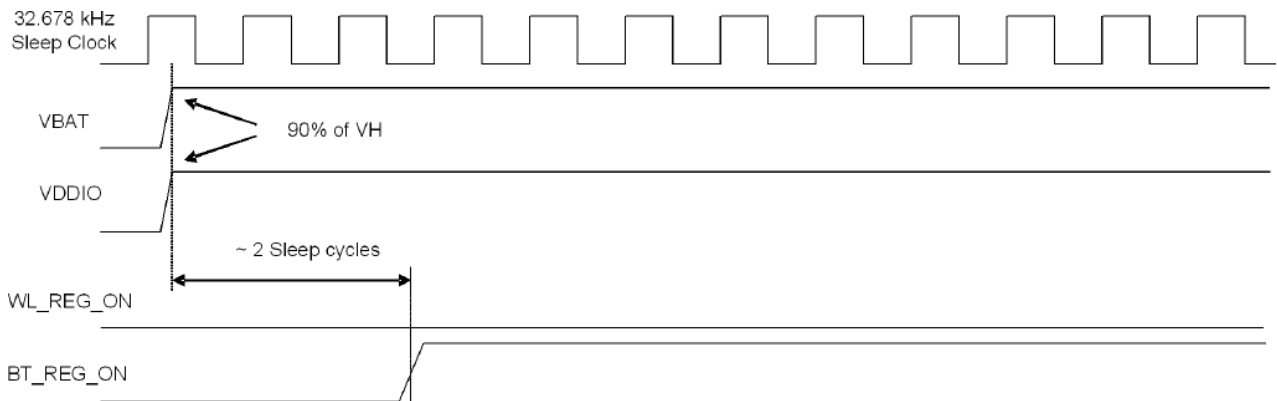
Power On Sequence for WLAN ON and BT ON



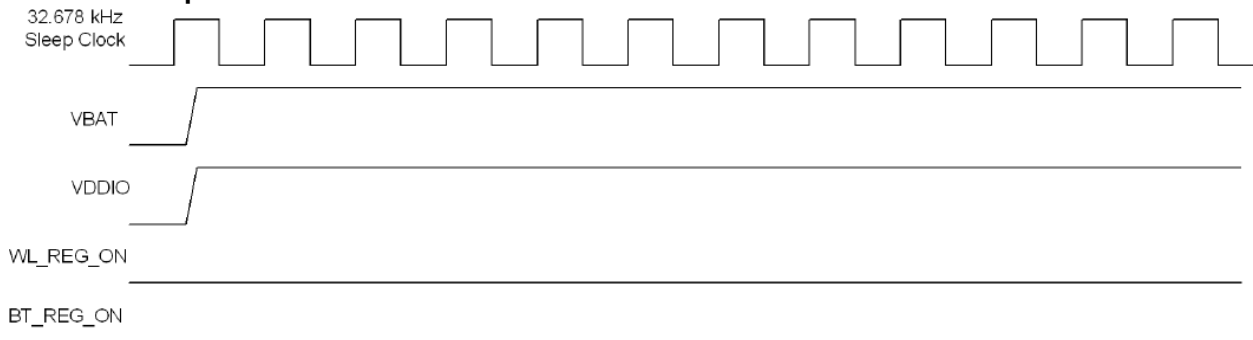
Power On Sequence for WLAN ON and BT Off



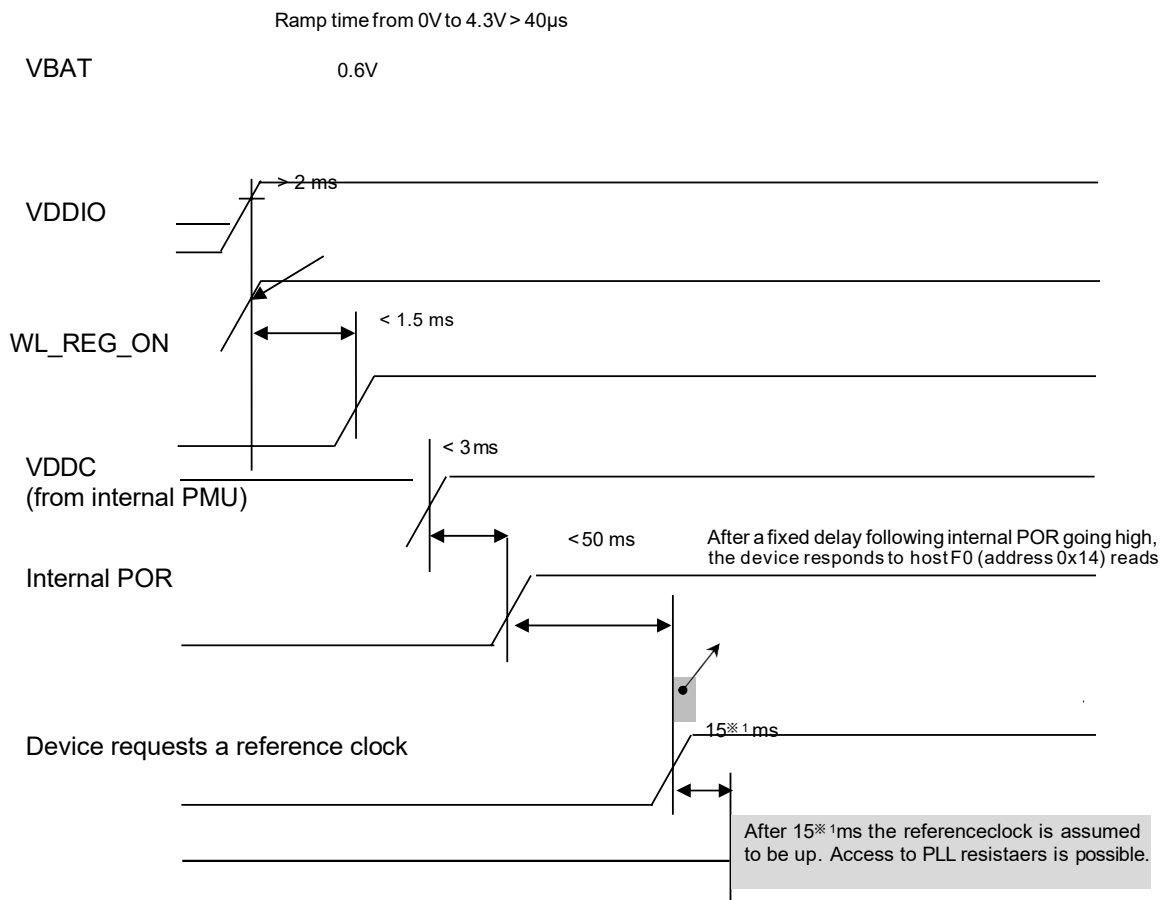
Power On Sequence for WLAN OFF and BT ON



