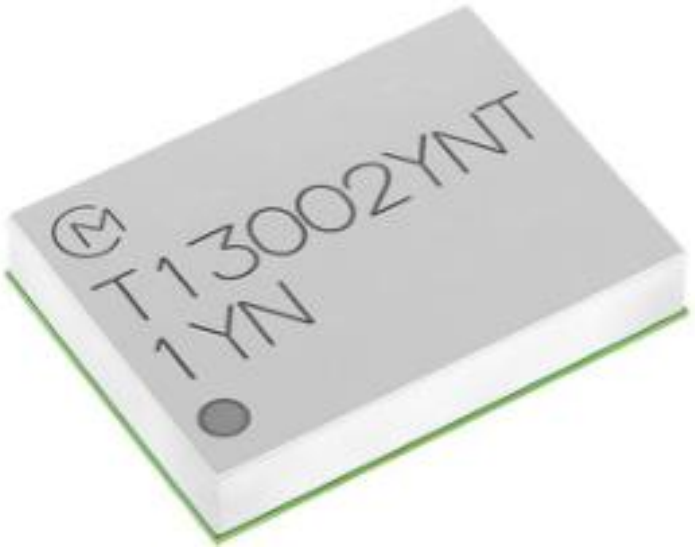
Datasheet

Type 1YN Wi-Fi™ + Bluetooth® Module

Infineon CYW43439 Chipset for 802.11b/g/n + Bluetooth 5.1
Datasheet – Rev. 8

- Design Name: Type 1YN
- Module P/N: LBEE5KL1YN-814



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About This Document

Type 1YN is a small and high performance module based on Infineon CYW43439 combo chipset which supports Wi-Fi™ 802.11b/g/n + Bluetooth 5.1 BR/EDR/LE. This datasheet describes Type 1YN module in detail.

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.

Audience & Purpose

Intended audience includes any customer looking to integrate this module into their product; specifically RF, hardware, software, and systems engineers.

Document Conventions

Table 1 describes the document conventions.

Table 1: Document Conventions

Conventions	Description
	Warning Note Indicates very important note. Users are strongly recommended to review.
	Info Note Intended for informational purposes. Users should review.
	Menu Reference Indicates menu navigation instructions. **Example**: Insert➔Tables➔Quick Tables➔Save Selection to Gallery
	External Hyperlink This symbol indicates a hyperlink to an external document or website. **Example**: Murata Click on the text to open the external link.
	Internal Hyperlink This symbol indicates a hyperlink within the document. **Example**: Scope Click on the text to open the link.
`Console input/output or code snippet`	**Console I/O or Code Snippet** This text ***Style*** denotes console input/output or a code snippet.
`# Console I/O comment` `// Code snippet comment`	**Console I/O or Code Snippet Comment** This text ***Style*** denotes a console input/output or code snippet comment. • Console I/O comment (preceded by "#") is for informational purposes only and does not denote actual console input/output. • Code Snippet comment (preceded by "//") may exist in the original code.

1 Scope

This specification characterizes the IEEE 802.11b/g/n + Bluetooth 5.1 BR/EDR/BLE combo module.

2 Key Features

- Infineon CYW43439 inside
- Supports IEEE 802.11b/g/n specification: 2.4 GHz.
- Up to 65 Mbps PHY data rates
- Supports Bluetooth specification version 5.1.
- For supported Bluetooth functions, refer to Bluetooth SIG site
- WLAN interface: SDIO 2.0
- Bluetooth interface: HCI UART and PCM
- Reference clock is embedded.
- Temperature Range: - 40 °C to 85 °C
- Dimensions: 6.95 x 5.15 x 1.1 mm
- MSL: 3
- Surface-mount type
- RoHS compliant.
- MAC/BD address are embedded.
- Total Fit : 134

3 Ordering Information

Table 2 describes the ordering information.

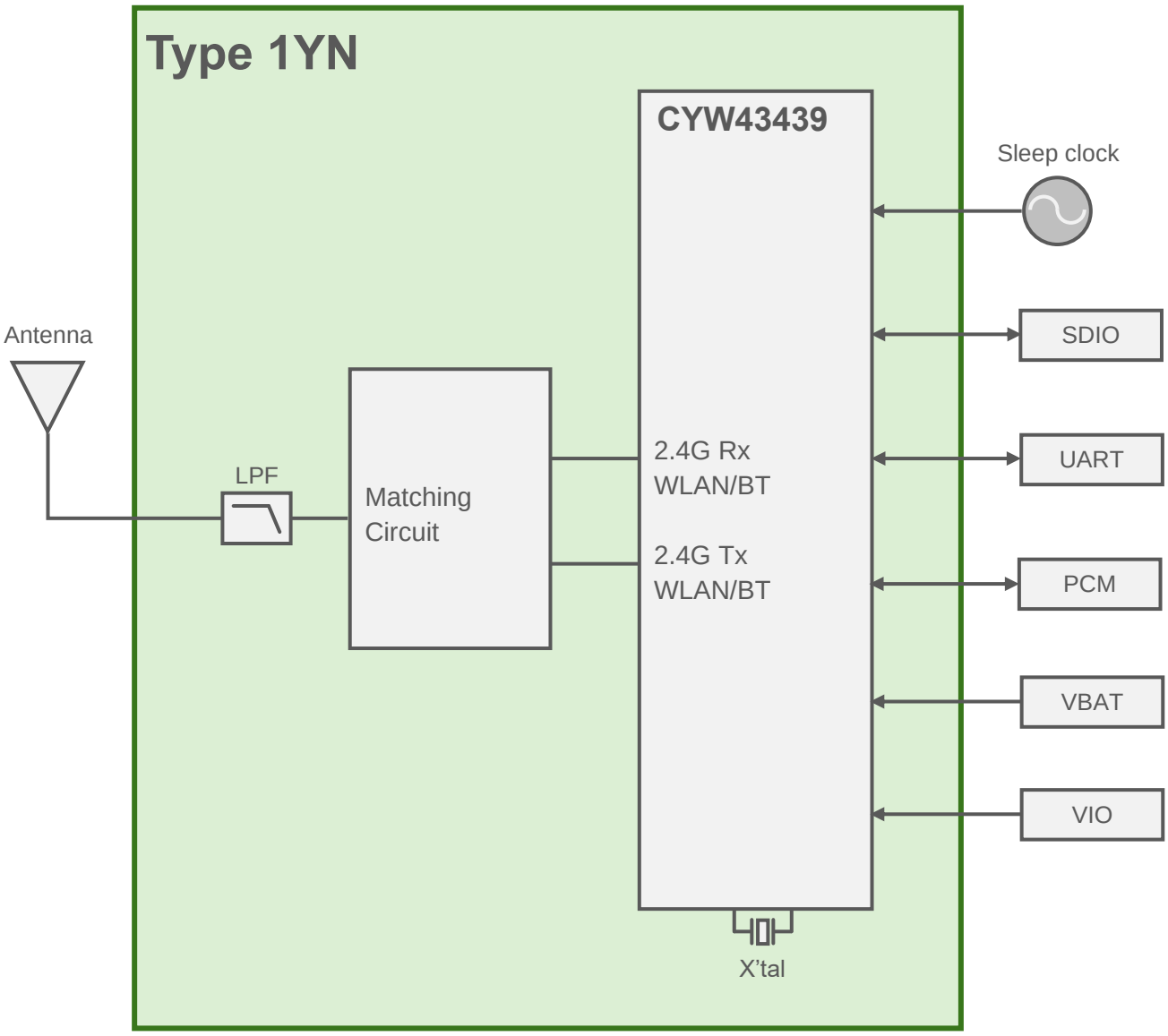
Table 2: Ordering Information

Ordering Part Number	Description
LBEE5KL1YN-814	Module order
LBEE5KL1YN-SMP	Sample module order (If module samples are not available through distribution, contact Murata referencing this part number)
EAR00389	Embedded Artists Type 1YN M.2 EVB (default EVB available through distribution)

4 Block Diagram

The Type 1YN block diagram is presented in **Figure 1**.

Figure 1: Block Diagram



5 Certification Information

This section has information about radio and Bluetooth certification.

5.1 Radio Certification

Table 3 describes the radio certification for 1YN module.

Table 3: Certification Information

Country	ID	Country Code
USA (FCC)	The ID VPYLB1DX of Type 1DX can be reused	US
Canada (IC)	The ID 772C-LB1DX of Type 1DX can be reused	CA
Europe	EN300328 v2.2.2 conducted test report of Type 1DX can be reused.	DE
Japan	Japanese type certification is prepared. R 01-P00840	JP

Each country code is defined by Murata's clm Blob file.
You can get Murata's clm Blob file at Murata GitHub

5.2 Radio Regulatory Certification by Country

Murata have prepared the document about Radio Regulatory Certification separately.

This document is designed to ensure that module manufacturers correctly communicate the necessary information to host manufacturers that incorporate their modules.

Refer to 【Regulatory Information】 : Type 1YN Radio Law Approval Application Note for Radio Law Certification user manual.

If you don't follow the rule written in Type 1YN Radio Law Approval Application Note, there is a risk of conflict Radio Law Certification.
Please be sure to check the document.

5.3 Bluetooth Qualification

- QDID: 140301
- For supported Bluetooth functions, search ICS detail at Bluetooth SIG site.

6 Dimensions, Markings and Terminal Configurations

This section has information on dimensions, marking, and terminal configurations for Type 1YN.

Figure 2 shows the dimensions, marking, and terminal configurations.

Figure 2: Dimension, Markings and Terminal Configuration

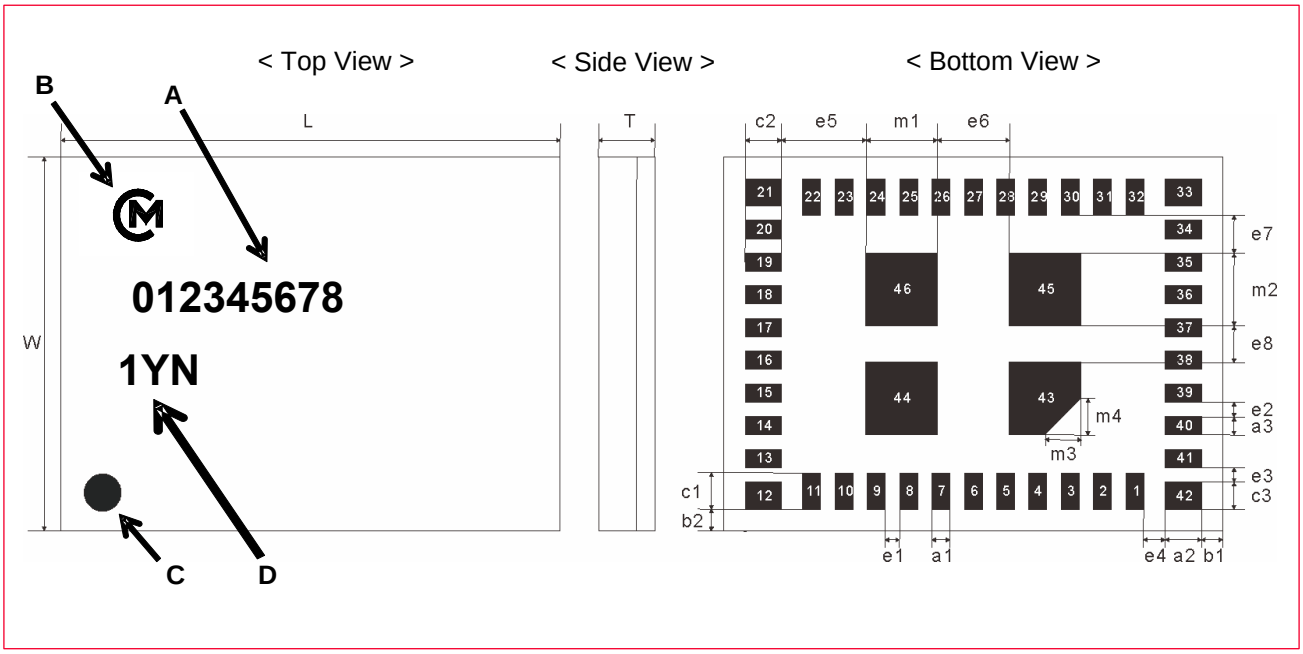


Table 4 describes the Type 1YN markings.

