

Type 2GF Wi-Fi™ + Bluetooth® Module

Infineon CYW43022 Chipset for 802.11a/b/g/n/ac +
Bluetooth 5.4 - Rev. 5

- Design Name: Type 2GF
- P/N: LBEE5WV2GF-001



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About This Document

Type 2GF is a small and high-performance module based on Infineon CYW43022 combo chipset which supports Wi-Fi 802.11a/b/g/n/ac + Bluetooth 5.4 BR/EDR/LE. This datasheet describes Type 2GF 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.
<code>Console input/output or code snippet</code>	Console I/O or Code Snippet This text Style denotes console input/output or a code snippet.
<code># Console I/O comment // Code snippet comment</code>	Console I/O or Code Snippet Comment This text Style denotes a console input/output or code snippet comment. <ul style="list-style-type: none"> • 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 802.11a/b/g/n/ac WLAN + Bluetooth 5.4 combo module.

2 Key Features

- ◆ Infineon CYW43022 inside
- ◆ Supports IEEE 802.11a/b/g/n/ac specification: Dual band 2.4 GHz and 5 GHz
- ◆ SISO with 20 MHz channels
- ◆ Supports MCS8 (256-QAM) for 20MHz channels enabling data rates up to 78 Mbps.
- ◆ Supports Bluetooth specification version 5.4.
- ◆ WLAN interface: SDIO 2.0 and SDIO 3.0
- ◆ Bluetooth interface: HCI UART and PCM
- ◆ Temperature range: -20 °C to 70 °C
- ◆ Dimensions: 10.0 x 7.2 x 1.5 mm
- ◆ Weight: 0.266 g
- ◆ MSL: 3
- ◆ Surface mount type
- ◆ RoHS compliant.
- ◆ MAC/BD address are embedded
- ◆ Total FIT: 215.3

3 Ordering Information

Table 2 describes the ordering information.

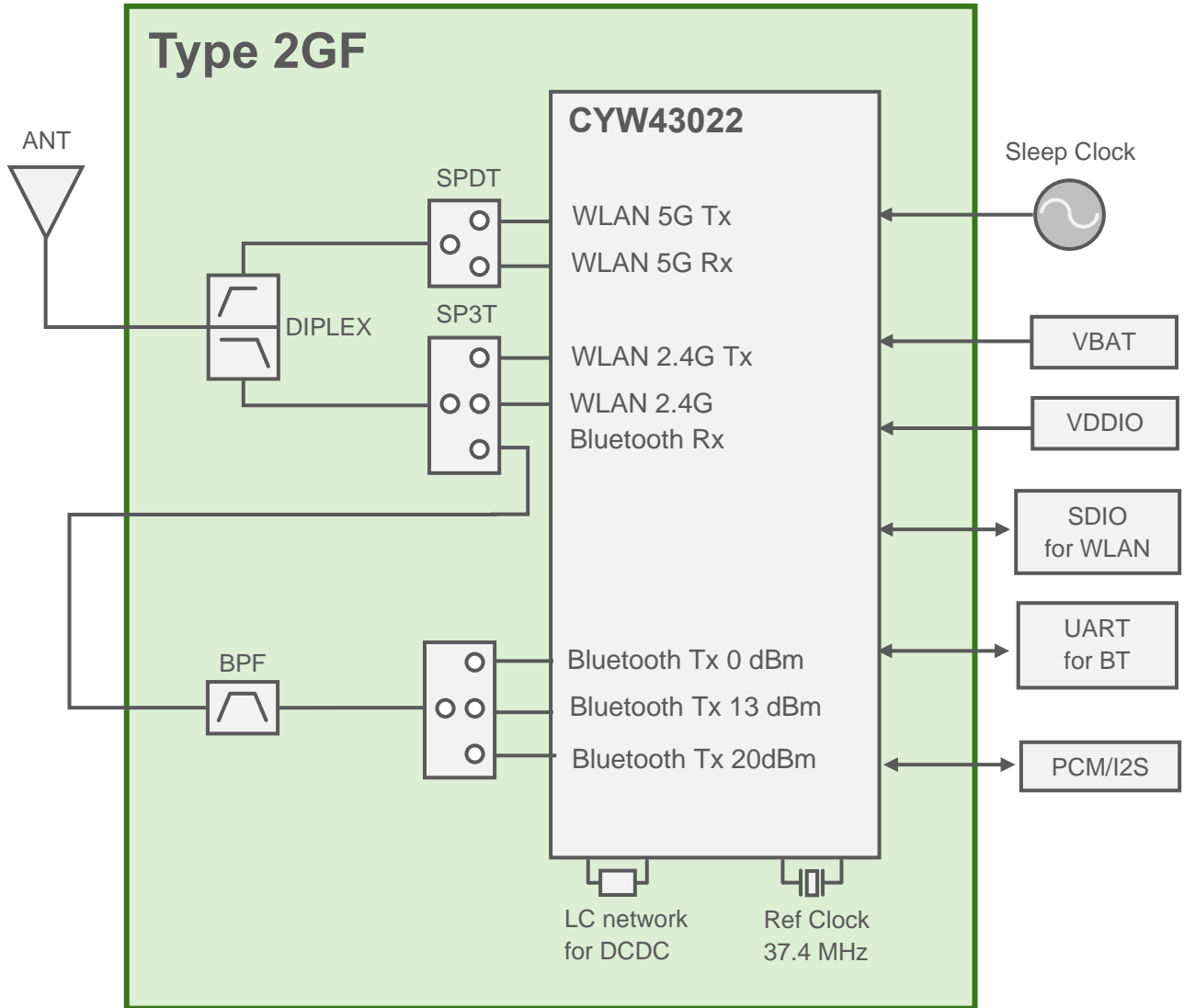
Table 2: Ordering Information

Ordering Part Number	Description
LBEE5WV2GF-001	Module order
LBEE5WV2GF-SMP	Sample module order (If module samples are not available through distribution, contact Murata referencing this part number)
EAR00497	Embedded Artists Type 2GF M.2 EVB (default EVB available through distribution)

4 Block Diagram

Figure 1 shows the Type 2GF block diagram.

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 2GF module.

Table 3: Certification Information

Country	ID	Country Code
USA (FCC)	VPYLBEE5WV2GF	US
Canada (IC)	772C-LBEE5WV2GF	CA
Europe	EN300328/301893, EN300440, The conducted test reports are prepared.	DE
Japan	Japanese type certification is prepared. R 001-P02073	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 2GF Radio Law Approval Application Note](#) for Radio Law Certification user manual.



If you don't follow the rule written in Type 2GF 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: 229805
- For supported Bluetooth functions, search ICS detail at [Bluetooth SIG site](#)

6 Dimensions, Markings and Terminal Configurations

This section has information on dimensions, markings, and terminal configurations for Type 2GF.

Figure 2 shows the dimensions, markings, and terminal configurations. **Table 4** and **Table 5** describes the Type 2GF markings and dimensions.