Power On Sequence for WLAN OFF and BT OFF

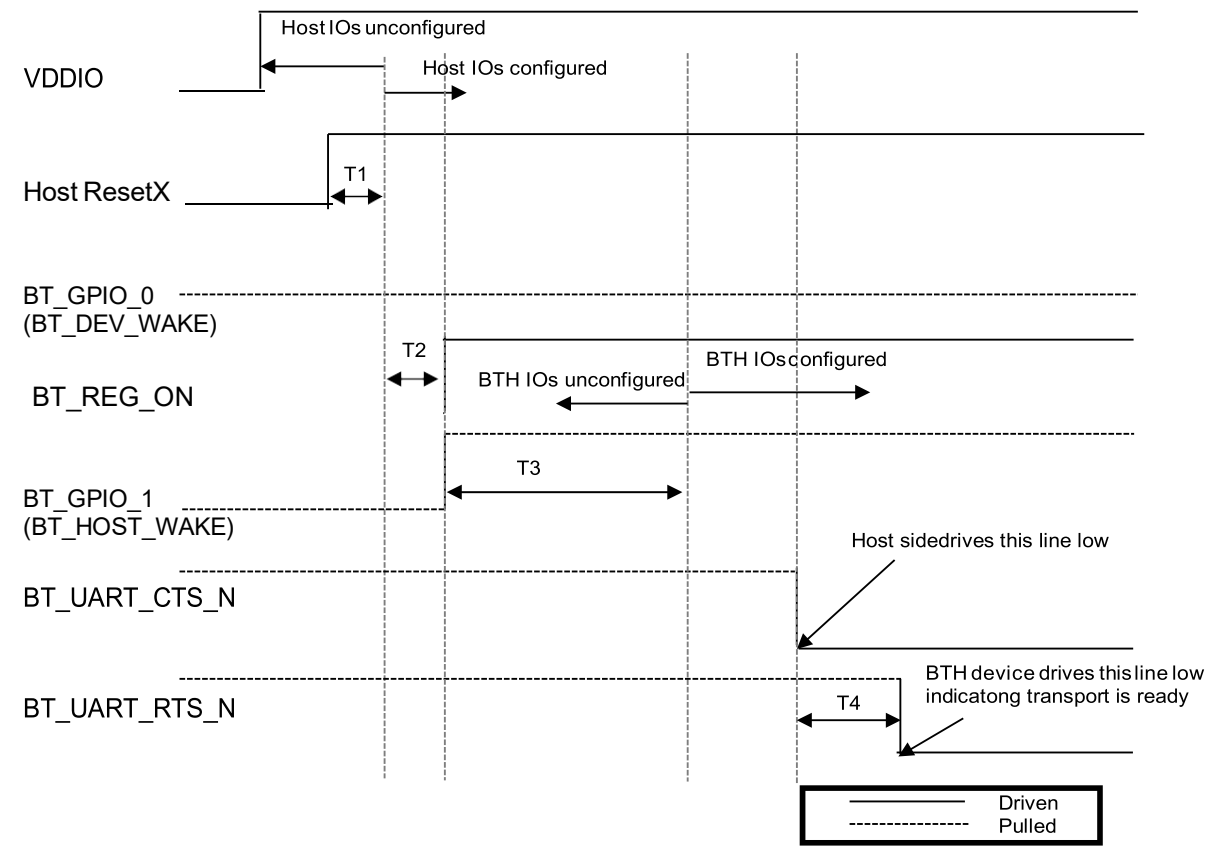


WLAN Boot up Sequence



※1 This wait time is programmable in sleep-clock increments from 1 to 255 (30 μ s to 15ms)

Startup Signaling Sequence



T1 is the time for host to settle its I/Os after a reset.

T2 is the time for host to drive BT_REG_ON high after the Host I/Os are configured.

T3 is the time for BTH (Bluetooth) device to settle its I/Os after a reset and reference clock settling time has elapsed.

T4 is the time for BTH device to drive BT_UART_RTS_N low after the host drives BT_UART_CTS_N low. This assumes the BTH device has already completed initialization.

Timing diagram assumes VBAT is present.

8. Digital I/O Requirements

SDIO Interface I/O Pins	Sym	min.	max.	unit
Input low voltage (VDDIO = 3.3V)	V _{IL}	-	0.25*VDDIO	V
Input high voltage (VDDIO = 3.3V)	V _{IH}	0.625*VDDIO	-	V
Input low voltage (VDDIO = 1.8V) ¹	V _{IL}	-	0.58	V
Input high voltage (VDDIO = 1.8V)	V _{IH}	1.27	-	V
Output low voltage (VDDIO = 3.3V)	V _{OL}	-	0.125*VDDIO	V
Output high voltage (VDDIO = 3.3V)	V _{OH}	0.75*VDDIO	-	V
Output low voltage (VDDIO = 1.8V)	V _{OL}	-	0.45	V
Output high voltage (VDDIO = 1.8V)	V _{OH}	1.40	-	V

Other Digital I/O Pins	Sym	min.	max.	unit
Input low voltage (VDDIO = 3.3V)	V _{IL}	-	0.8	V
Input high voltage (VDDIO = 3.3V)	V _{IH}	2.0	-	V
Input low voltage (VDDIO = 1.8V) ¹	V _{IL}	-	0.35*VDDIO	V
Input high voltage (VDDIO = 1.8V)	V _{IH}	0.65*VDDIO	-	V
Output low voltage (VDDIO = 3.3V)	V _{OL}	-	0.40	V
Output high voltage (VDDIO = 3.3V)	V _{OH}	VDDIO-0.4	-	V
Output low voltage (VDDIO = 1.8V)	V _{OL}	-	0.45	V
Output high voltage (VDDIO = 1.8V)	V _{OH}	VDDIO-0.45	-	V

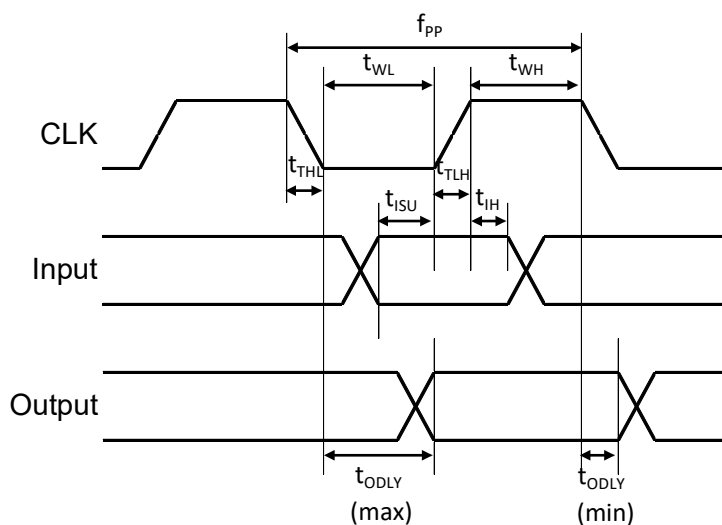
9. External LPO Specification

Parameter	Condition/Notes	Specification			
		Minimum	Typical	Maximum	Units
Frequency	-	-	32.768	-	KHz
Frequency accuracy	-	-200	-	+200	ppm
Duty cycle	-	30	-	70	%
Input amplitude	-	200	-	3300	mV, p-p
Signal type	Square wave or sine wave	-	-	-	-
Input impedance ^a	Resistive	100	-	-	kΩ
	Capacitive	-	-	5	pF
Clock jitter	-	-	-	10,000	ppm

a. When power is applied or switched off.