Table 4: Markings

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

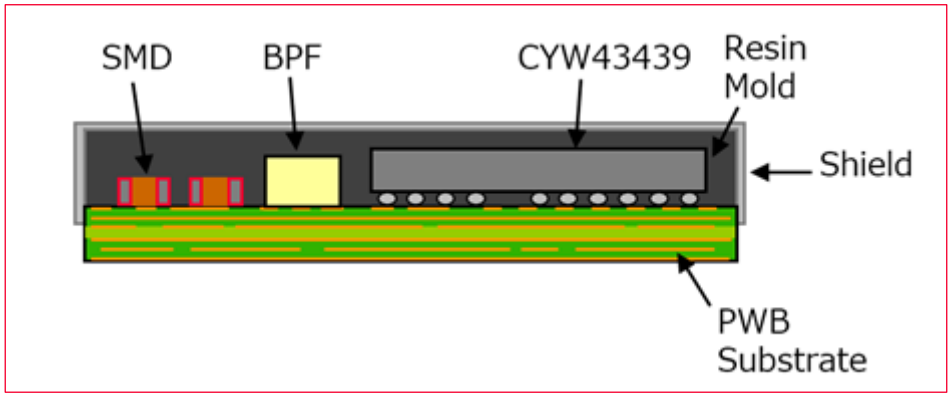
Table 5 describes the Type 1YN dimensions.

Table 5: Dimensions

Mark	Dimensions (mm)	Mark	Dimensions (mm)	Mark	Dimensions (mm)
L	6.95 +/- 0.2	W	5.15 +/- 0.2	T	1.1 maximum
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		

Figure 3 shows the structure of Type 1YN module.

Figure 3: Structure



7 Module Pin Descriptions

This section has the pin descriptions of Type 1YN and pin assignments layout descriptions.

7.1 Module Pin Layout

The pin assignment (top view) layout is shown in **Figure 4**.

Figure 4: Pin Assignments Top View

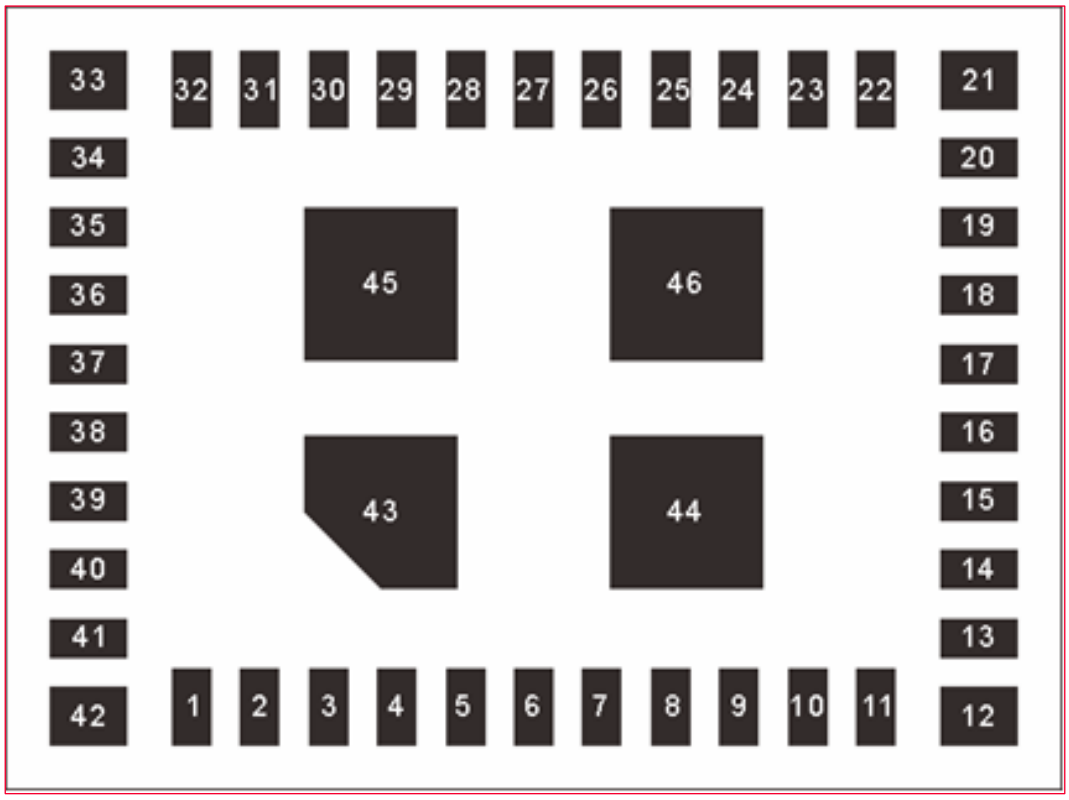


Table 6 illustrates the terminal configurations.

Table 6: Terminal Configurations

No.	Terminal Name	No.	Terminal Name	No.	Terminal Name
1	GND	15	NC	29	GND
2	BT_UART_RXD	16	NC	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	NC	20	SDIO_CLK	34	SR_VLX
7	NC	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	NC	27	WL_GPIO_0_HOST_WAKE	41	ANT
14	BT_REG_ON	28	WL_REG_ON	42~46	GND

7.2 Pin Descriptions

Table 7 describes Type 1YN Pins.

Table 7: Pin Descriptions

No.	Pin name	Type	Connection to IC Pin Name	Description
1	GND			Ground
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	NC			
7	NC			
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	NC			
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 de-asserted, 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	NC			

No.	Pin name	Type	Connection to IC Pin Name	Description
16	NC			
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 de-asserted, 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, WLRF_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 (32 kHz)	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			

7.3 SDIO Pin Descriptions

This section describes the SDIO pins and UART connections. **Table 8** shows the SDIO pin descriptions.

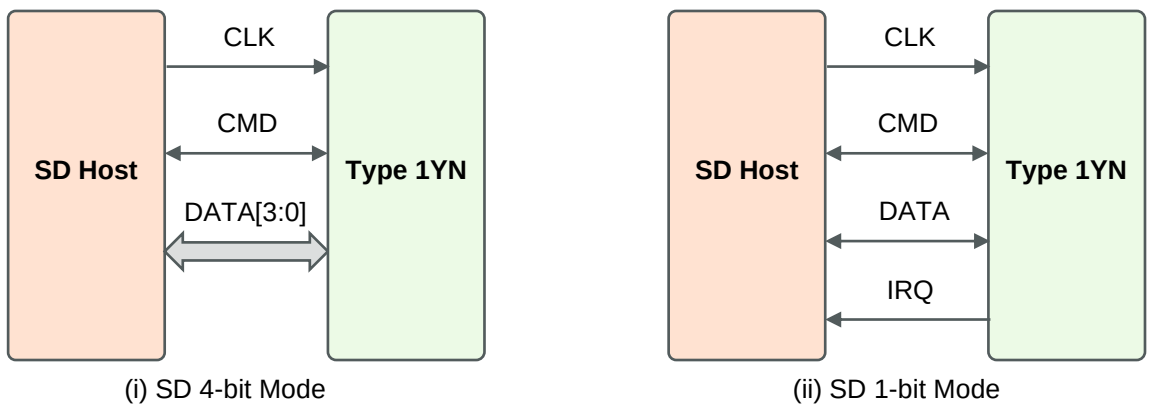
Table 8: SDIO Pin Descriptions

No.	Pin Name	(i) SD 4-bit Mode		(ii) SD 1-bit Mode	
20	SDIO_CLK	CLK	Clock	CLK	Clock

No.	Pin Name	(i) SD 4-bit Mode		(ii) SD 1-bit Mode	
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

Figure 5 shows the SDIO pins.

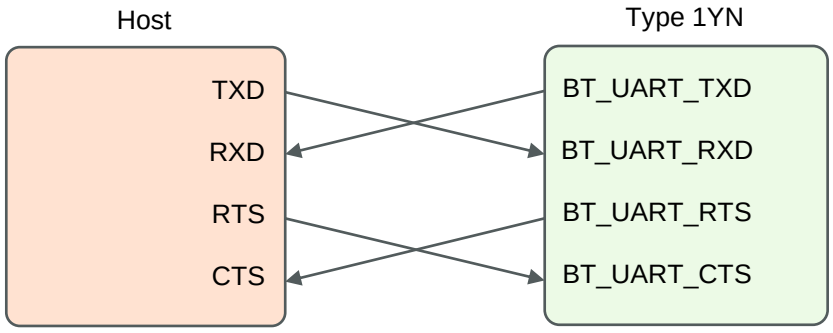
Figure 5: SDIO Pins



10 to 100 kΩ 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 resisters or properly programming internal SDIO host pull-ups.

Figure 6 shows the UART connections.

Figure 6: UART Connection



8 Absolute Maximum Ratings

The absolute and maximum ratings are shown in **Table 9.**

Table 9: Absolute Maximum Ratings

Parameter		Minimum	Maximum	Unit
Storage Temperature		-40	+85	°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.

9 Operating Conditions

The operating conditions are shown in **Table 10**.

Table 10: Operating Conditions

Parameter		Minimum	Typical	Maximum	Unit
Operating Temperature Range		-40	+25	+85	°C
Specification Temperature Range		-10	+25	+55	°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

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

10 Power-On Sequences

This section describes the power-on sequences along with their parameters.

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

Figure 7 shows the power-on sequence graphs for WLAN ON and BT ON.

Figure 7: Power-On Sequence Graph - WLAN ON and BT ON

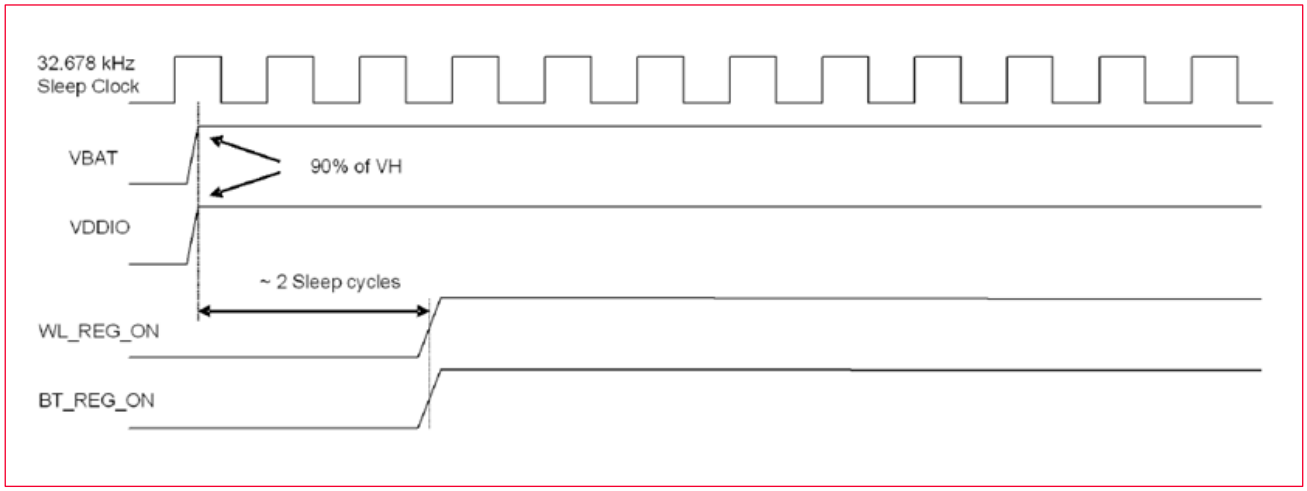


Figure 8 shows the power-on sequence graph for WLAN ON and BT OFF.