Figure 2: Dimensions, Markings and Terminal Configurations

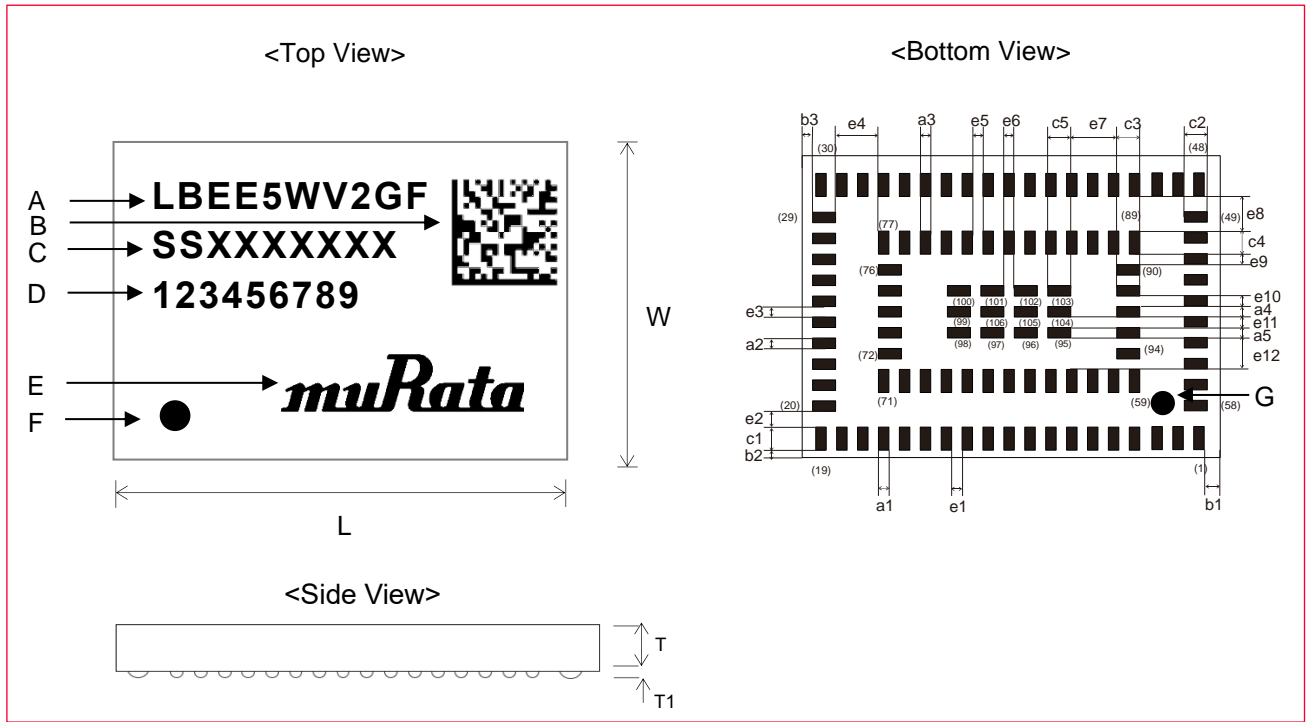


Table 4: Markings

Marking	Meaning
A	Module Part Number
B	2D code
C	Inspection Number
D	Serial Number
E	Murata Logo
F	Pin1 Marking
G	Pin1 Marking for bottom side

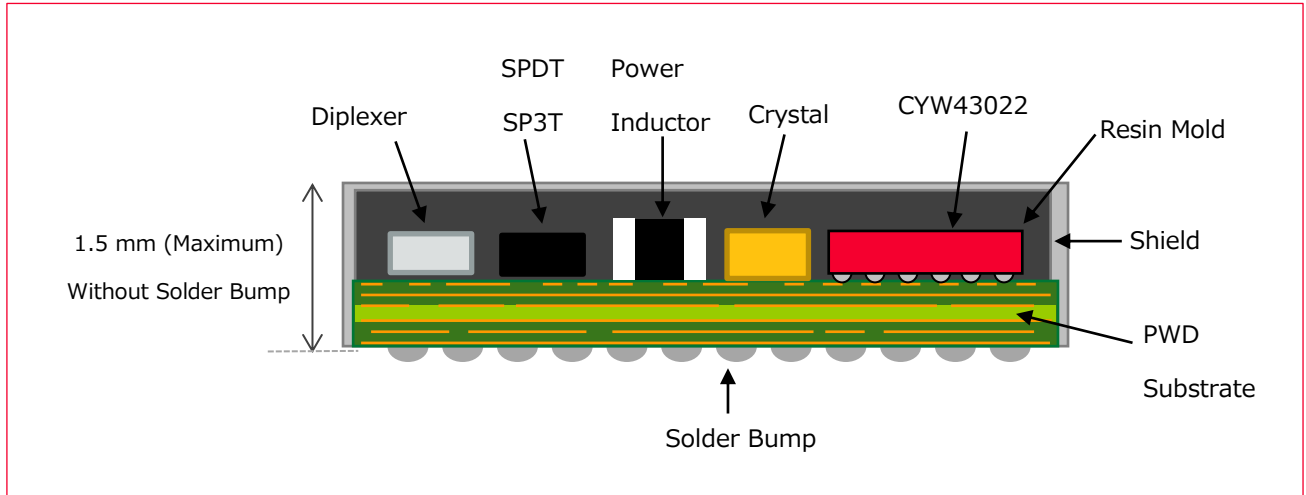
Table 5: Dimensions

Mark	Dimensions (mm)	Mark	Dimensions (mm)	Mark	Dimensions (mm)
L	10.0 +/- 0.2	W	7.2 +/- 0.2		
T	1.5 maximum	T1	0.04 typical		
a1	0.25 +/- 0.1	a2	0.25 +/- 0.1	a3	0.25 +/- 0.1
a4	0.25 +/- 0.1	a5	0.25 +/- 0.1	b1	0.375 +/- 0.2
b2	0.30 +/- 0.2	b3	0.30 +/- 0.2	c1	0.55 +/- 0.1
c2	0.55 +/- 0.1	c3	0.55 +/- 0.1	c4	0.55 +/- 0.1
c5	0.55 +/- 0.1	e1	0.25 +/- 0.1	e2	0.375 +/- 0.1
e3	0.25 +/- 0.1	e4	1.025 +/- 0.1	e5	0.25 +/- 0.1
e6	0.25 +/- 0.1	e7	1.100 +/- 0.1	e8	0.825 +/- 0.1

Mark	Dimensions (mm)	Mark	Dimensions (mm)	Mark	Dimensions (mm)
e9	0.25 +/- 0.1	e10	0.25 +/- 0.1	e11	0.25 +/- 0.1
e12	0.75 +/- 0.1				

Figure 3 shows Type 2GF structure.

Figure 3: Structure



The sides of the module are GND shielded. In order to avoid contact between the GND shield and the electrodes on the mother board, please carefully evaluate the standoff before use the module.

7 Module Pin Descriptions

This section has the pin descriptions of Type 2GF and pin assignments layout descriptions.