10. Interface Timing

10.1. SDIO Timing (Default Mode)

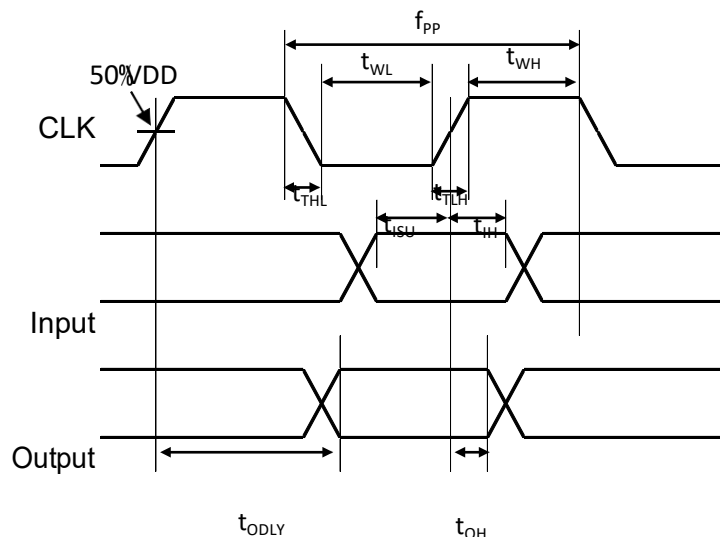


Parameter	Symbol	Min ⁽¹⁾	Typ ⁽¹⁾	Max ⁽¹⁾	Unit
Clock CLK (All values are referred to min. VIH and max. VIL ⁽²⁾)					
Frequency-Data Transfer Mode	f_{PP}	0	-	25	MHz
Frequency-Identification Mode	f_{OD}	0	-	400	kHz
Clock Low Time	t_{WL}	10	-	-	ns
Clock High Time	t_{WH}	10	-	-	ns
Clock Rise Time	t_{TLH}	-	-	10	ns
Clock Fall 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

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

(2). Min (Vih) = $0.7 \cdot V_{DDIO}$ and max (Vil) = $0.2 \cdot V_{DDIO}$.

10.2. SDIO Timing (High Speed Mode)

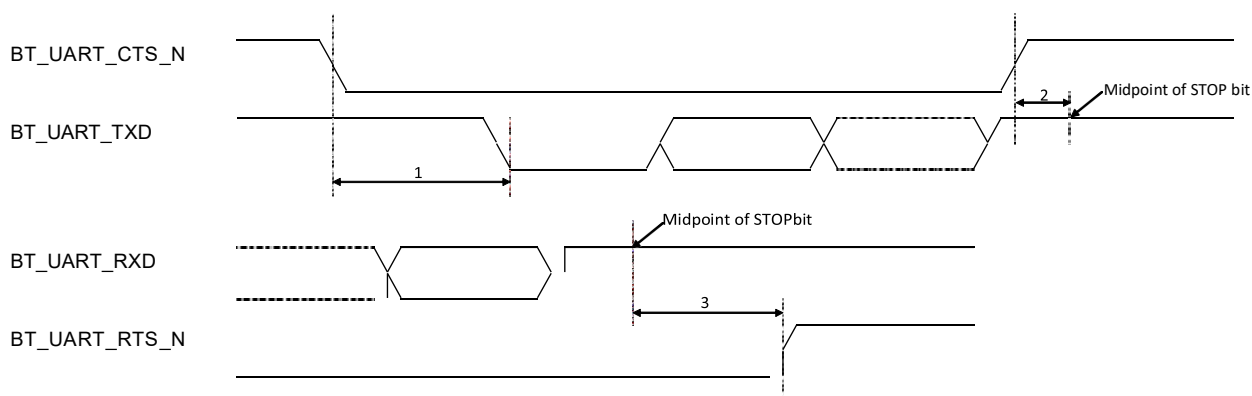


Parameter	Symbol	Min ⁽¹⁾	Typ ⁽¹⁾	Max ⁽¹⁾	Unit
Clock CLK (All values are referred to min. VIH and max. VIL ⁽²⁾)					
Frequency-Data Transfer Mode	f_{PP}	0	-	50	MHz
Frequency-Identification Mode	f_{OD}	0	-	400	kHz
Clock Low Time	t_{WL}	7	-	-	ns
Clock High Time	t_{WH}	7	-	-	ns
Clock Rise Time	t_{TLH}	-	-	3	ns
Clock Fall Time	t_{THL}	-	-	3	ns
Inputs: CMD, DAT (referenced to CLK)					
Input Setup Time	t_{SU}	6	-	-	ns
Input Hold Time	t_{IH}	2	-	-	ns
Outputs: CMD, DAT (referenced to CLK)					
Output Delay Time-Data Transfer Mode	t_{ODLY}	-	-	14	ns
Output Hold time	t_{OH}	2.5	-	-	ns
Total System Capacitance (each line)	CL	-	-	40	pF

(1). Timing is based on $CL \leq 40\text{pF}$ load on CMD and Data.

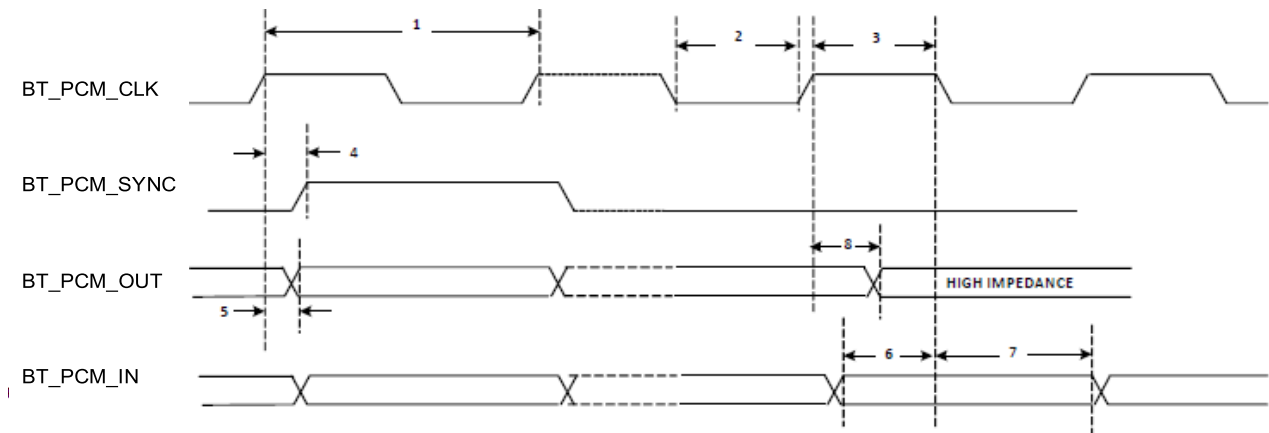
(2). Min (Vih) = $0.7 \cdot V_{DDIO}$ and max (Vil) = $0.2 \cdot V_{DDIO}$.

10.3. Bluetooth UART Timing (Default Mode)



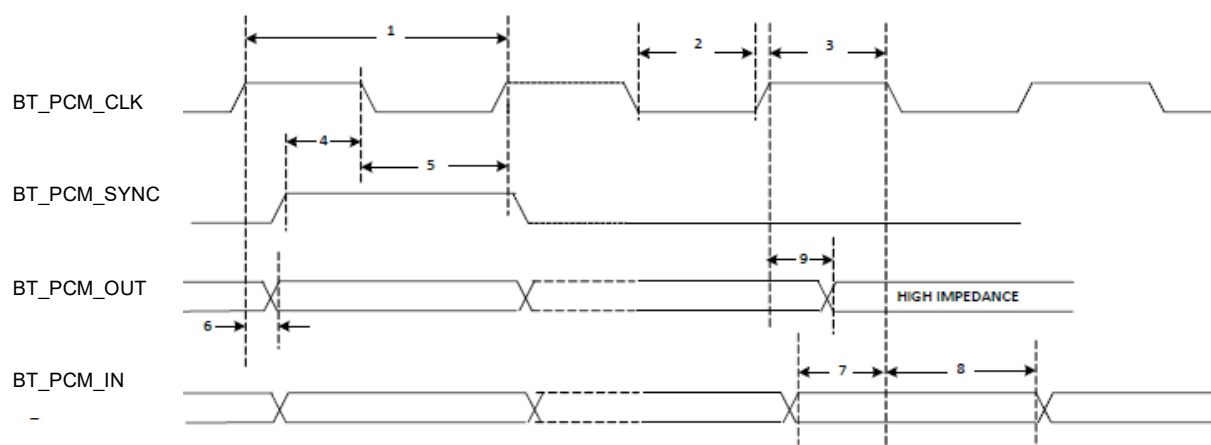
Reference	Description	Min	Typ	Max	Unit
1	Delay time, UART_CTS_N low to UART_TXD valid	-	-	1.5	Bit periods
2	Setup time, UART_CTS_N high before midpoint of stop bit	-	-	0.5	Bit periods
3	Delay time, midpoint of stop bit to UART_RTS_N high	-	-	0.5	Bit periods