Figure 8: Power-On Sequence Graph - WLAN ON and BT OFF

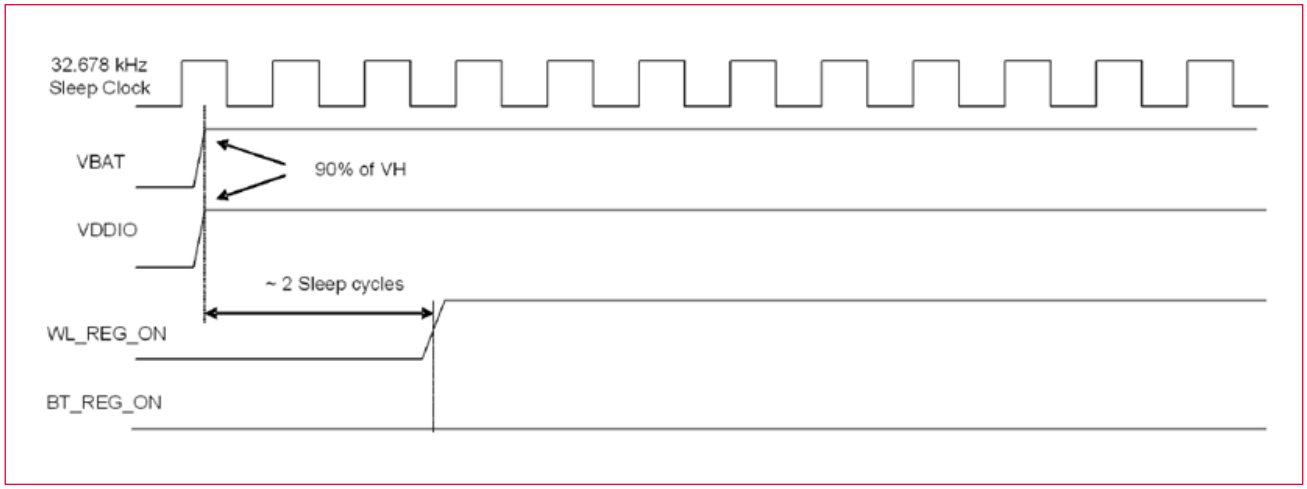


Figure 9 shows the power-on sequence graph for WLAN OFF and BT ON.

Figure 9: Power-On Sequence Graph - WLAN OFF and BT ON

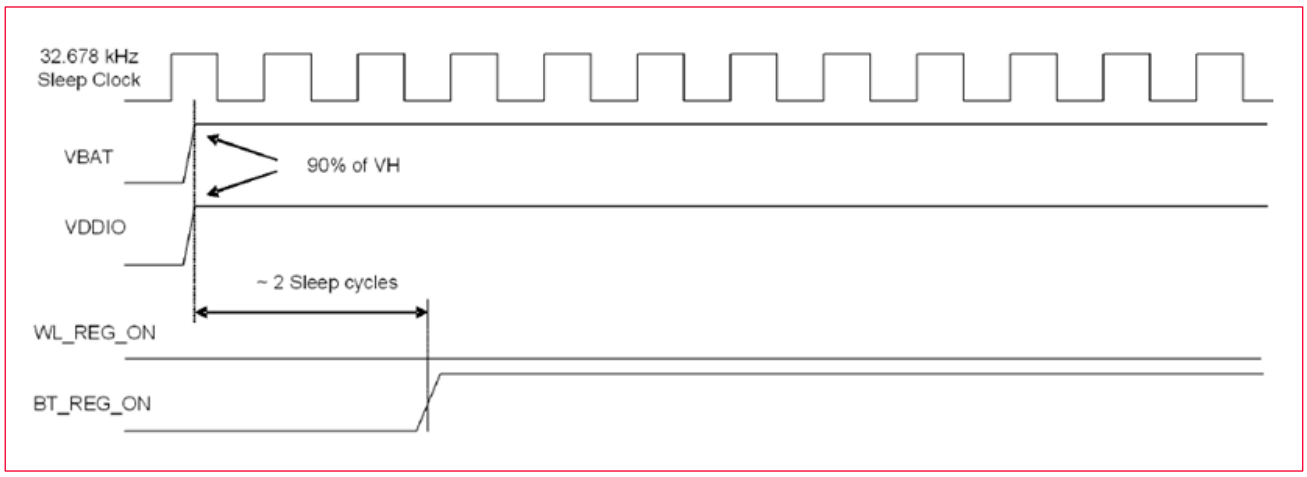


Figure 10 shows the power-on sequence graph for WLAN OFF and BT OFF.

Figure 10: Power-On Sequence Graph - WLAN OFF and BT OFF

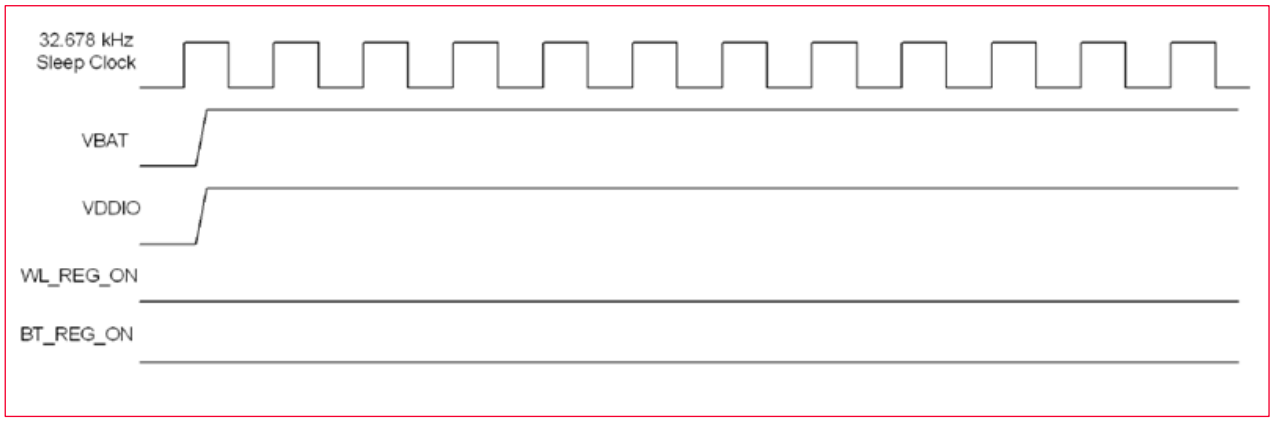
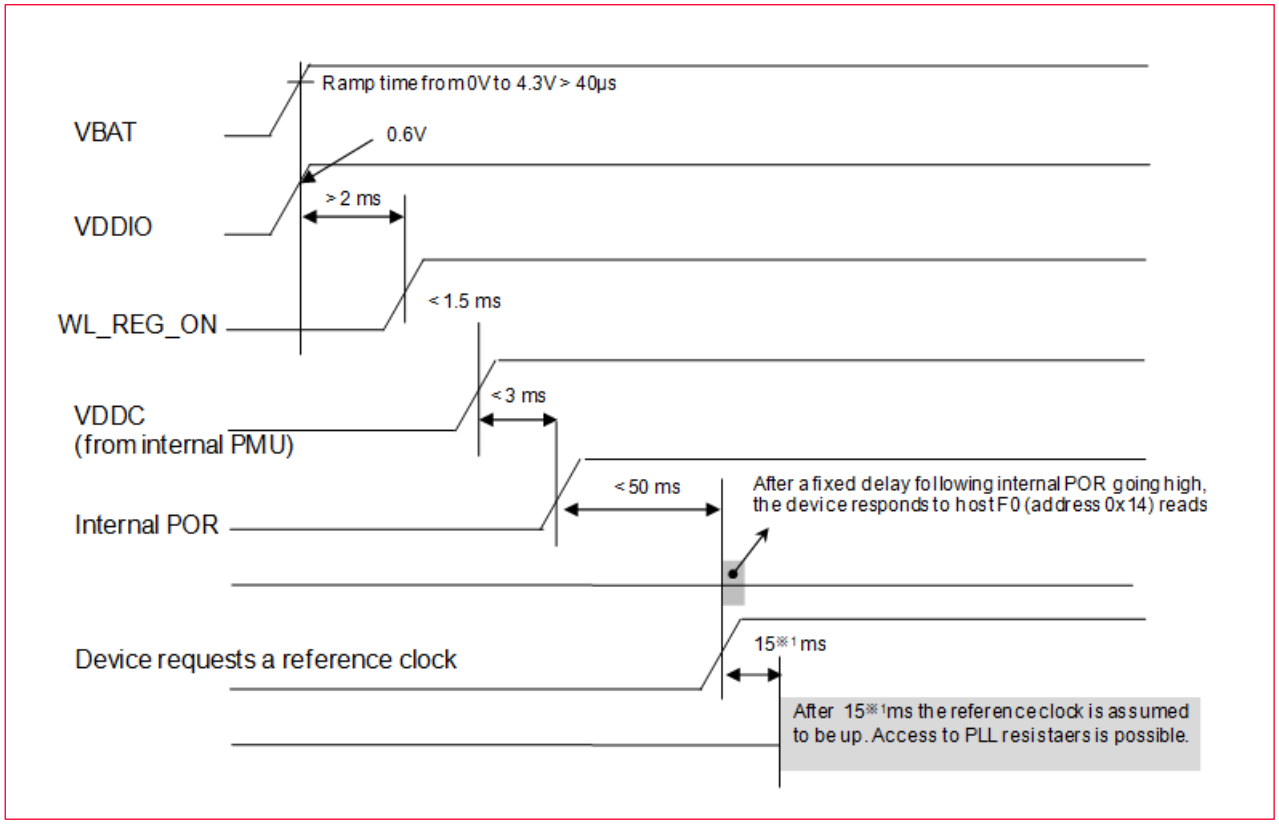


Figure 11 shows the WLAN boot up sequence.

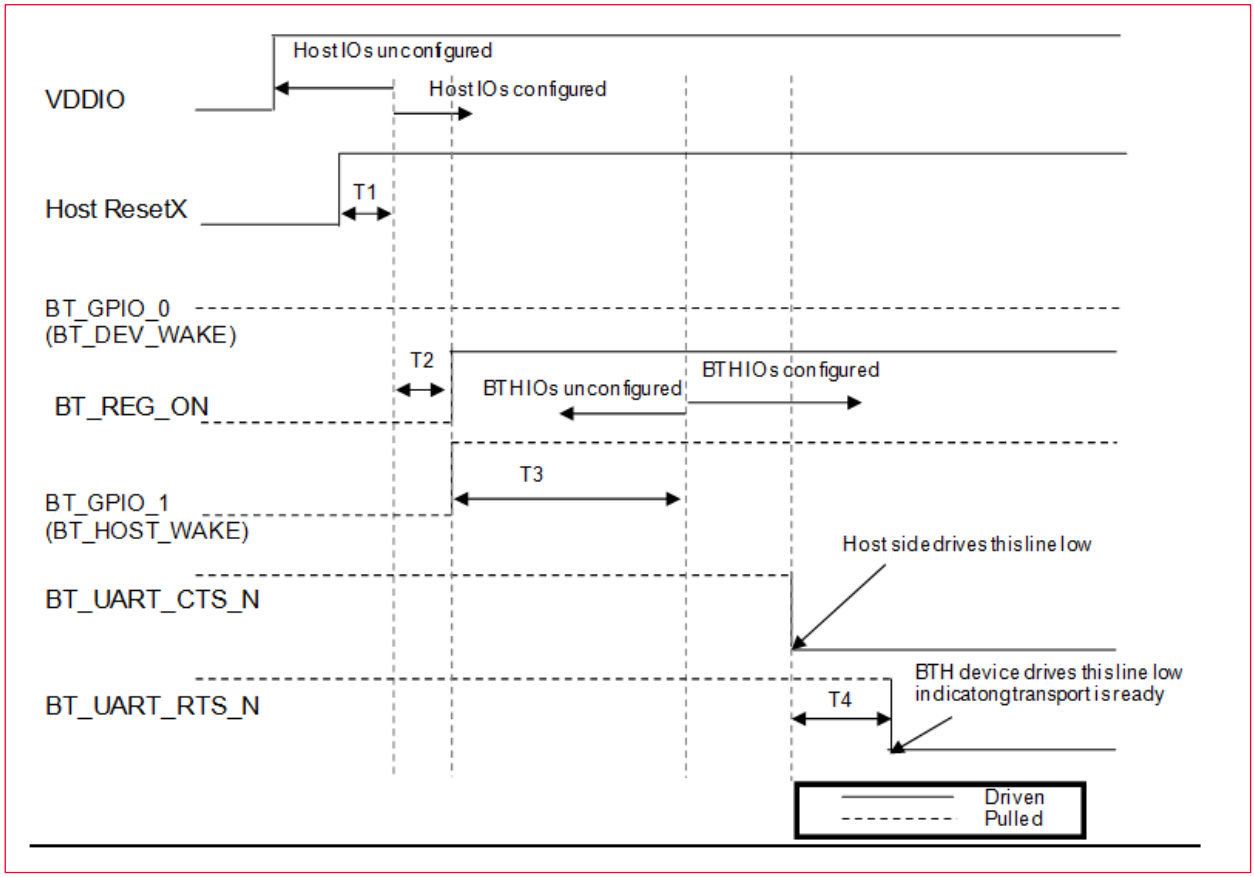
Figure 11: WLAN Boot Up Sequence



1 This wait time is programmable in sleep-clock increments from 1 to 255 (30 µs to 15 milliseconds).

Figure 12 shows the startup signaling sequence.