7.1 Module Pin Layout

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

Figure 4: Pin Layout Top View

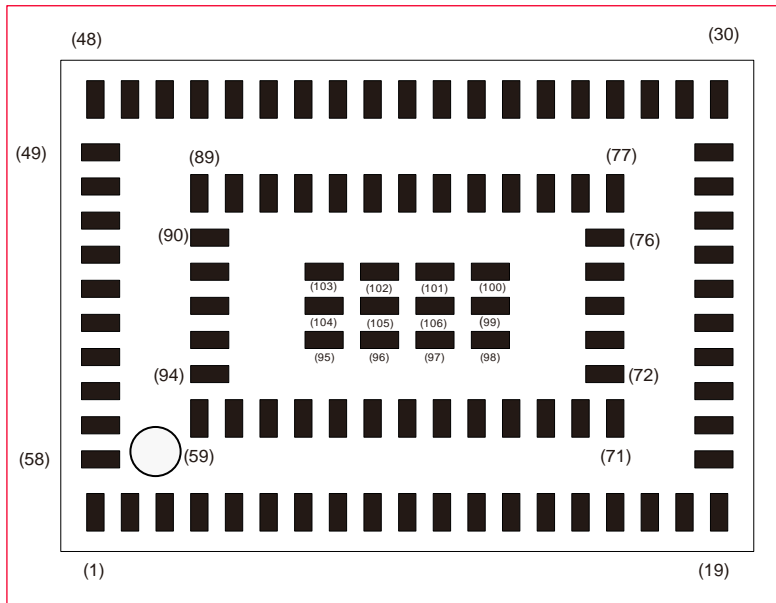


Table 6 illustrates the terminal configurations.

Table 6: Terminal Configurations

No.	Pin Name	No.	Pin Name	No.	Pin Name	No.	Pin Name
1	GND	25	SDIO_DATA_3	49	BT_RF_OUT	73	GND
2	GND	26	SDIO_CMD	50	GND	74	Reserved
3	GND	27	GND	51	BT_RF_IN	75	Reserved
4	Reserved	28	VDDOUT_VDDIO	52	GND	76	Reserved
5	BT_HOST_WAKE	29	BT_GPIO_0	53	GND	77	Reserved
6	GND	30	GND	54	NC	78	Reserved
7	WL_HOST_WAKE	31	BT_UART_TXD	55	RF_SW_CTRL_10	79	Reserved
8	WL_GPIO_1	32	BT_UART_RXD	56	NC	80	EXT_LPO
9	BT_REG_ON	33	BT_UART_RTS	57	GND	81	CLK_REQ
10	WL_REG_ON	34	BT_UART_CTS	58	ANT0	82	BT_PCM_OUT
11	GND	35	VDDIO	59	GND	83	BT_PCM_SYNC
12	VOUT_3P3	36	GND	60	GND	84	BT_PCM_IN
13	VBAT	37	P9	61	WL_GPIO_15	85	BT_PCM_CLK
14	VBAT	38	P11	62	WL_GPIO_13	86	BT_I2S_WS
15	GND	39	P13	63	WL_GPIO_12	87	BT_I2S_CLK
16	RF_SW_CTRL_8	40	P5	64	WL_GPIO_14	88	BT_I2S_DI
17	RF_SW_CTRL_12	41	P6	65	GND	89	BT_I2S_DO
18	RF_SW_CTRL_11	42	P8	66	WL_GPIO_5	90	BT_GPIO_2

No.	Pin Name	No.	Pin Name	No.	Pin Name	No.	Pin Name
19	GND	43	P7	67	WL_GPIO_4	91	BT_GPIO_5
20	GND	44	P12	68	WL_GPIO_3	92	BT_GPIO_4
21	SDIO_DATA_2	45	P0	69	WL_GPIO_2	93	BT_GPIO_3
22	SDIO_DATA_1	46	P1	70	NC	94-106	GND
23	SDIO_DATA_0	47	GND	71	WL_GPIO_6		
24	SDIO_CLK	48	GND	72	GND		

7.2 Pin Descriptions

Table 7 describes Type 2GF pins.

Table 7: Pin Descriptions

No.	Pin name	Type	Connection to IC Pin Name	Description
1	GND		GND	Ground
2	GND		GND	Ground
3	GND		GND	Ground
4	Reserved	I	VDDIO_SFL	DC supply voltage for SFLASH I/O
5	BT_HOST_WAKE	O	BT_HOST_WAKE	Bluetooth host wake.
6	GND	-	GND	Ground
7	WL_HOST_WAKE	I/O	GPIO_0	WL_HOST_WAKE
8	WL_GPIO_1	I/O	GPIO_1	WLAN general-purpose I/Os
9	BT_REG_ON	I	BT_REG_ON	Used by the PMU to power-up or power-down the internal regulators used by the Bluetooth section
10	WL_REG_ON	I	WL_REG_ON	Used by the PMU to power up or power down the internal regulators used by the WLAN section
11	GND	-	GND	Ground
12	VOUT_3P3	O	VDDOUT_RF3P3 VDDIO_RF1	Output of 3.3V RF LDO
13	VBAT	I	SR_VDDBAT5 LDO_VDDBAT5 WRF_GENTRAL_VDD_V5P0 WRF_TX_VDD_V5P0 ET_LINREG_VDD_V5P0 ET_SWREG_VDD_V5P0	Power Supply
14	VBAT			
15	GND	-	GND	Ground
16	RF_SW_CTRL_8	O	RF_SW_CTRL_8	Programmable RF switch-control lines
17	RF_SW_CTRL_12	O	RF_SW_CTRL_12	Programmable RF switch-control lines
18	RF_SW_CTRL_11	O	RF_SW_CTRL_11	Programmable RF switch-control lines
19	GND	-	GND	Ground
20	GND	-	GND	Ground
21	SDIO_DATA_2	I/O	SDIO_DATA_2	SDIO data line 2
22	SDIO_DATA_1	I/O	SDIO_DATA_1	SDIO data line 1
23	SDIO_DATA_0	I/O	SDIO_DATA_0	SDIO data line 0
24	SDIO_CLK	I	SDIO_CLK	SDIO clock
25	SDIO_DATA_3	I/O	SDIO_DATA_3	SDIO data line 3
26	SDIO_CMD	I/O	SDIO_CMD	SDIO command line
27	GND		GND	Ground