10.4. PCM Timing Short Frame Sync, Master Mode



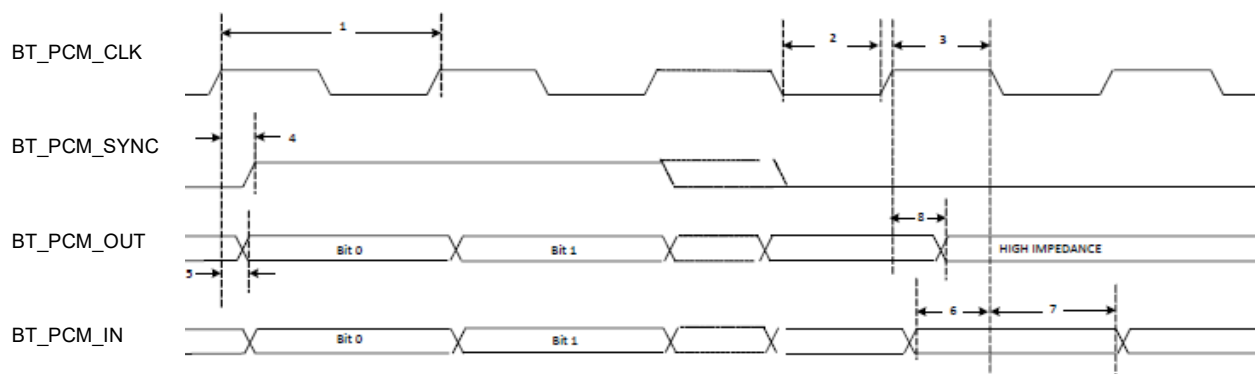
Reference	Description	Min	Typ	Max	Unit
1	PCM bit clock frequency	-	-	12	MHz
2	PCM bit clock low	41	-	-	ns
3	PCM bit clock high	41	-	-	ns
4	PCM_SYNC delay	0	-	25	ns
5	PCM_OUT delay	0	-	25	ns
6	PCM_IN setup	8	-	-	ns
7	PCM_IN hold	8	-	-	ns
8	Delay from rising edge of PCM_CLK during last bit period to PCM_OUT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

10.5. PCM Timing Short Frame Sync, Slave Mode



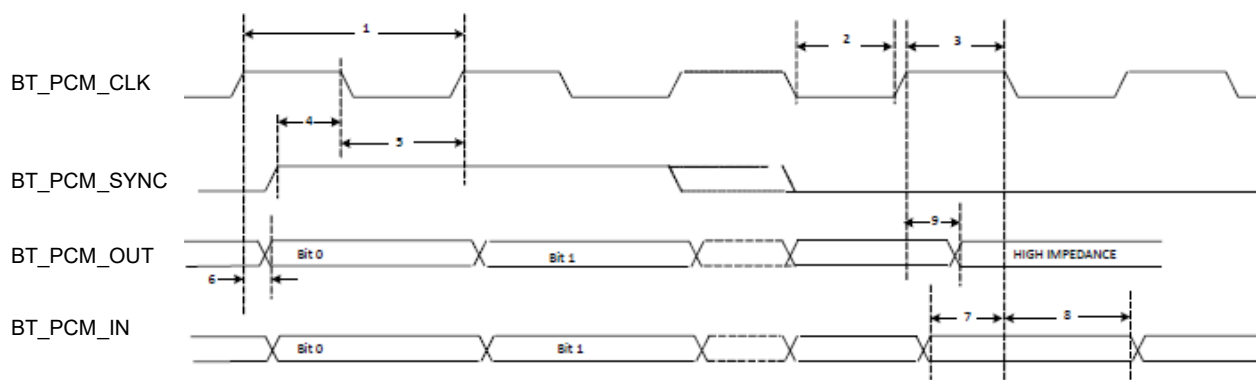
Reference	Description	Min	Typ	Max	Unit
1	PCM bit clock frequency	-	-	12	MHz
2	PCM bit clock Low	41	-	-	ns
3	PCM bit clock High	41	-	-	ns
4	PCM_SYNC setup	8	-	-	ns
5	PCM_SYNC hold	8	-	-	ns
6	PCM_OUT delay	0	-	25	ns
7	PCM_IN setup	8	-	-	ns
8	PCM_IN hold	8	-	-	ns
9	Delay from rising edge of PCM_CLK during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

10.6. PCM Timing Long Frame Sync, Master Mode



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

10.7. PCM Timing Long Frame Sync, Slave Mode



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

11. DC/RF Characteristics

11.1. DC/RF Characteristics for IEEE802.11b

Specification	IEEE802.11b
Mode	DSSS / CCK
Frequency	2400 - 2483.5MHz
Data rate	1, 2, 5.5, 11Mbps

Conditions: 25deg.C, VBAT=3.6V, VDDIO= 3.3V, Output power setting=17dBm, 11Mbps mode

Items	Contents			
- DC Characteristics -	min.	typ.	max.	unit
DC current				
1) Tx mode (1024byte, 20usec interval)		320	370	mA
2) Rx mode		47	60	mA
- Tx Characteristics -	min.	typ.	max.	unit
Output Power (tolerance)	15	17	19	dBm
Spectrum Mask				
1) 1st side lobes	-	-43	-30	dBr
2) 2nd side lobes	-	-54	-50	dBr
Power-on and Power-down ramp	-		2.0	μsec
RF Carrier Suppression	15		-	dB
Modulation Accuracy (EVM)	-	15	35	%
Outband Spurious Emissions				
1) 30MHz to 1GHz (BW=100kHz)	-	-	-36	dBm
2) 1GHz to 12.75GHz (BW=100kHz)	-	-	-30	dBm
3) 1.8GHz to 1.9GHz (BW=100kHz)	-	-	-47	dBm
4) 5.15GHz to 5.3GHz (BW=100kHz)	-	-	-47	dBm
- Rx Characteristics -	min.	typ.	max.	unit
Minimum Input Level (FER ≤ 8%)	-	-89	-76	dBm
Maximum Input Level (FER ≤ 8%)	-10	-	-	dBm
Adjacent Channel Rejection (FER ≤ 8%)	35	-	-	dB

11.2. DC/RF Characteristics for IEEE802.11g

Specification	IEEE802.11g
Mode	OFDM
Frequency	2400 - 2483.5MHz
Data rate	6, 9, 12, 18, 24, 36, 48, 54Mbps

Conditions: 25deg.C, VBAT=3.6V, VDDIO= 3.3V, Output power setting=13dBm, 54Mbps mode