Figure 12: Startup Signaling Sequence



- T1 is the time for host to settle it's IOs after a reset.
- T2 is the time for host to drive BT_REG_ON high after the Host IOs are configured.
- T3 is the time for BTH(Bluetooth) device to settle its IOs 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.

11 Digital I/O Requirements

Table 11 shows the digital I/O requirements for Type 1YN module.

Table 11: Digital I/O Requirement Pins

SDIO Interface I/O Pins	Symbol	Minimum	Maximum	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))	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

Table 12 shows the other digital I/O pins.

Table 12: Other Digital I/O Pins

Other Digital I/O Pins	Symbol	Minimum	Maximum	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)	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

12 External Sleep Clock Requirement

Table 13 shows the external LPO specification for Type 1YN module.

Table 13: 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[1]	Resistive	100			kΩ
	Capacitive			5	pF
Clock jitter				10,000	ppm

[1] When power is applied or switched off.

13 Interface Timing

This section describes the interface timing, its speed modes, related parameters, and graphs.

13.1 SDIO Timing

This section describes the SDIO timings for different modes.

13.1.1 Default Mode

The default mode in shown in **Figure 13**.

Figure 13: SDIO Timing Diagram - Default Mode

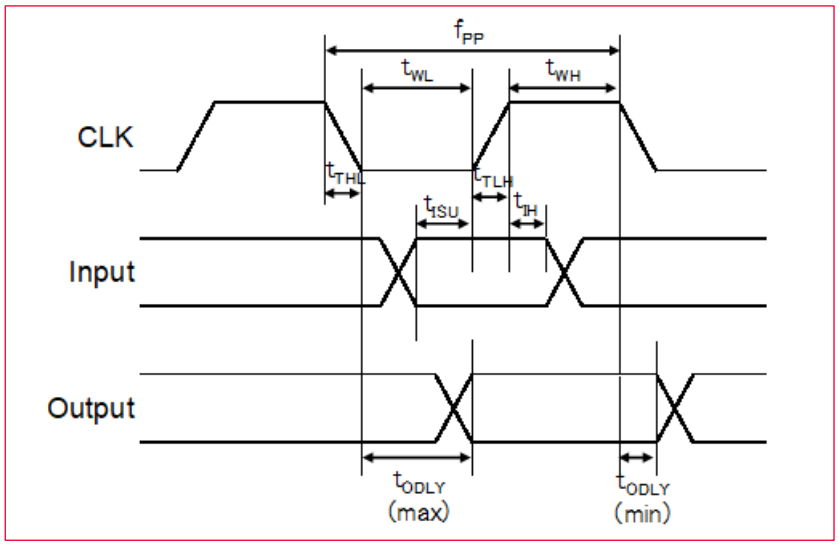


Table 14 Table 13 shows the SDIO timing parameters in default mode.

Table 14: SDIO Timing Parameters - Default Mode

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Clock CLK (All values are referred to minimum VIH and maximum VIL)					
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

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Output Delay Time-Identification Mode	t_{ODLY}	0		50	ns

Timing is based on CL < 40 pF load on CMD and Data.
Minimum (Vih) = 0.7*VDDIO and maximum (Vil) = 0.2*VDDIO

13.1.2 High Speed Mode

Figure 14 shows the SDIO timing diagram in high-speed mode.

Figure 14: SDIO Timing Diagram - High Speed Mode

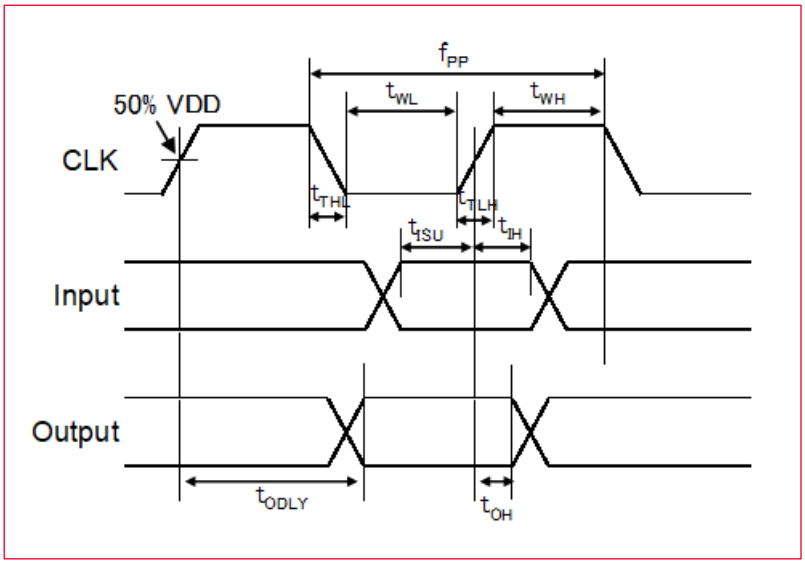


Table 15 shows the SDIO timing parameters in high-speed mode.

Table 15: SDIO Timing Parameters - High Speed Mode

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Clock CLK (All values are referred to minimum VIH and maximum VIL)					
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_{ISU}	6			ns
Input Hold Time	t_{tH}	2			ns
Outputs: CMD, DAT (referenced to CLK)					

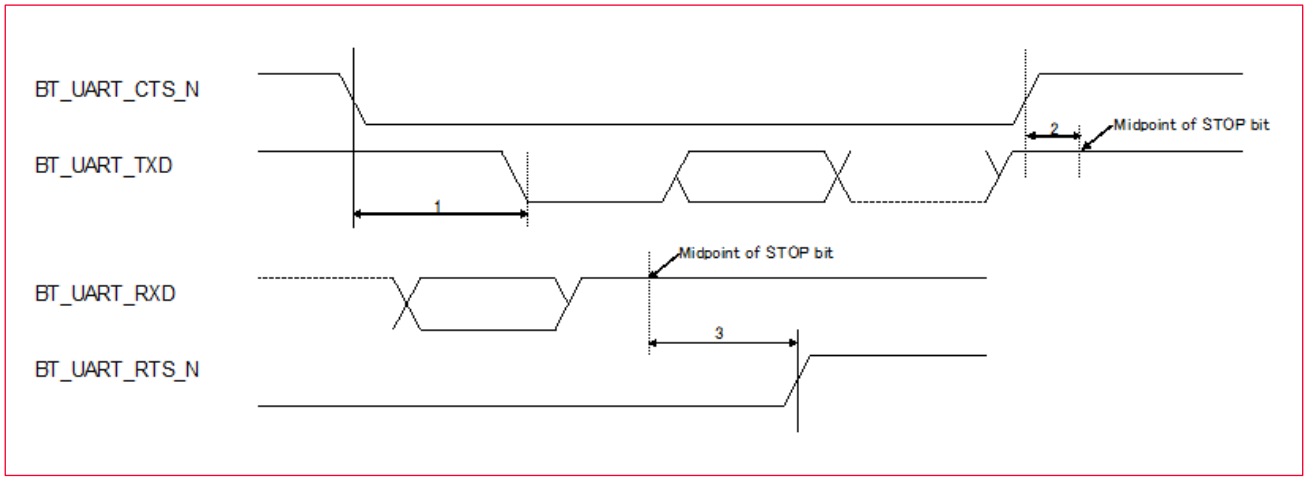
Parameter	Symbol	Minimum	Typical	Maximum	Unit
Output Delay Time-Data Transfer Mode	t_{ODLY}			14	ns
Output Hold time	t_{OH}	2.5			ns
Total System Capacitance (each line)	CL			40	pF

Timing is based on CL < 40 pF load on CMD and Data.
Minimum (Vih) = 0.7*VDDIO and maximum (Vil) = 0.2*VDDIO

13.2 Bluetooth UART Timing - Default Mode

Bluetooth UART timing diagram in default mode is shown in **Figure 15**.

Figure 15: Bluetooth UART Timing Diagram - Default Mode



Bluetooth UART timing parameters in default mode are shown in **Table 16**.

Table 16: Bluetooth UART Timing Parameters - Default Mode

Reference	Description	Minimum	Typical	Maximum	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

13.3 Bluetooth PCM Timing

This section describes the Bluetooth PCM timing sync signals along with their parameters for both long frame and short frame, as well as master and slave modes.

13.3.1 PCM Timing Short Frame Sync - Master Mode

Figure 16 shows the PCM short frame sync signal in master mode.

Figure 16: PCM Timing Short Frame Sync Signal - Master Mode

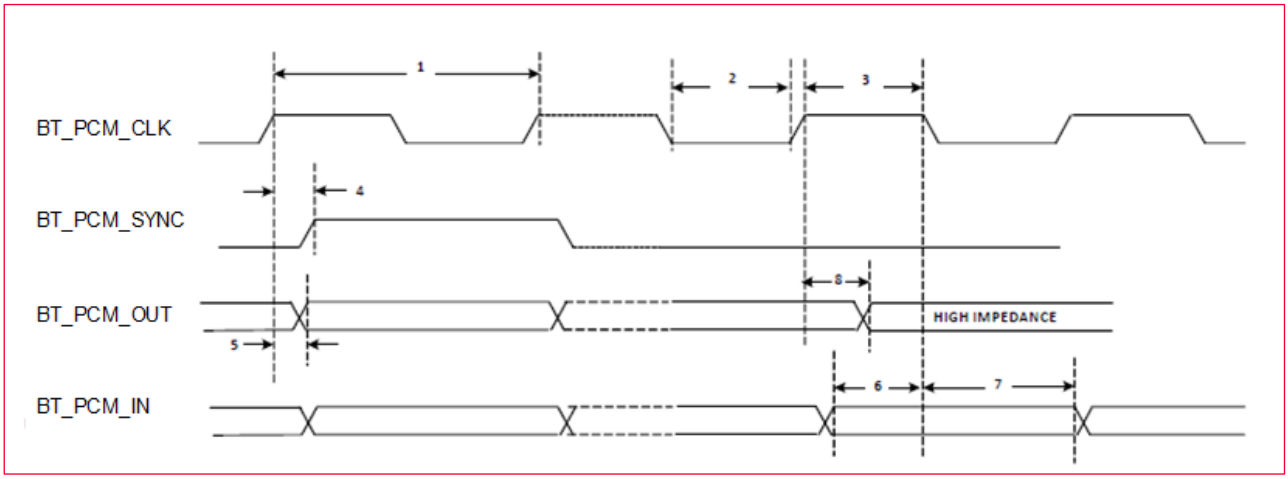


Table 17 lists information about PCM short frame sync in master mode.