No.	Pin name	Type	Connection to IC Pin Name	Description
28	VDDOUT_VDDIO	O	VDDOUT_VDDIO OTP_VDD1P8 VDDP_RF1 VDDP_SFL	Output for 1.8V power switch
29	BT_GPIO_0	I/O	BT_GPIO_0	Bluetooth general-purpose I/Os
30	GND		GND	Ground
31	BT_UART_TXD	O	BT_UART_TXD	UART serial output
32	BT_UART_RXD	I	BT_UART_RXD	UART serial input
33	BT_UART_RTS	O	BT_UART_RTS_N	UART request-to-send
34	BT_UART_CTS	I	BT_UART_CTS_N	UART clear-to-send
35	VDDIO	I	VDDIO PMU_VDDIOA PMU_VDDIOP STRAP_OFF_1P8 VDD18_FLL,BT_VDDO BT_VDDO_HIB PAD_ADC_AVDDC	Power supply
36	GND		GND	Ground
37	P9	I/O	P9	Programmable LHL/HIB pads
38	P11	I/O	P11	Programmable LHL/HIB pads
39	P13	I/O	P13	Programmable LHL/HIB pads
40	P5	I/O	P5	Programmable LHL/HIB pads P5 is used as BT_DEV_WAKE
41	P6	I/O	P6	Programmable LHL/HIB pads
42	P8	O	P8	Programmable LHL/HIB pads *Output Only
43	P7	I/O	P7	Programmable LHL/HIB pads P7 is used as WL_DEV_WAKE
44	P12	I/O	P12	Programmable LHL/HIB pads
45	P0	I/O	P0	Programmable LHL/HIB pads
46	P1	I/O	P1	Programmable LHL/HIB pads
47	GND		GND	Ground
48	GND		GND	Ground
49	BT_RF_OUT	I/O		Bluetooth Antenna
50	GND		GND	Ground
51	BT_RF_IN	I/O	(SP3T)	BT/WiFi one antenna: Routed to BT_RF_OUT Separate BT/WiFi antenna: connect to 50 Ω terminal.
52	GND		GND	Ground
53	GND		GND	Ground
54	NC	O	RF_SW_CTRL_6	NC
55	RF_SW_CTRL_10	O	RF_SW_CTRL_10	Programmable RF switch-control lines
56	NC	O	RF_SW_CTRL_5	NC
57	GND		GND	Ground
58	ANT0	I/O		
59	GND		GND	Ground
60	GND		GND	Ground
61	WL_GPIO_15	I/O	GPIO_15	Programmable GPIO lines
62	WL_GPIO_13	I/O	GPIO_13	Programmable GPIO lines
63	WL_GPIO_12	I/O	GPIO_12	Programmable GPIO lines
64	WL_GPIO_14	I/O	GPIO_14	Programmable GPIO lines
65	GND		GND	Ground

No.	Pin name	Type	Connection to IC Pin Name	Description
66	WL_GPIO_5	I/O	GPIO_5	Programmable GPIO lines
67	WL_GPIO_4	I/O	GPIO_4	Programmable GPIO lines
68	WL_GPIO_3	I/O	GPIO_3	Programmable GPIO lines
69	WL_GPIO_2	I/O	GPIO_2	Programmable GPIO lines
70	NC	I	JTAG_SEL	Wi-Fi JTAG interface is intended to be used by Infineon's internal teams only
71	WL_GPIO_6	I/O	GPIO_6	Programmable GPIO lines
72	GND		GND	Ground
73	GND		GND	Ground
74	Reserved	I/O	SFL_IO0	Reserved
75	Reserved	I/O	SFL_IO3	Reserved
76	Reserved	I/O	SFL_IO2	Reserved
77	Reserved	O	SFL_CLK	Reserved
78	Reserved	I/O	SFL_IO1	Reserved
79	Reserved	O	SFL_CS	Reserved
80	EXT_LPO	I	LPO_IN	External sleep-clock input(32.768kHz)
81	CLK_REQ	I/O	CLK_REQ	Reference clock request The CLK_REQ polarity is active-high.
82	BT_PCM_OUT	O	BT_PCM_OUT	PCM data output
83	BT_PCM_SYNC	I/O	BT_PCM_SYNC	PCM sync, can be master (output) or slave (input)
84	BT_PCM_IN	I	BT_PCM_IN	PCM data input
85	BT_PCM_CLK	I/O	BT_PCM_CLK	PCM clock, can be master (output) or slave (input)
86	BT_I2S_WS	I/O	BT_I2S_WS	I ² S serial word select
87	BT_I2S_CLK	I/O	BT_I2S_CLK	I ² S serial clock
88	BT_I2S_DI	I	BT_I2S_DI	I ² S serial data input
89	BT_I2S_DO	O	BT_I2S_DO	I ² S serial data output
90	BT_GPIO_2	I/O	BT_GPIO_2	Bluetooth general-purpose I/Os
91	BT_GPIO_5	I/O	BT_GPIO_5	Bluetooth general-purpose I/Os
92	BT_GPIO_4	I/O	BT_GPIO_4	Bluetooth general-purpose I/Os
93	BT_GPIO_3	I/O	BT_GPIO_3	Bluetooth general-purpose I/Os
94-106	GND		GND	Ground

8 Absolute Maximum Ratings

The absolute maximum ratings are shown in **Table 8**.

Table 8: Absolute Maximum Ratings

Parameter	Minimum	Maximum	Unit
Storage Temperature	-40	85	°C
Supply Voltage	VBAT	5.0	V
	VDDIO	2.2	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 9**.

Table 9: Operating Conditions

Parameter	Minimum	Typical	Maximum	Unit
Operating Temperature	-20	25	+70	°C
Supply Voltage	VBAT	3.6	4.4	V
	VDDIO	1.8	1.98	V
Peak current			450	mA



Functionality is guaranteed but the specifications require the derating at over-temperatures, over-voltage condition.

10 External Sleep Clock Requirement

External LPO requirements are shown in **Table 10**.

Table 10: External LPO Requirement

Parameter	External LPO Clock	Unit
Nominal input frequency	32.768	kHz
Frequency accuracy	+/-250	ppm
Duty cycle	30-70	%
Input signal amplitude	500 – 1800	mVp-p
Signal type	Square-wave or sinewave	
Input impedance ¹	> 100k	Ω

¹ When the power is applied or switched off

11 Power-On Sequences

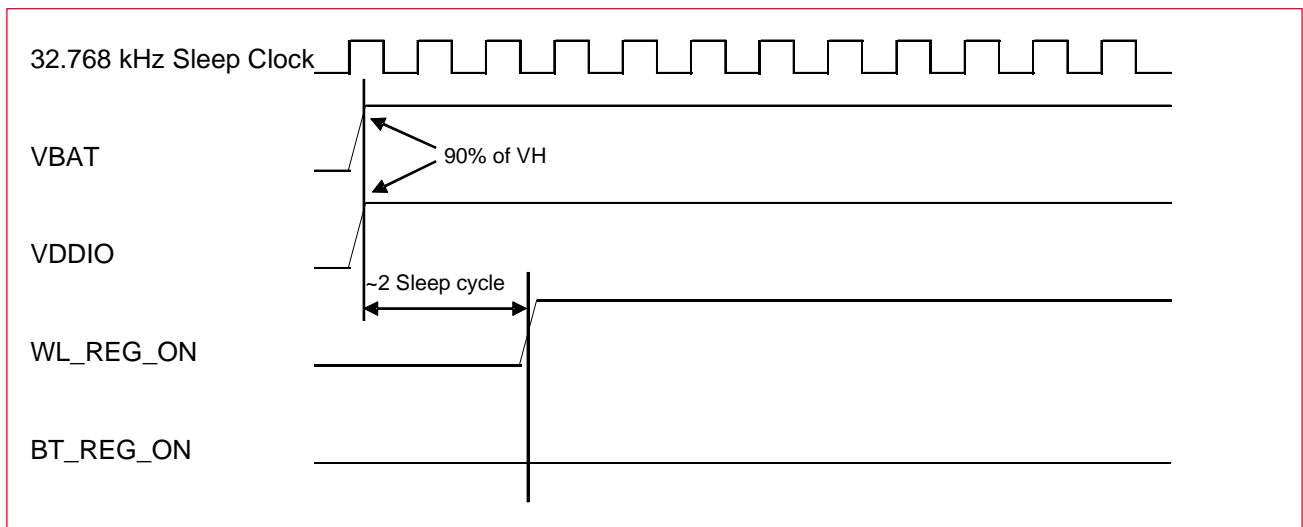
This section describes the power-on sequences along with their parameters.