Items	Contents			
- DC Characteristics -	min.	typ.	max.	unit
DC current				
1) Tx mode (1024byte, 20usec interval)		270	310	mA
2) Rx mode		47	60	mA
- Tx Characteristics -	min.	typ.	max.	unit
Output Power (tolerance)	11	13	15	dBm
Spectrum Mask				
1) 9MHz to 11MHz (0dB ~ -20dB)		-33	-20	dBr
2) 11MHz to 20MHz (-20dB ~ -28dB)		-41	-28	dBr
3) 20MHz to 30MHz (-28dB ~ -40dB)		-53	-40	dBr
4) 30MHz to 33MHz (-40dB)		-53	-40	dBr
Constellation Error (EVM)	-	-30	-25	dB
Outband Spurious Emissions				
1) 30MHz to 1GHz (BW=100kHz)	-	-	-36	dBm
2) 1GHz to 12.75GHz (BW=100kHz)	-	-	-30	dBm
3) 1.8GHz to 1.9GHz (BW=100kHz)	-	-	-47	dBm
4) 5.15GHz to 5.3GHz (BW=100kHz)	-	-	-47	dBm
- Rx Characteristics -	min.	typ.	max.	unit
Minimum Input Level (PER ≤ 10%)	-	-75	-65	dBm
Maximum Input Level (PER ≤ 10%)	-20	-	-	dBm
Adjacent Channel Rejection (PER ≤ 10%)	-1	-	-	dB

11.3. DC/RF Characteristics for IEEE802.11n

Specification	IEEE802.11n
Mode	OFDM
Frequency	2400 - 2483.5MHz
Data rate	6.5, 13, 19.5, 26, 39, 52, 58.5, 65Mbps

Conditions: 25deg.C, VBAT=3.6V, VDDIO= 3.3V, Output power setting=12dBm, 65Mbps mode

Items	Contents			
- DC Characteristics -	min.	typ.	max.	unit
DC current				
1) Tx mode (1024byte, 20usec interval)		260	300	mA
2) Rx mode		47	60	mA
- Tx Characteristics -	min.	typ.	max.	unit
Output Power (tolerance)	10	12	14	dBm
Spectrum Mask				
1) 9MHz to 11MHz (0dB ~ -20dB)		-33	-20	dBr
2) 11MHz to 20MHz (-20dB ~ -28dB)		-41	-28	dBr
3) 20MHz to 30MHz (-28dB ~ -45dB)		-53	-45	dBr
4) 30MHz to 33MHz (-45dB)		-53	-45	dBr
Constellation Error (EVM)	-	-31	-27	dB
Outband Spurious Emissions				
1) 30MHz to 1GHz	-	-	-36	dBm
2) 1GHz to 12.75GHz	-	-	-30	dBm
3) 1.8GHz to 1.9GHz	-	-	-47	dBm
4) 5.15GHz to 5.3GHz	-	-	-47	dBm
- Rx Characteristics -	min.	typ.	max.	unit
Minimum Input Level (PER $\leq$ 10%)	-	-73	-64	dBm
Maximum Input Level (PER $\leq$ 10%)	-20	-	-	dBm
Adjacent Channel Rejection (PER $\leq$ 10%)	-2	-	-	dB

11.4. DC/RF Characteristics for Bluetooth

Normal conditions : 25deg.C, VBAT = 3.6V, VDDIO = 3.3V

Items	Contents			
Bluetooth specification (power class)	Version 2.1 + EDR (Class1)			
Channel frequency (spacing)	2402 to 2480 MHz (1MHz)			
Current Consumption	min.	typ.	max.	unit
(a) Tx=Rx=DH5 (fully occupied)	-	28	60	mA
(b) Tx=Rx=2DH5 (fully occupied)	-	25	50	mA
(c) Tx=Rx=3DH5 (fully occupied)	-	25	50	mA
Transmitter	min.	typ.	max.	unit
Output Power	6	10	14	dBm
Frequency range	2400	-	2483.5	MHz
20dB bandwidth	-	-	1	MHz
Adjacent Channel Power ^{*1}				
(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	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	%
Out-of-Band Spurious Emissions				
(a) 30-1000MHz	-	-	-36	dBm
(b) 1000-12750MHz	-	-	-30	dBm
(c) 1800-1900MHz	-	-	-47	dBm
(d) 5150-5300MHz	-	-	-47	dBm
Receiver	Min.	Typ.	Max.	unit
Sensitivity (BER<0.1%)	-	-91	-80	dBm
C/I Performance (BER<0.1%) ^{*2}				
(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 (PER<0.1%)	-20	-	-	dBm
EDR Sensitivity (PER<0.007%)				
(a) 8DPSK	-	-88	-77	dBm

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

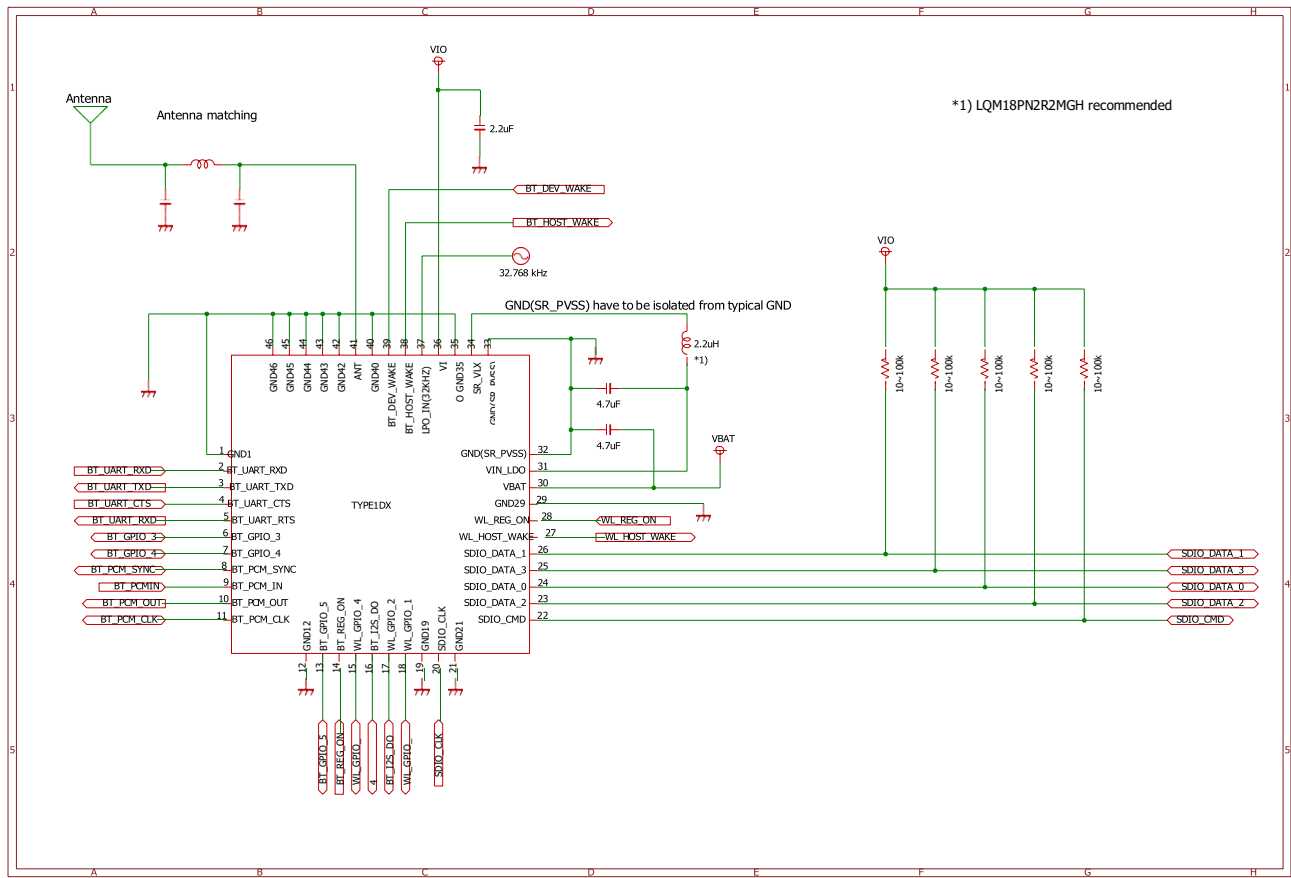
*2: Up to five spurious responses within Bluetooth limits are allowed.