Table 17: Symbol Definitions for PCM Timing Short Frame Sync Signal - Master Mode

Reference	Description	Minimum	Typical	Maximum	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

13.3.2 PCM Timing Short Frame Sync - Slave Mode

Figure 17 shows the PCM short frame sync signal in slave mode.

Figure 17: PCM Timing Short Frame Sync Signal - Slave Mode

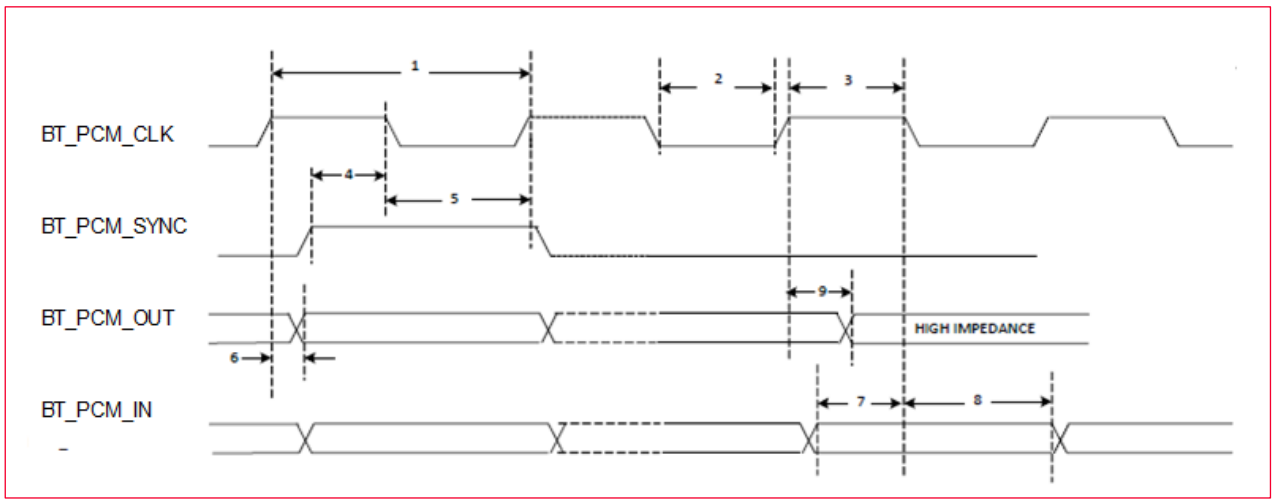


Table 18 lists information about PCM short frame sync in slave mode.

Table 18: Symbol Definitions for PCM Timing Short Frame Sync Signal - Slave Mode

Reference	Description	Minimum	Typical	Maximum	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

13.3.3 PCM Timing Long Frame Sync - Master Mode

Figure 18 shows the PCM long frame sync signal in master mode.

Figure 18: PCM Timing Long Frame Sync Signal - Master Mode

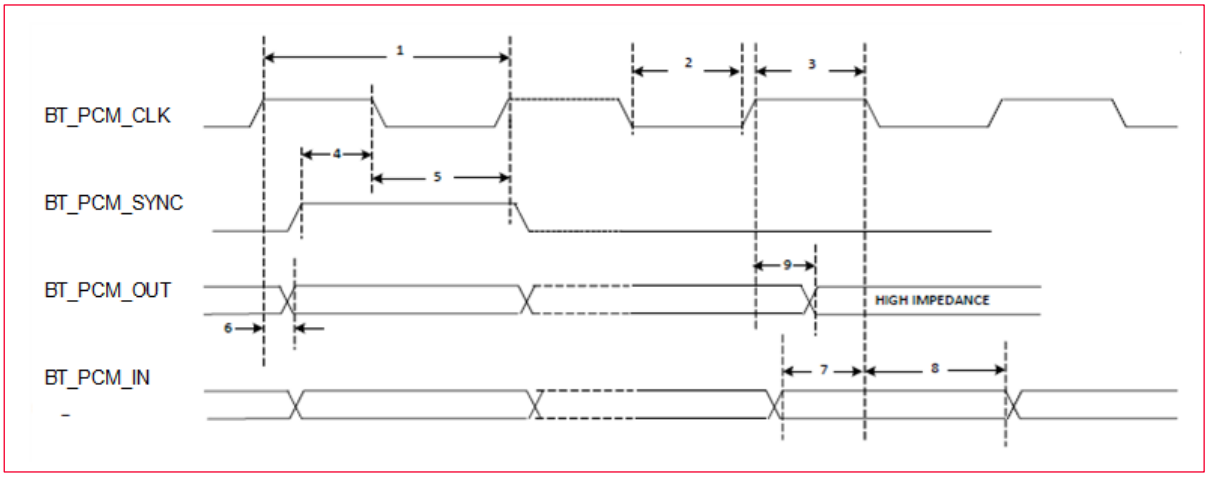


Table 19 lists information about PCM long frame sync in master mode.

Table 19: Symbol Definitions for PCM Timing Long Frame Sync Signal - Master Mode

Reference	Description	Minimum	Typical	Maximum	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

13.3.4 PCM Timing Long Frame Sync - Slave Mode

Figure 19 shows PCM long frame sync signal in slave mode.

Figure 19: PCM Timing Long Frame Sync Signal - Slave Mode

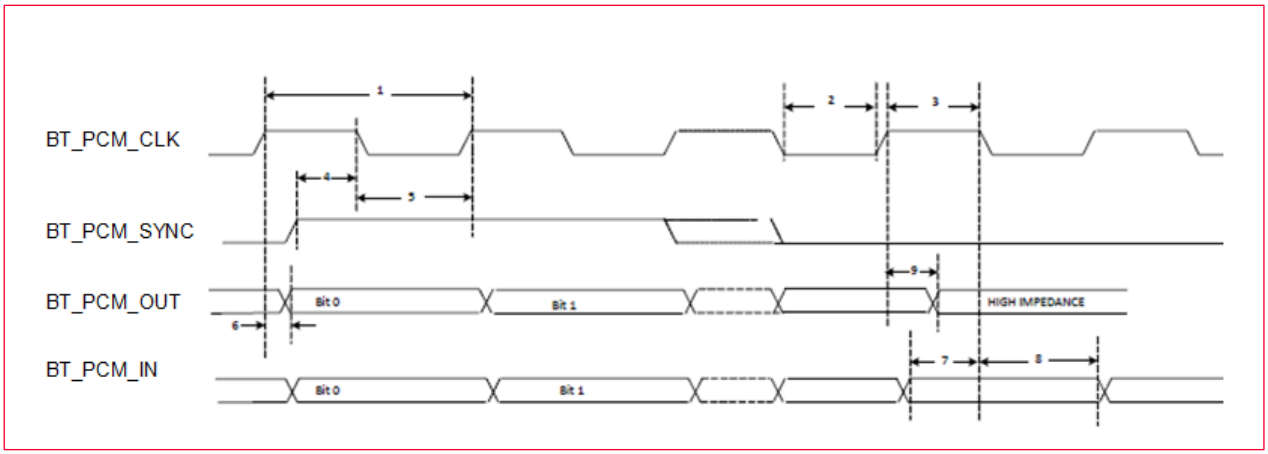


Table 20 lists information about PCM short frame sync in slave mode.

Table 20: Symbol Definitions for PCM Timing Long Frame Sync Signal - Slave Mode

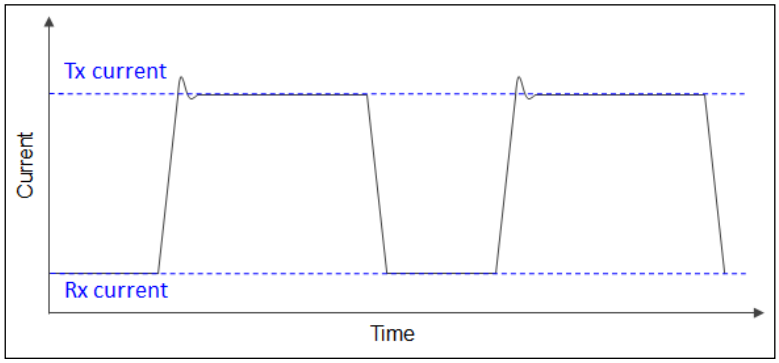
Reference	Description	Minimum	Typical	Maximum	Unit
1	PCM bit clock frequency			12	MHz
2	PCM bit clock low	41			ns
3	PCM bit clock high	41			ns
4	PCM_SYNC setup	8			ns
5	PCM_SYNC hold	8			ns
6	PCM_OUT delay	0		25	ns
7	PCM_IN setup	8			ns
8	PCM_IN hold	8			ns
9	Delay from rising edge of PCM_CLK during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

14 DC/RF Characteristics

This section describes the electrical characteristics of the Type 1YN module.

Burst current definition is shown in **Figure 20**.

Figure 20: Burst Current Definition



14.1 DC/RF Characteristics for IEEE 802.11b

Table 21: Characteristics Values for IEEE 802.11b

Items	Contents
Specification	IEEE 802.11b
Mode	DSSS / CCK
Frequency	2400 - 2483.5 MHz
Data Rate	1, 2, 5.5, 11 Mbps

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

Table 22: DC/RF Characteristics for IEEE 802.11b

Items	Contents			
DC Characteristics	**Minimum**	**Typical**	**Maximum**	**Unit**
DC Current				
• Tx mode (1024 byte, 20 µs interval)		320	370	mA
• Rx mode		47	60	mA
TX Characteristics	**Minimum**	**Typical**	**Maximum**	**Unit**
Output Power (Tolerance)	15	17	19	dBm
Spectrum Mask Margin				
• 1st side lobes (-30 dBr)	0			dB
• 2nd side lobes (-50 dBr)	0			dB
Power-on and Power-off ramp			2.0	µs
RF Carrier Suppression	15			dB
Modulation Accuracy (EVM)		15	35	%
Spurious Emissions				
• 30 - 47 MHz (BW = 100 kHz)			-36	dBm
• 47 - 74 MHz (BW = 100 kHz)			-54	dBm

Items	Contents			
• 74 - 87.5 MHz (BW = 100 kHz)			-36	dBm
• 87.5 - 118 MHz (BW =100 kHz)			-54	dBm
• 118 - 174 MHz (BW = 100 kHz)			-36	dBm
• 174 - 230 MHz (BW = 100 kHz)			-54	dBm
• 230 - 470 MHz (BW = 100 kHz)			-36	dBm
• 470 - 862 MHz (BW = 100 kHz)			-54	dBm
• 862 - 1000 MHz (BW = 100 kHz)			-36	dBm
• 1000 - 12750 MHz (BW = 1 MHz)			-30	dBm
Rx Characteristics	**Minimum**	**Typical**	**Maximum**	**Unit**
Minimum Input Level (FER ≤ 8%)		-89	-76	dBm
Maximum Input Level (FER ≤ 8%)	-10			dBm
Adjacent Channel Rejection (FER ≤ 8%)	35			dB

14.2 DC/RF Characteristics for IEEE 802.11g

Table 23: Characteristics Values for IEEE 802.11g

Items	Contents
Specification	IEEE 802.11g
Mode	OFDM
Frequency	2400 - 2483.5 MHz
Data Rate	6, 9, 12, 18, 24, 36, 48, 54 Mbps