- VBAT should not rise 10%-90% faster than 40 microseconds.
- VBAT should be up before or at the same time as VDDIO. VDDIO should NOT be present first or be held high before VBAT is high.

11.1 Power-On Sequence for WLAN ON and BT ON

Figure 5 shows the power-on sequence signals for WLAN ON and BT ON.

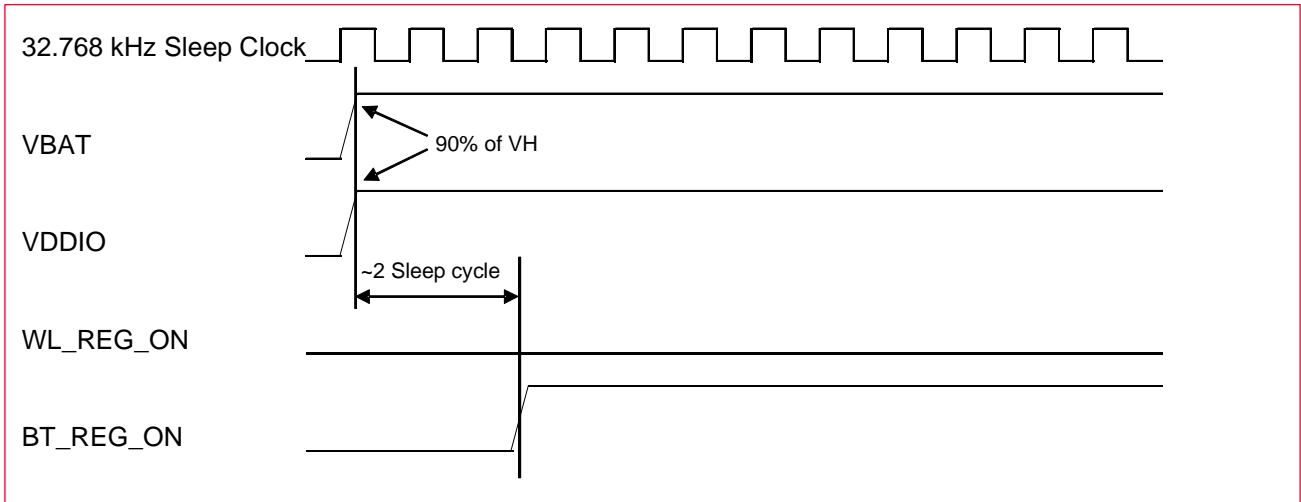
Figure 5: Power-On Sequence for WLAN ON and BT ON



11.2 Power-On Sequence for WLAN ON and BT OFF

Figure 6 shows the power-on sequence signals for WLAN ON and BT OFF.

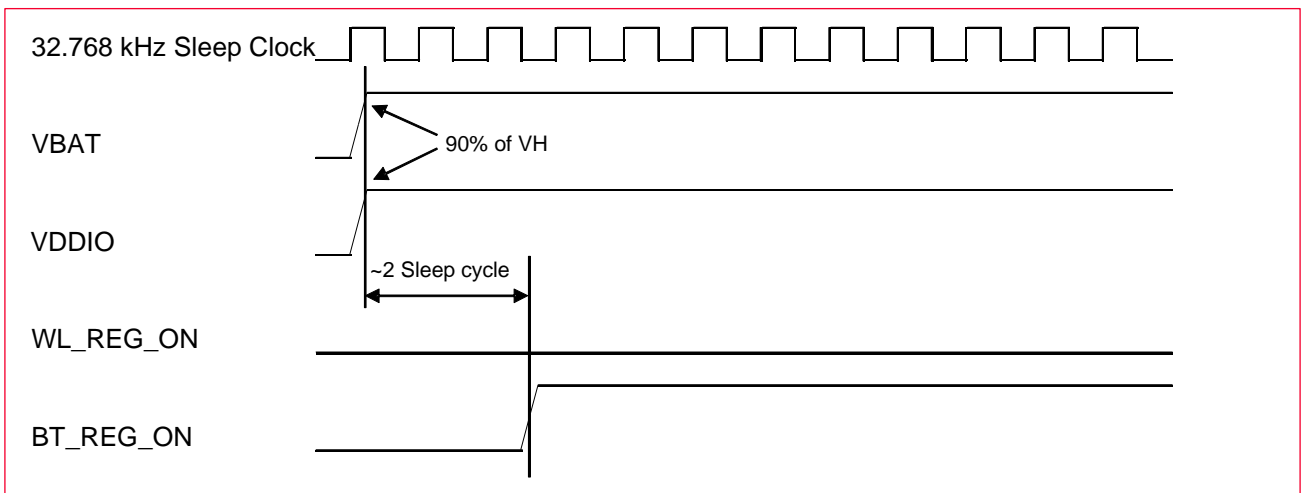
Figure 6: Power-On Sequence for WLAN ON and BT OFF



11.3 Power-On Sequence for WLAN OFF and BT ON

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

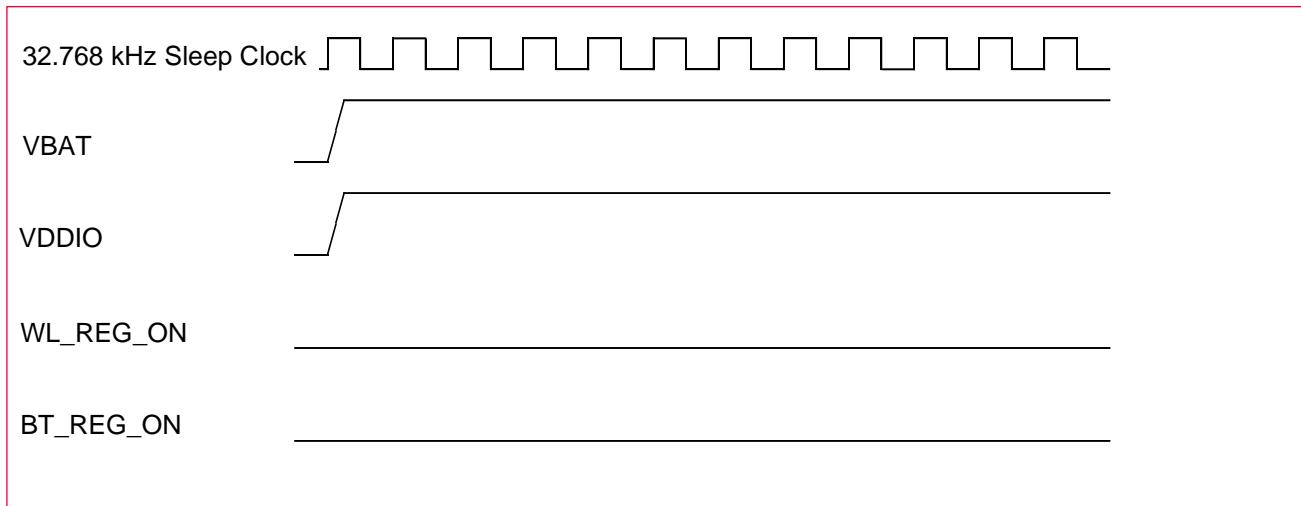
Figure 7: Power-On Sequence for WLAN OFF and BT ON



11.4 Power-On Sequence for WLAN OFF and BT OFF

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

Figure 8: Power-On Sequence for WLAN OFF and BT OFF



12 Digital I/O Requirements

This section describes the digital input/output pins and related parameters.