11.5. DC/RF Characteristics for Bluetooth(LE)

Conditions : 25deg.C, VBAT=3.6V, VDDIO= 3.3V

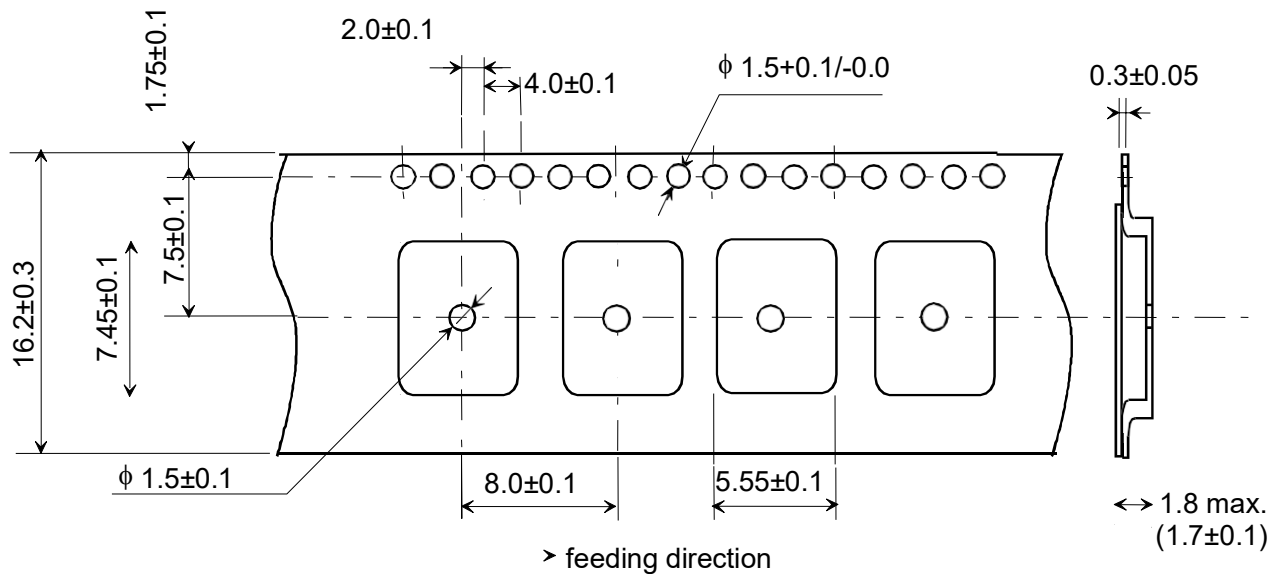
Items	Contents			
Bluetooth specification (power class)	Version 5.1(LE)			
Channel frequency (spacing)	2402 to 2480 MHz (2MHz)			
Number of RF Channel	40			
Item / Condition	Min.	Typ.	Max.	Unit
Center Frequency	2402	-	2480	MHz
Channel Spacing	-	2	-	MHz
Number of RF channel	-	40	-	-
Output power	-	-	10	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%)	-	-95	-70	dBm
Maximum input signal level (PER < 30.8%)	-10	-	-	dBm
PER Report Integrity (-30dBm input)	50	-	65.4	%

13. Reference Circuit



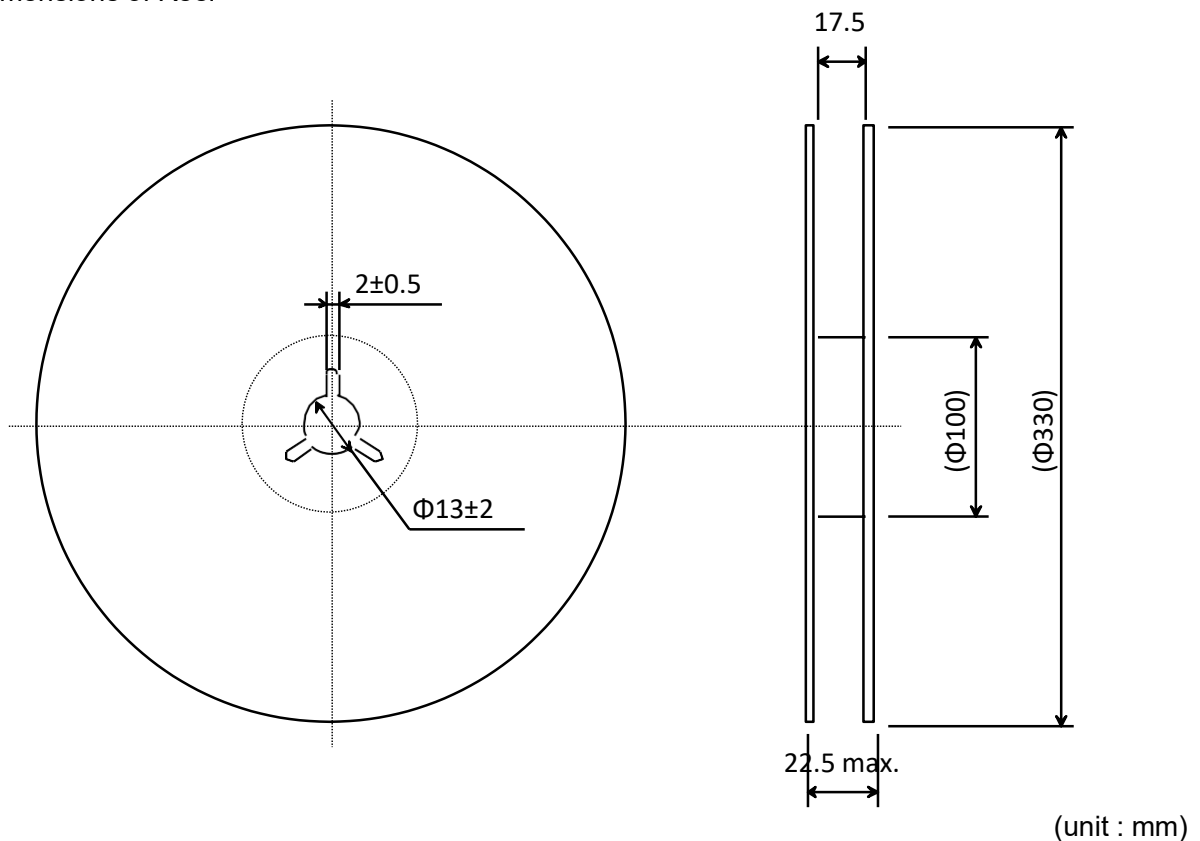
14. Tape and Reel Packing

(1) Dimensions of Tape (Plastic tape)



- 1) The corner and ridge radiuses (R) of inside cavity are 0.3mm max.
- 2) Cumulative tolerance of 10 pitches of the sprocket hole is ± 0.2 mm
- 3) Measuring of cavity positioning is based on cavity center in accordance with JIS/IES standard.