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

Table 24: DC/RF Characteristics for IEEE 802.11g

Items	Contents			
DC Characteristics	**Minimum**	**Typical**	**Maximum**	**Unit**
DC Current				
• Tx mode (1024 byte, 20 µs interval)		270	310	mA
• Rx mode		47	60	mA
TX Characteristics	**Minimum**	**Typical**	**Maximum**	**Unit**
Output Power (Tolerance)	11	13	15	dBm
Spectrum Mask Margin				
• 9 MHz to 11 MHz (0 ~ -20 dBr)	0			dB
• 11 MHz to 20 MHz (-20 ~ -28 dBr)	0			dB
• 20 MHz to 30 MHz (-28 ~ -40 dBr)	0			dB
• 30 MHz to 33 MHz (-40 dBr)	0			dB
Constellation Error (EVM)		-30	-25	dB
Spurious Emissions				
• 30 - 47 MHz (BW = 100 kHz)			-36	dBm
• 47 -74 MHz (BW = 100 kHz)			-54	dBm
• 74 - 8 7.5 MHz (BW = 100 kHz)			-36	dBm
• 87.5 - 118 MHz (BW = 100 kHz)			-54	dBm
• 118 - 174 MHz (BW = 100 kHz)			-36	dBm
• 174 - 230 MHz (BW = 100 kHz)			-54	dBm
• 230 - 470 MHz (BW = 100 kHz)			-36	dBm
• 470 - 862 MHz (BW = 100 kHz)			-54	dBm
• 862 - 1000 MHz (BW = 100 kHz)			-36	dBm
• 1000 - 12750 MHz (BW = 1 MHz)			-30	dBm
Rx Characteristics	**Minimum**	**Typical**	**Maximum**	**Unit**
Minimum Input Level (PER ≤ 10%)		-75	-65	dBm
Maximum Input Level (PER ≤ 10%)	-20			dBm
Adjacent Channel Rejection (PER ≤ 10%)	-1			dB

14.3 DC/RF Characteristics for IEEE 802.11n

Table 25: Characteristics Values for IEEE 802.11n

Items	Contents
Specification	IEEE 802.11n
Mode	OFDM
Frequency	2400 - 2483.5 MHz
Data Rate	6.5, 13, 19.5, 26, 39, 52, 58.5, 65 Mbps

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

Table 26: DC/RF Characteristics for IEEE 802.11n

Items	Contents			
DC Characteristics	**Minimum**	**Typical**	**Maximum**	**Unit**
DC Current				
• Tx mode (1024 byte, 20 µs interval)		260	300	mA
• Rx mode		47	60	mA
TX Characteristics	**Minimum**	**Typical**	**Maximum**	**Unit**
Output Power (Tolerance)	10	12	14	dBm
Spectrum Mask Margin				
• 9 MHz to 11 MHz (0 ~ -20 dBr)	0			dB
• 11 MHz to 20 MHz (-20 ~ -28 dBr)	0			dB
• 20 MHz to 30 MHz (-28 ~ -45 dBr)	0			dB
• 30 MHz to 33 MHz (-45 dBr)	0			dB
Constellation Error (EVM)		-31	-27	dB
Spurious Emissions				
• 30 - 47 MHz (BW = 100 kHz)			-36	dBm
• 47 -74 MHz (BW = 100 kHz)			-54	dBm
• 74 - 8 7.5 MHz (BW = 100 kHz)			-36	dBm
• 87.5 - 118 MHz (BW = 100 kHz)			-54	dBm
• 118 - 174 MHz (BW = 100 kHz)			-36	dBm
• 174 - 230 MHz (BW = 100 kHz)			-54	dBm
• 230 - 470 MHz (BW = 100 kHz)			-36	dBm
• 470 - 862 MHz (BW = 100 kHz)			-54	dBm
• 862 - 1000 MHz (BW = 100 kHz)			-36	dBm
• 1000 - 12750 MHz (BW = 1 MHz)			-30	dBm
Rx Characteristics	**Minimum**	**Typical**	**Maximum**	**Unit**
Minimum Input Level (PER ≤ 10%)		-73	-64	dBm
Maximum Input Level (PER ≤ 10%)	-20			dBm
Adjacent Channel Rejection (PER ≤ 10%)	-2			dB

14.4 DC/RF Characteristics for Bluetooth

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

Table 27: DC/RF Characteristics for Bluetooth

Items	Contents			
Bluetooth Specification (power class)	Ver 5.1 (Class 1)			
Channel Frequency (spacing)	2402 to 2480 MHz (1 MHz)			
Current Consumption	Minimum	Typical	Maximum	Unit
• Tx = Rx = DH5 (fully occupied)		28	60	mA
• Tx = Rx = 2DH5 (fully occupied)		25	50	mA
• Tx = Rx = 3DH5 (fully occupied)		25	50	mA
Transmitter	**Minimum**	**Typical**	**Maximum**	**Unit**
Output Power	6	10	14	dBm
Frequency Range	2400		2483.5	MHz
20 dB Bandwidth			1	MHz
Adjacent Channel Power[2]				
[M-N] = 2			-20	dBm
[M-N] ≥ 3			-40	dBm
Modulation Characteristics	**Minimum**	**Typical**	**Maximum**	**Unit**
• Modulation $\Delta f1_{avg}$	140		175	kHz
• Modulation $\Delta f2_{max}$	115			kHz
• Modulation $\Delta f2_{avg}$ / $\Delta f1_{avg}$	0.8			
Carrier Frequency Drift	**Minimum**	**Typical**	**Maximum**	**Unit**
• 1slot	-25		+25	kHz
• 3slot / 5slot	-40		+40	kHz
• Maximum drift rate			+20	kHz/50µs
EDR Relative Power	-4		+1	dB
EDR Carrier Frequency Stability and Modulation Accuracy				
• ωi	-75		+75	kHz
• ωi+ωo	-75		+75	kHz
• ωo	-10		+10	kHz
• RMS DEVM (DQPSK)			20	%
• Peak DEVM (DQPSK)			35	%
• 99% DEVM (DQPSK)			30	%
• RMS DEVM (8DPSK)			13	%
• Peak DEVM (8DPSK)			25	%
• 99% DEVM (8DPSK)			20	%
Spurious Emissions				
• 30 - 47 MHz (BW = 100 kHz)			-36	dBm
• 47 - 74 MHz (BW = 100 kHz)			-54	dBm
• 74 - 87.5 MHz (BW = 100 kHz)			-36	dBm
• 87.5 - 118 MHz (BW = 100 kHz)			-54	dBm
• 118 - 174 MHz (BW = 100 kHz)			-36	dBm
• 174 - 230 MHz (BW = 100 kHz)			-54	dBm
• 230 - 470 MHz (BW = 100 kHz)			-36	dBm

[2] Up to three spurious responses within Bluetooth limits are allowed.

Items	Contents			
• 470 - 862 MHz (BW = 100 kHz)			-54	dBm
• 862 - 1000 MHz (BW = 100 kHz)			-36	dBm
• 1000 - 12750 MHz (BW = 1 MHz)			-30	dBm
Receiver	Minimum	Typical	Maximum	Minimum
Sensitivity (BER ≤ 0.1%)		-91	-80	dBm
C/I Performance (BER ≤ 0.1%)3				
• co-channel			11	dB
• 1 MHz			0	dB
• 2 MHz			-30	dB
• 3 MHz			-40	dB
• image (+4 MHz)			-9	dB
• image +/- 1 MHz			-20	dB
Maximum Input Level (PER ≤ 0.1%)	-20			dBm
EDR(8DPSK) Sensitivity (PER ≤ 0.007%)		-88	-77	dBm

[3] Up to five spurious responses within Bluetooth limits are allowed.

14.5 DC/RF Characteristics for Bluetooth Low Energy

Conditions: 25 °C, VBAT = 3.6V, VDDIO = 3.3V

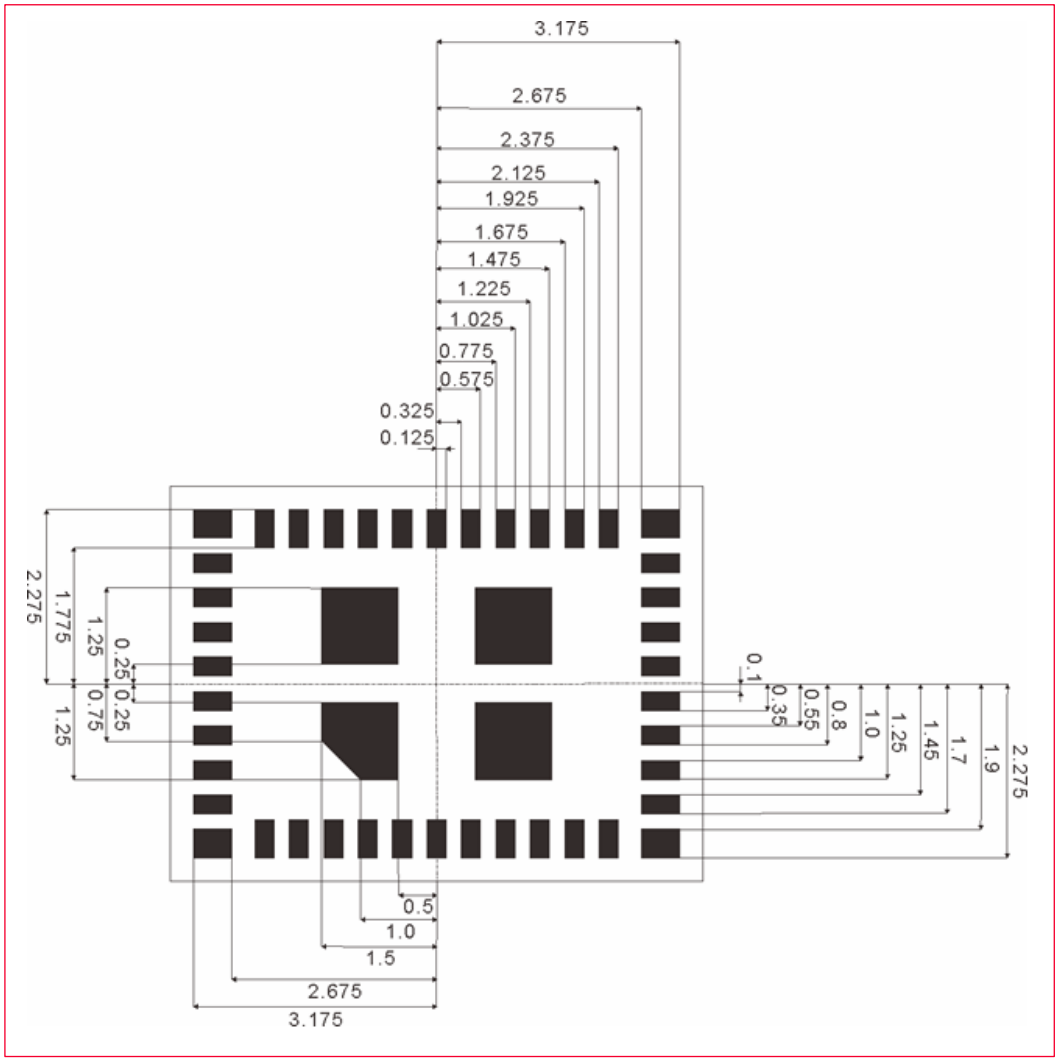
Table 28: DC/RF Characteristics for BLE

Items	Contents			
Bluetooth Specification (power class)	Version 5.1 (LE)			
Channel Frequency (spacing)	2402 to 2480 MHz (2 MHz)			
Number of RF Channel	40			
Transmitter	**Minimum**	**Typical**	**Maximum**	**Unit**
Center Frequency	2402		2480	MHz
Channel Spacing		2		MHz
Number of RF Channels		40		
Output Power			10	dBm
Modulation Characteristics				
• $\Delta f1_{avg}$	225		275	kHz
• $\Delta f2_{max}$ (at 99.9%)	185			kHz
• $\Delta f2_{avg}$ / $\Delta f1_{avg}$	0.8			
Carrier frequency offset and drift				
• Frequency offset			150	kHz
• Frequency drift			50	kHz
• Drift rate			20	kHz
Spurious Emissions				
• 30 - 47 MHz (BW = 100 kHz)			-36	dBm
• 47 - 74 MHz (BW = 100 kHz)			-54	dBm
• 74 - 87.5 MHz (BW = 100 kHz)			-36	dBm
• 87.5 - 118 MHz (BW = 100 kHz)			-54	dBm
• 118 - 174 MHz (BW = 100 kHz)			-36	dBm
• 174 - 230 MHz (BW = 100 kHz)			-54	dBm
• 230 - 470 MHz (BW = 100 kHz)			-36	dBm
• 470 - 862 MHz (BW = 100 kHz)			-54	dBm
• 862 - 1000 MHz (BW = 100 kHz)			-36	dBm
• 1000 - 12750 MHz (BW = 1 MHz)			-30	dBm
Receiver	**Minimum**	**Typical**	**Maximum**	**Unit**
Receiver sensitivity (PER < 30.8%)		-95	-70	dBm
Maximum input signal level (PER < 30.8%)	-10			dBm
PER Report Integrity (-30 dBm input)	50		65.4	%

15 Land Pattern

The land pattern is shown in **Figure 21.**

Figure 21**: Land Pattern (Unit: mm)**



16 Tape and Reel Packing

This section provides the general specifications for tape and reel packing.