Table 11 describes the symbols, units, and the minimum and maximum levels of digital I/O pins.

Table 11: Digital I/O Pins

Digital I/O Pins	Symbol	Minimum	Typical	Maximum	Unit
For VDDIO = 1.8V					
Input high voltage	VIH	0.65xVDDIO			V
Input low voltage	VIL			0.35xVDDIO	V
Output high voltage @2 mA	VOH	VDDIO-0.45			V
Output low voltage @2 mA	VOL			0.45	V

Table 12 describes the symbols, units, and the minimum and maximum levels of WLAN/BT control pins.

Table 12: BT/WL_REG_ON Pins

BT/WL_REG_ON	Symbol	Minimum	Typical	Maximum	Unit
Input high voltage	VIH	1		4.6	V
Input low voltage	VIL	VSS		0.3	V
Pull-down resistance (internal)	RPD		50		kΩ
Leakage discharged Current	ILEAK_DIS		28		nA
REG OFF time	TREG_OFF	2			ms

13 Interface Timing and AC Characteristics

This section describes the interface timing for SDIO, Bluetooth, and PCM, their speed modes, related parameters, and graphs.

13.1 Bluetooth UART Timing

Figure 9 and **Table 13** show the Bluetooth UART timing diagram and related parameters.

Figure 9: Bluetooth UART Timing

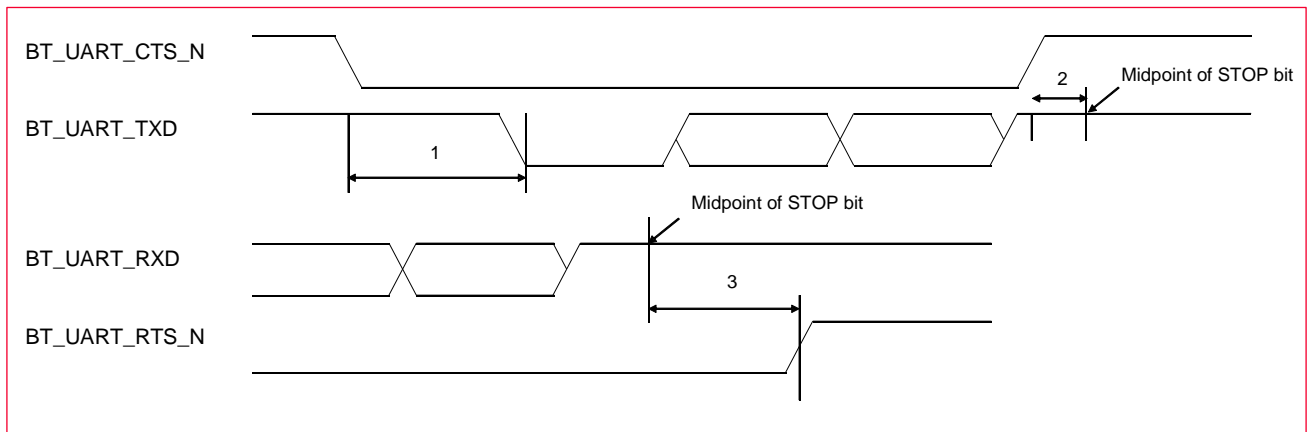


Table 13: UART Timing Parameters – Default Mode

Reference	Description	Minimum	Typical	Maximum	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

13.2 SDIO Timing

This section describes the SDIO timings for different modes.

13.2.1 SDIO Timing - Default Mode

The SDIO default timing diagram and related parameters are shown in **Figure 10** and **Table 14**.

Figure 10: SDIO Timing Diagram - Default Mode

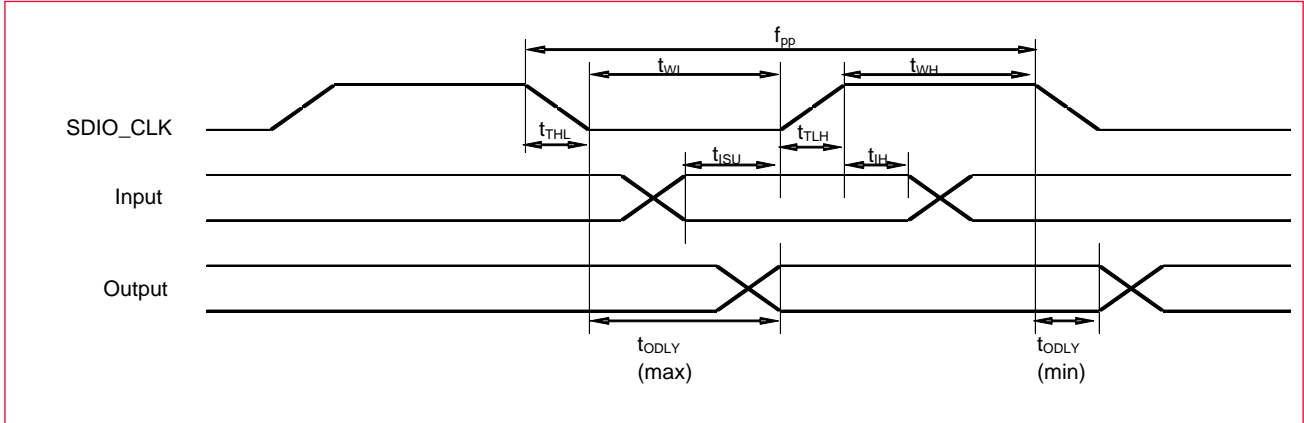


Table 14: SDIO Bus Timing Parameters - Default Mode

Parameter	Symbol	Minimum	Typical	Maximum	Unit
SDIO 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 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



Timing is based on $CL \leq 40$ pF load on CMD and Data.
Minimum (V_{ih}) = $0.7 \cdot V_{DDIO}$ and maximum (V_{il}) = $0.2 \cdot V_{DDIO}$

13.2.2 SDIO Timing - High Speed Mode

SDIO high speed timing diagram and parameters are shown in Figure 11 and Table 15.