(2) Dimensions of Reel



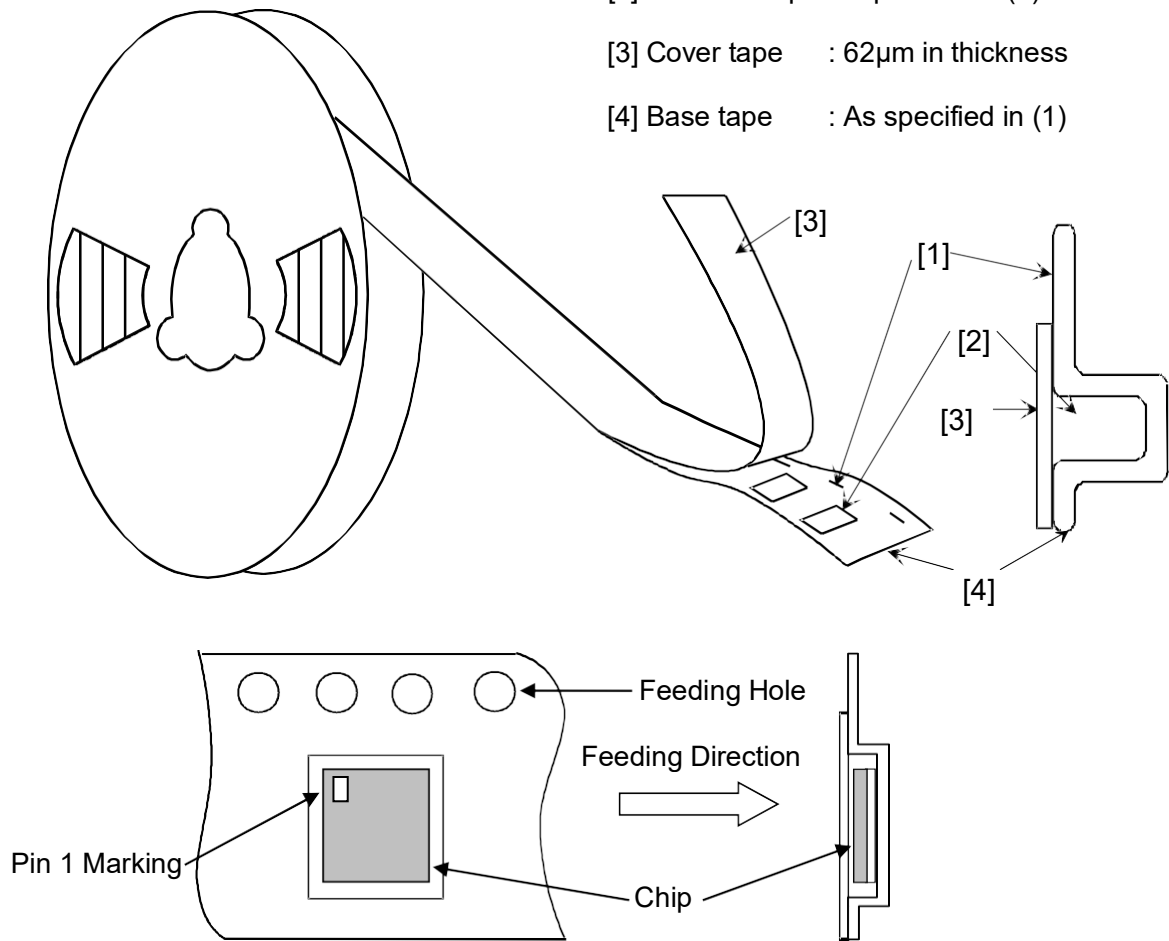
(3) Taping Diagrams

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

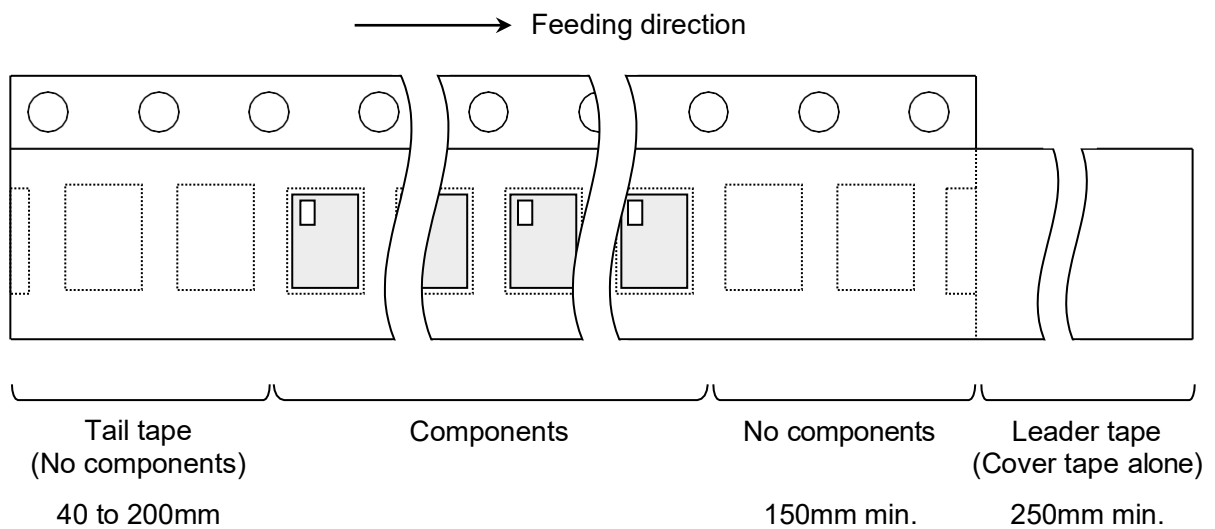
[2] Hole for chip: As specified in (1)

[3] Cover tape : 62µm in thickness

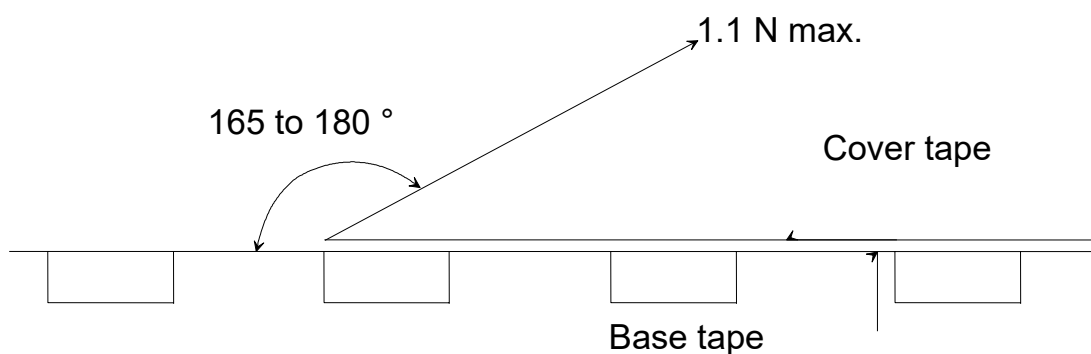
[4] Base tape : As specified in (1)