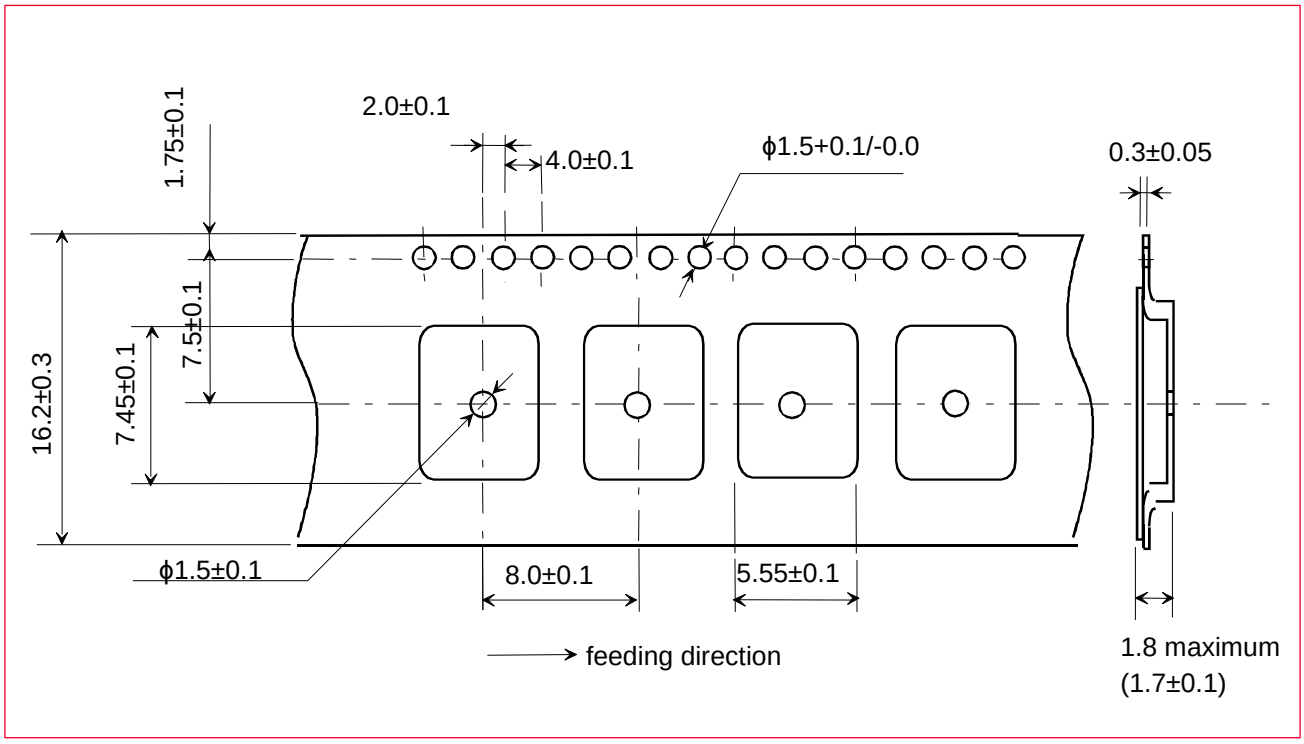
16.1 Dimensions of Tape (Plastic Tape)

The dimension of the tape is as follows:

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

Figure 22 is a graphical representation of the tape dimension (plastic tape).

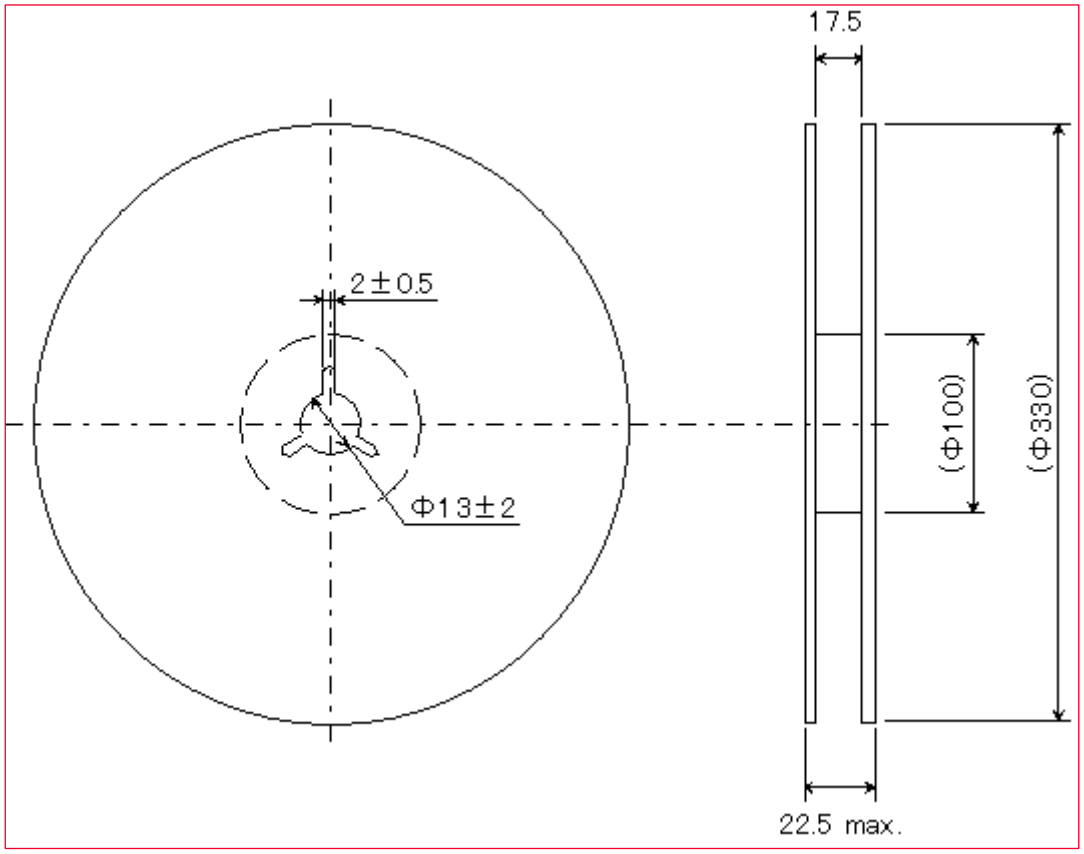
Figure 22: Dimensions of Tape (Plastic Tape)



16.2 Dimension of Reel

Figure 23 shows the reel dimensions in millimeters.

Figure 23: Dimensions of Reel (Unit: mm)



16.3 Taping Diagrams

Figure 24 shows the tapings diagrams.

Figure 24: Taping Diagrams

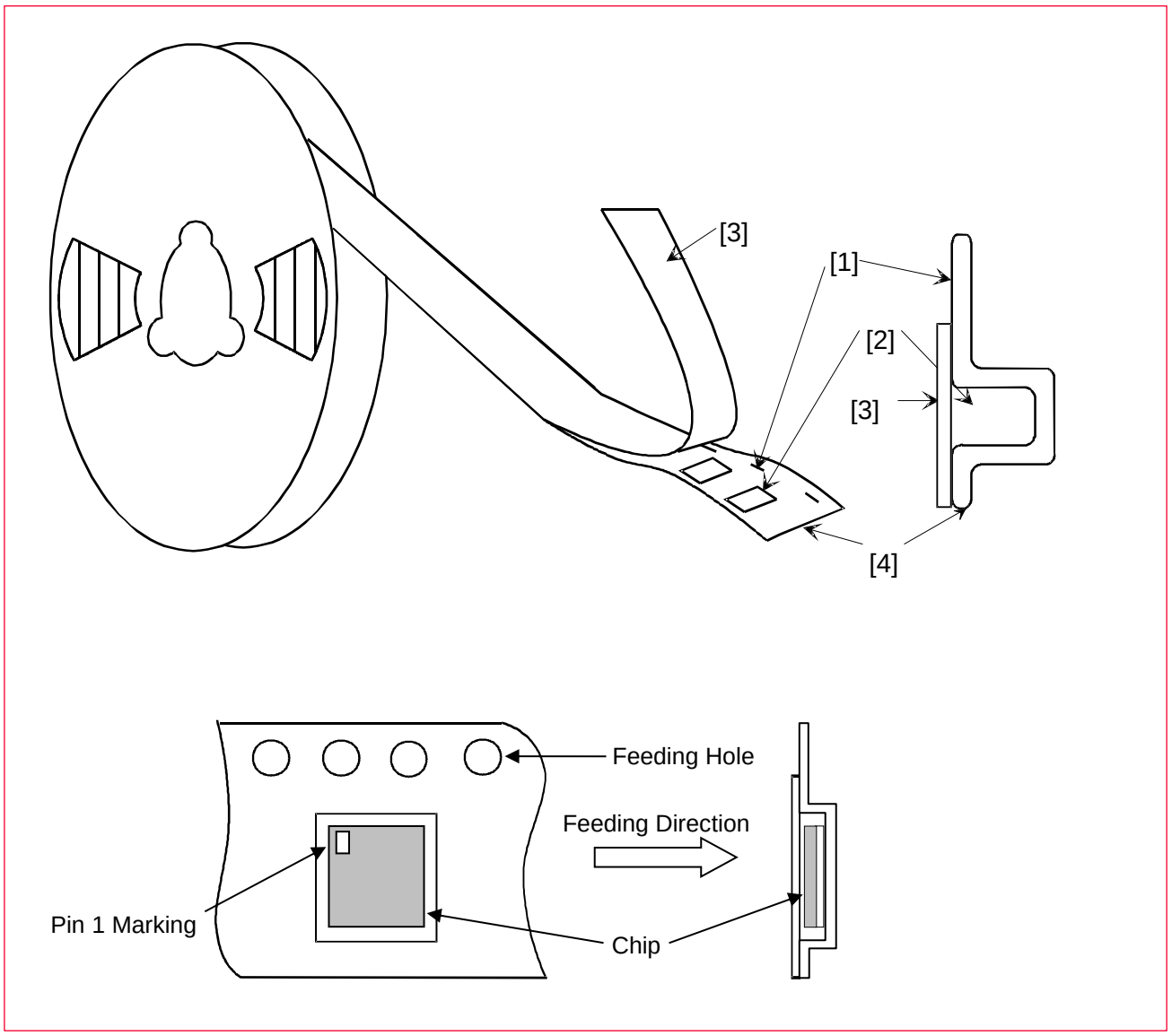


Table 29 shows the taping specifications.