Figure 11: SDIO Timing Diagram - High Speed Mode

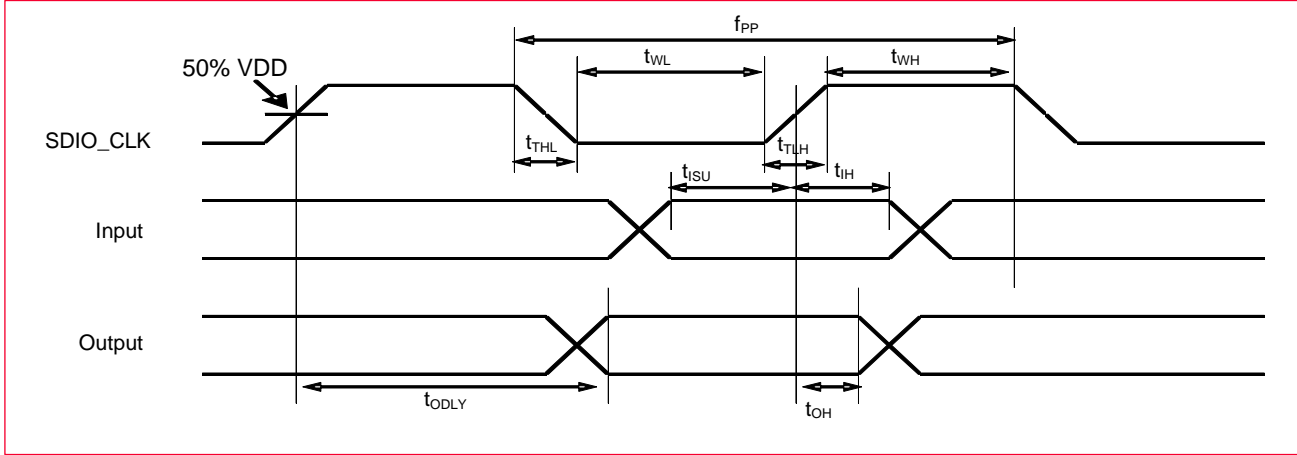


Table 15: SDIO Bus Timing Parameters - High Speed Mode

Parameter	Symbol	Minimum	Typical	Maximum	Unit
SDIO 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 Low Time	t_{THL}			3	ns
Inputs: CMD, DAT (referenced to CLK)					
Input Setup Time	t_{ISU}	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



Timing is based on $CL \leq 40$ pF load on CMD and Data
 Minimum (V_{ih}) = $0.7 \cdot V_{DDIO}$ and maximum (V_{il}) = $0.2 \cdot V_{DDIO}$

13.2.3 SDIO BUS Timing Specifications in SDR Modes

This section describes the SDIO bus timing specifications in SDR modes.

13.2.3.1 Clock Timing

Figure 12 shows the clock timing diagram.

Figure 12: Clock Timing - SDR Modes

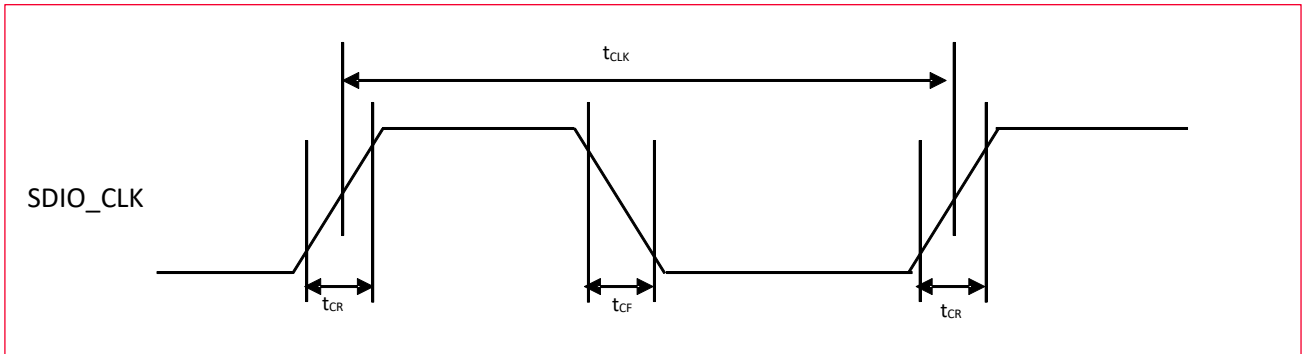


Table 16 describes the clock timing parameters.

Table 16: SDIO Clock Timing Parameters - SDR Modes

Parameter	Symbol	Minimum	Maximum	Unit	Comments
	t_{CLK}	40		ns	SDR12 mode
		20		ns	SDR25 mode
		12.5		ns	SDR50 mode
	t_{CR}, t_{CF}		$0.2 \times t_{CLK}$	ns	$t_{CR}, t_{CF} < 2.00$ ns (maximum) @ 100 MHz cCARD = 10 pF $t_{CR}, t_{CF} < 0.96$ ns (maximum) @ 208 MHz cCARD = 10 pF
Clock duty cycle		30	70	%	

13.2.3.2 Card Input Timing

Figure 13 shows the card input timing diagram.

Figure 13: Card Input Timing - SDR Modes

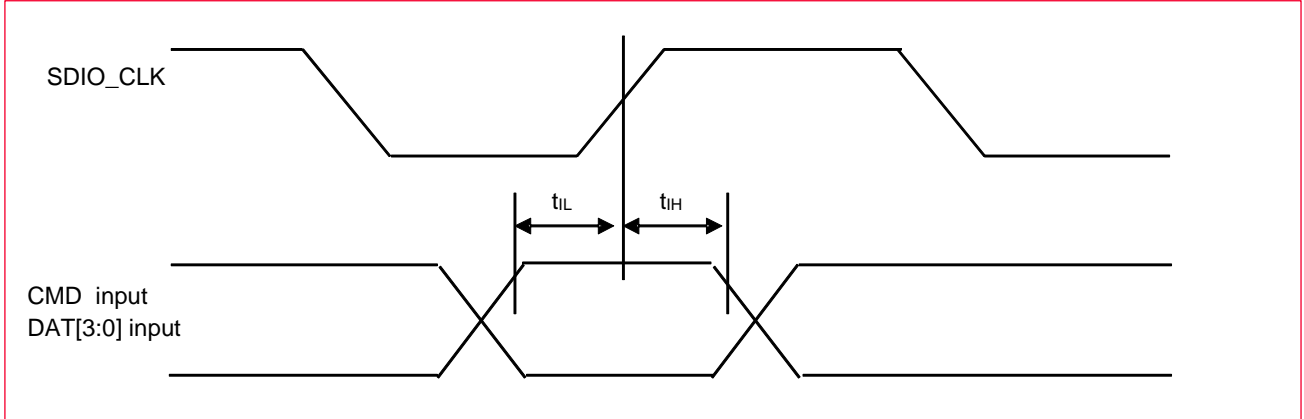


Table 17 shows the SDIO input timing parameters.

Table 17: SDIO Bus Input Timing Parameters - SDR Modes

Symbol	Minimum	Maximum	Unit	Comments
SDR50 Mode				
t_{IS}	3.0		ns	$C_{CARD} = 10\text{ pF}$, $V_{CT} = 0.975\text{V}$
t_{IH}	0.8		ns	$C_{CARD} = 5\text{ pF}$, $V_{CT} = 0.975\text{V}$

13.2.3.3 Card Output Timing

Figure 14 shows the card output timing diagram (up to 50 MHz).