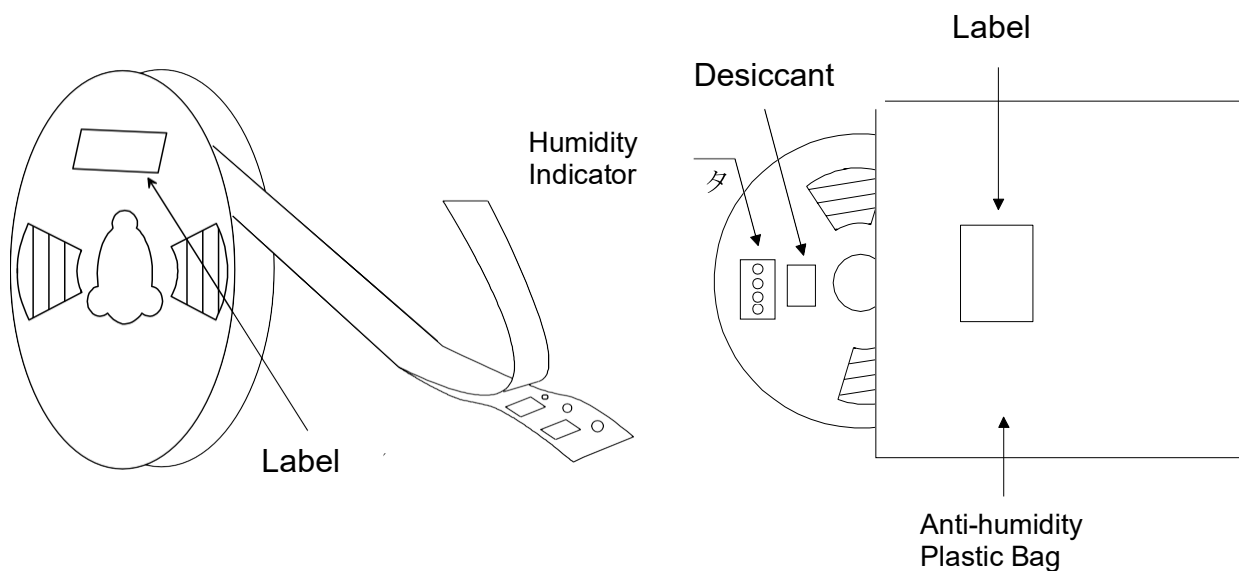
(4) Leader and Tail tape



- (5) The tape for chips is wound clockwise, the feeding holes to the right side as the tape is pulled toward the user.
- (6) The cover tape and base tape are not adhered at no components area for 250mm min.
- (7) Tear off strength against pulling of cover tape: 5N min.
- (8) Packaging unit: 1000pcs./ reel
- (9) material: Base tape: Plastic
 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 35deg.C and humidity from 20 to 70%RH.

(Packing materials may be deformed at the temperature over 40deg.C.)

- The product left more than 6months after reception, it needs to be confirmed the solderability before used.

- The product shall be stored in non-corrosive gas (Cl₂, NH₃, SO₂, NO_x, etc.).

- Any excess mechanical shock including, but not limited to, sticking the packing materials by sharp object, and dropping the product, shall not be applied in order not to damage the packing materials.

This product is applicable to MSL3 (Based on JEDEC Standard J-STD-020)

- After the packing opened, the product shall be stored at $\leq 30\text{deg.C}$ / $\leq 60\%\text{RH}$ and the product shall be used within 168hours.

- When the color of the indicator in the packing changed, the product shall be baked before soldering.

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

The products shall be baked on the heat-resistant tray because the material (Base Tape, Reel Tape and Cover Tape) is 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.

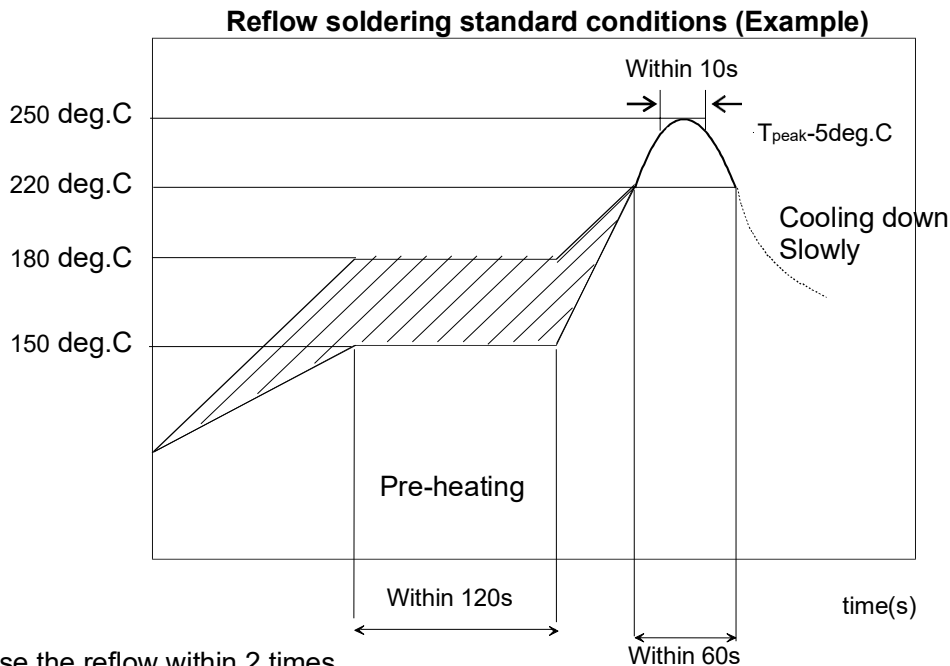
15.4. Notice for Chip Placer:

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 (Cl₂, NH₃, SO_x, NO_x, etc.).
- In an atmosphere containing combustible and volatile gases.
- Dusty place.
- Direct sunlight place.
- Water splashing place.
- Humid place where water condenses.
- Freezing place.

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

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

15.8. Input Power Capacity:

Products shall be used in the input power capacity as specified in these specifications.

Inform Murata beforehand, in case that the components are used beyond such input power capacity

range.

APPENDIX

1DX Installation Manual (FCC)

FCC ID of this product is as follows.

FCC ID: 2A83TWFASPD

For OEM integration only – device cannot be sold to general public. Therefore, we will ask OEM to include the following statements required by FCC on the product and in the Installation manual Notice.

Contents

1. Bluetooth
2. Antenna
3. Notice

1. Bluetooth

- The FCC ID for the product is only applicable to the Wi-Fi aspects of the module. Bluetooth should by default be disabled, however a check should be performed prior to installation. Instructions to disable Bluetooth are found below

1. At a terminal, run: `bluetoothctl`

```
root@stm32mp1:~# bluetoothctl
Agent registered
[CHG] Controller 43:43:A1:12:1F:AC Pairable: yes
```

- 2.
3. Then you will be at a `[bluetooth#]` prompt. (use help for all the available commands)
4. Use the list command to confirm the bluetooth controller

```
[bluetooth]# list
Controller 43:43:A1:12:1F:AC stm32mp1 [default]
```

- 5.
6. Then power off

```
[bluetooth]# power off
Changing power off succeeded
```

- 7.

2. Antenna

- Please perform the antenna design that followed the specifications of the antenna.

The concrete contents of a check are the following three points.

1. It is the same type as the antenna type of antenna specifications. Confirm the same size as the Gerber file.
2. An antenna gain is lower than a gain given in antenna specifications. Measure the gain, and confirm the peak gain is less than the application value (1.4dBi)
3. The emission level is not getting worse. Measure the spurious and confirm degradation of less than 3dB than spurious value of worst of report used for the application.

3. Notice

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

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines.

RF Exposure requirements are met when installed in mobile equipment.

Note)

Portable equipment: Equipment for which the spaces between human body and antenna are used within 20cm.