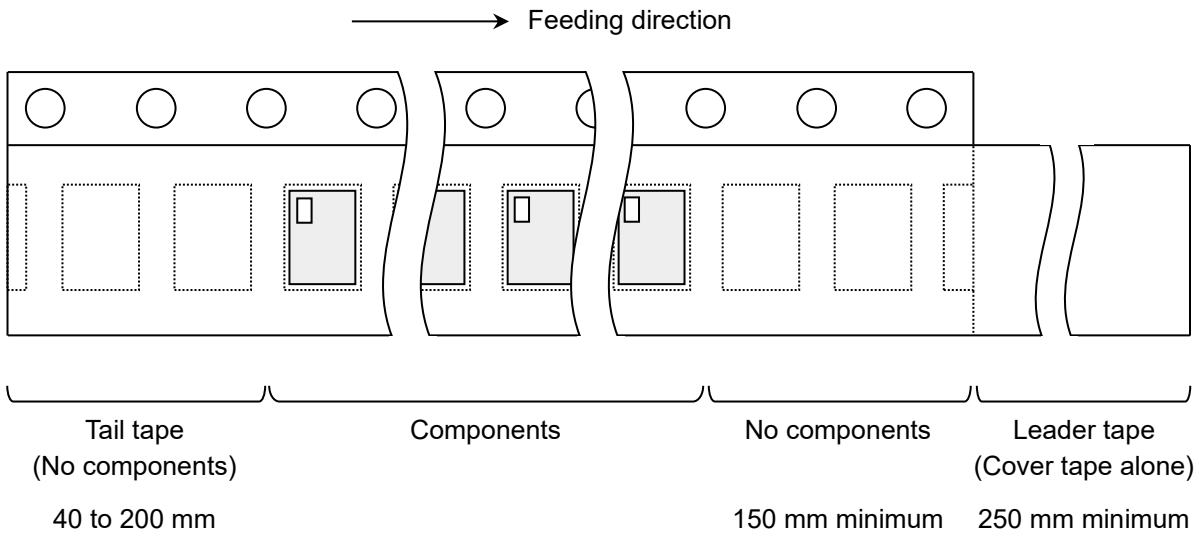
Table 29: Taping Specifications

Mark	Description
1	Feeding Hole. As specified in Dimensions of Tape (Plastic tape).
2	Hole for chip. As specified in Dimensions of Tape (Plastic tape).
3	Cover tape. 62 µm in thickness.
4	Base tape. As specified in Dimensions of Tape (Plastic tape).

16.4 Leader and Tail Tape

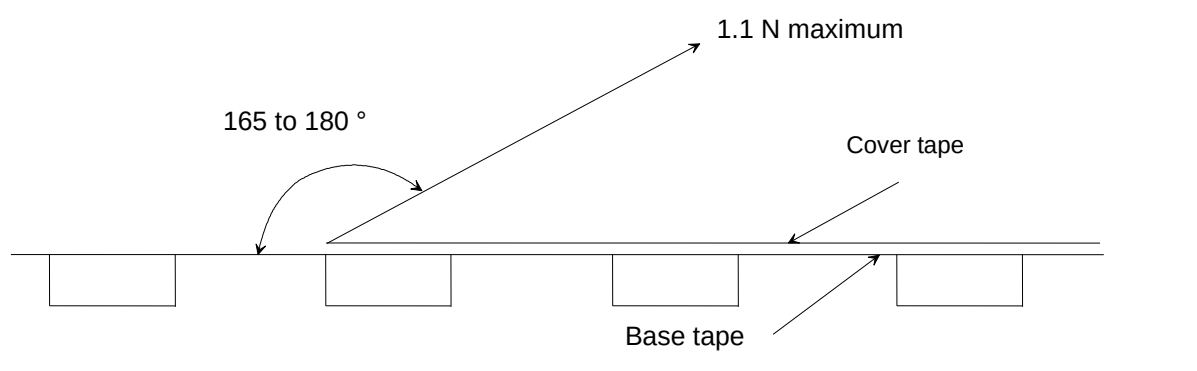
The leader and tail tape are shown in **Figure 25**.

Figure 25: Leader and Tail Tape



1. The tape for chips is wound clockwise, the feeding holes to the right side as the tape is pulled toward the user.
2. The cover tape and base tape are not adhered at no components area for 250 mm minimum.
3. Tear off strength against pulling of cover tape: 5 N minimum.
4. Packaging unit: 1000 pcs. / Reel
5. Material:
   - Base tape: Plastic
   - Reel: Plastic
   - Cover tape, cavity tape and reel are made the anti-static processing.
6. Peeling off force: 1.1 N maximum in the direction of peeling as shown in **Figure 26**.

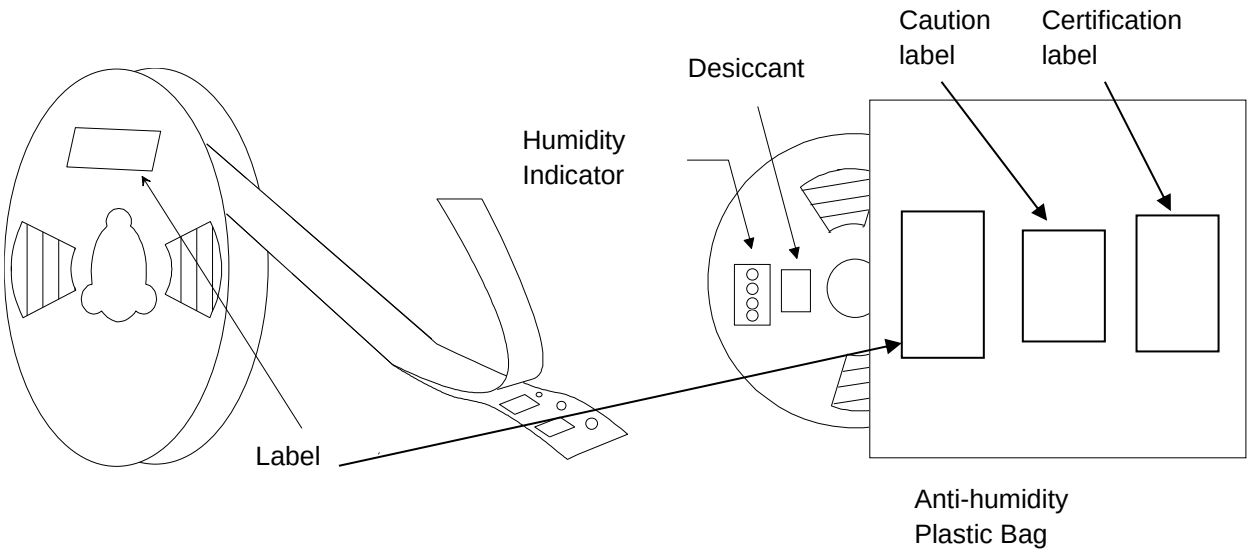
Figure 26: Peeling Off Force



16.5 Packaging (Humidity Proof Packing)

Figure 27 shows the humidity proof packaging.

Figure 27: Humidity Proof Packaging



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

17 Notice

17.1 Storage Conditions

- Please use this product within 6 months after receipt.
  - The product must 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 6 months after receipt, the solderability needs to be confirmed the before it is used.
  - The product shall be stored in non-corrosive gas (Cl_2, NH_3, SO_2, NO_X, etc.).
  - Any excess mechanical shock including, but not limited to, sticking the packing materials by sharp object, and dropping the product, shall not be applied in order not to damage the packing materials.
- This product is applicable to MSL3 (Based on JEDEC standard J-STD-020)
  - After the packing opened, the product shall be stored at ≤ 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) is not heat-resistant.

17.2 Handling Conditions

Be careful while 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.

17.3 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 should be 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.

17.4 Notice for Chip Placer

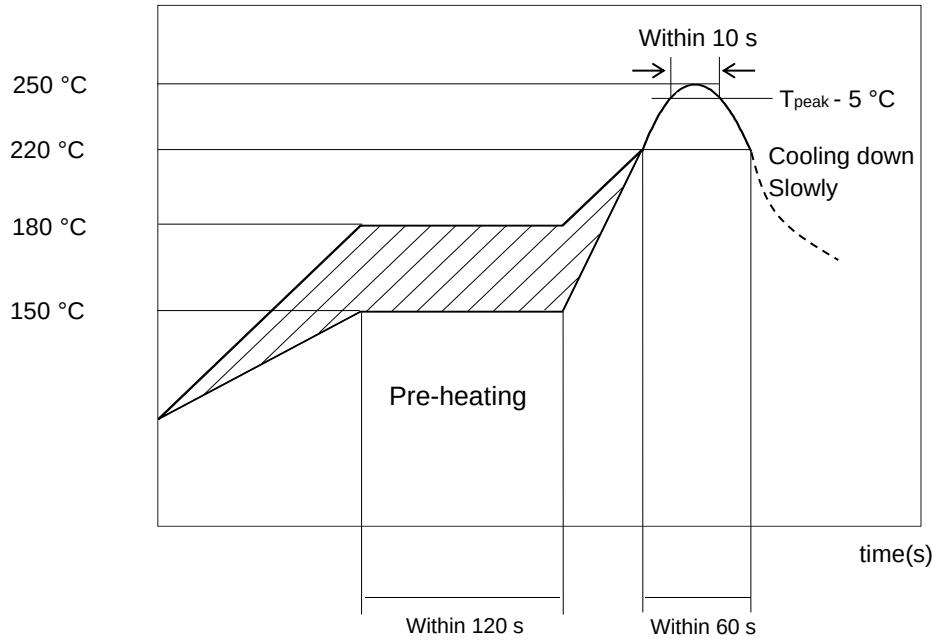
When placing products on the PCB, products may be stressed and broken by uneven forces from a worn-out chucking locating claw or a suction nozzle. To prevent products from damages, be sure to follow the specifications for the maintenance of the chip placer being used. For the positioning of products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

17.5 Soldering Conditions

The recommendation conditions of soldering are as in **Figure 28**.

Soldering must be carried out by the above-mentioned conditions to prevent products damage. Set up the highest temperature of reflow within 260 °C. Contact Murata before use concerning other soldering conditions.

Figure 28: Reflow Soldering Standard Conditions (Example)



Please use the reflow within 2 times.
Use rosin type flux or weakly active flux with a chlorine content of 0.2 wt. % or less.

17.6 Cleaning

This product is moisture sensitive therefore, cleaning is not recommended. If any cleaning process is done the customer is responsible for any issues or failures caused by the cleaning process.

17.7 Operational Environment Conditions

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

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

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

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

17.8 Input Power Capacity

Products shall be used in the input power capacity as specified in this specification.

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

18 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 DISCLAIM 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.

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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.

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- 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.

Even in the unlikely event that an abnormality or malfunction occurs in this product under operating conditions that conform to the specifications, be sure to add an appropriate fail-safe function to the system to prevent secondary accidents.

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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.

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- Improper use of engineering samples.
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If you can’t agree with the above contents, please contact sales.

Revision History

Revision	Date	Changed Item	Comment
1	Dec 10, 2020		First Issue
2 (A)	Jun 01, 2021	1. Scope 4. Certification Information 14. Tape and Reel Packing Appendix	Update Update Update Added
3 (B)	Jun 14, 2022.	1. Scope	Update
4 (C)	Dec 10, 2022	1. Scope 3. Ordering Information 13. Reference Circuit Appendix	• Updated information. Created new section 'Key Features'. • Added Embedded Artists' M.2 module information. Renamed section. • Moved section to HW app note. • Moved Appendix information into Section 16. • Added transmit power tables. • Moved antenna sections to HW app note. Updated to new format
5 (D)	Feb 02, 2023	2. Key Features	• Changes the operating temperature range from -30 ~ 70 °C to -40 ~ 85 °C
6 (E)	Jul 07, 2023	5. Certification Information	• Added more Certification ID information.
7 (F)	Sep 10, 2024	2. Key Features 5. Certification Information 16 Radio Regulatory Certification by Country for LBEE5KL1YN	• Add Fit value • Remove certification information
8	Mar 31, 2025	ALL 5. Certification Information 13 DC/RF Characteristics	• Modify BT ver • Add certification information • Format change • Updated (Base IC datasheet revision: F)