Figure 14: Card Output Timing - SDR Modes (up to 50 MHz)

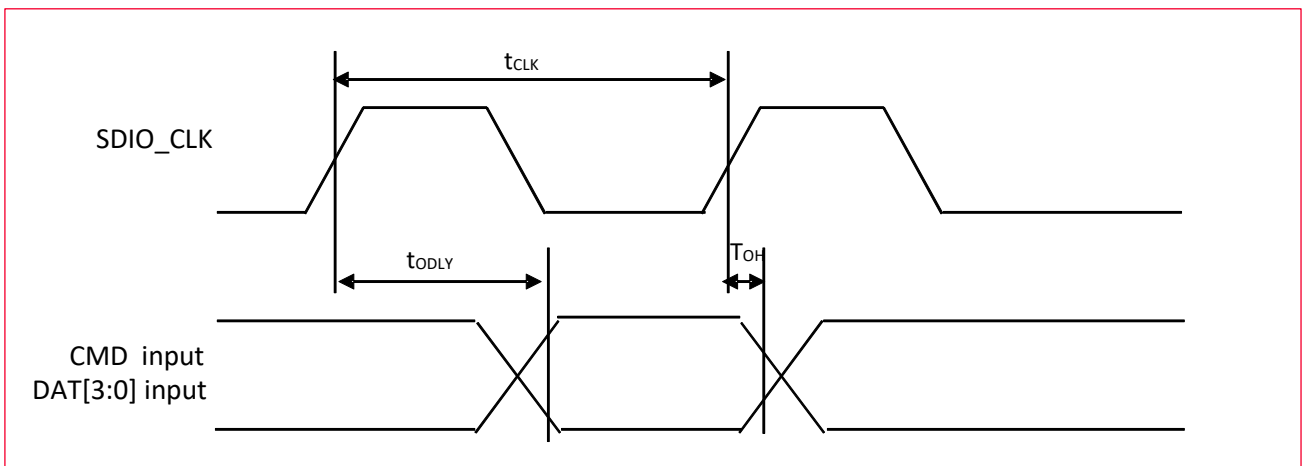


Table 18 describes the SDIO output timing parameters.

Table 18: SDIO Bus Output Timing Parameters - SDR Modes (up to 50 MHz)

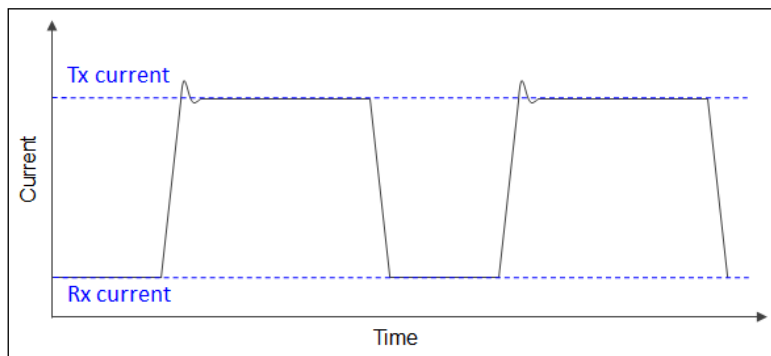
Symbol	Minimum	Maximum	Unit	Comments
t _{ODLY}		7.5	ns	t _{CLK} ≥ 10 ns CL = 30 pF using driver Type B for SDR50
t _{ODLY}		14.0	ns	t _{CLK} ≥ 20 ns CL = 40 pF using for SDR12, SDR25
t _{OH}	1.5		ns	Hold time at the t _{ODLY} (min) CL = 15 pF

14 DC/RF Characteristics

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

Burst current definition is shown in **Figure 15**.

Figure 15: Burst Current Definition



14.1 DC/RF Characteristics for IEEE 802.11b - 2.4 GHz

Table 19: Characteristics Values for IEEE 802.11b - 2.4 GHz

Contents	Items
Specification	IEEE 802.11b
Mode	DSSS / CCK
Channel Frequency	2412 to 2472 MHz
Data rate	1, 2, 5.5, 11 Mbps

14.1.1 High-Rate Condition for IEEE 802.11b - 2.4 GHz

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V, Output power setting = 17 dBm, 11 Mbps mode unless otherwise specified.

Table 20: High-Rate Condition for IEEE 802.11b - 2.4 GHz

Items	Contents			
	Minimum	Typical	Maximum	Unit
DC Characteristics				
DC Current				
• Tx Mode		210	310	mA
• Rx Mode		20		mA
Tx Characteristics	Minimum	Typical	Maximum	Unit
Output Power	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-down ramp			2.0	μs
RF Carrier Suppression	15			dB
Modulation Accuracy (EVM)			35	%
Frequency Tolerance	-20		20	ppm
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
Rx Characteristics	Minimum	Typical	Maximum	Unit
Minimum Input Level (FER ≤ 8%)		-90	-76	dBm
Maximum input Level (FER ≤ 8%)	-10			dBm
Adjacent Channel Rejection (FER ≤ 8%)	35			dB

14.1.2 Low-Rate Condition for IEEE 802.11b - 2.4 GHz

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V, Output power setting = 17 dBm, 1 Mbps mode unless otherwise specified.

Table 21: High-Rate Condition for IEEE 802.11b - 2.4 GHz

Items	Contents			
DC Characteristics	Minimum	Typical	Maximum	Unit
DC Current				
• Tx Mode		200	300	mA
• Rx Mode		20		mA
Tx Characteristics	Minimum	Typical	Maximum	Unit
Output Power	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-down ramp			2.0	μs
RF Carrier Suppression	15			dB
Modulation Accuracy (EVM)			35	%
Frequency Tolerance	-20		20	ppm
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
Rx Characteristics	Minimum	Typical	Maximum	Unit
Minimum Input Level (FER ≤ 8%)		-98	-80	dBm
Maximum input Level (FER ≤ 8%)	-10			
Adjacent Channel Rejection (FER ≤ 8%)	35			dB

14.2 DC/RF Characteristics for IEEE 802.11g - 2.4 GHz

Table 222: Characteristics Values for IEEE 802.11g - 2.4 GHz

Contents	Items
Specification	IEEE 802.11g
Mode	OFDM
Channel Frequency	2412 to 2472 MHz
Data rate	6, 9, 12, 18, 24, 36, 48, 54 Mbps

14.2.1 High-Rate Condition for IEEE 802.11g - 2.4 GHz

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V, Output power setting = 14 dBm, 54 Mbps mode unless otherwise specified.

Table 23: High-Rate Condition for IEEE 802.11g - 2.4 GHz

Items	Contents			
DC Characteristics	Minimum	Typical	Maximum	Unit
DC Current				
• Tx Mode		170	230	mA
• Rx Mode		20		mA
Tx Characteristics	Minimum	Typical	Maximum	Unit
Output Power	12	14	16	dBm
Spectrum Mask Margin				
• 9 MHz to 11 MHz (0 ~ -20 dB)	0			dB
• 11 MHz to 20 MHz (-20 ~ -28 dB)	0			dB
• 20 MHz to 30 MHz (-28 ~ -40 dB)	0			dB
• 30 MHz to 33 MHz (-40 dB)	0			dB
Constellation Error (EVM)			-25	dB
Frequency Tolerance	-20		20	ppm
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
Rx Characteristics	Minimum	Typical	Maximum	Unit
Minimum Input Level (FER ≤ 10%)		-77	-65	dBm
Maximum input Level (FER ≤ 10%)	-20			dBm
Adjacent Channel Rejection (PER ≤ 10%)	-1			dB

14.2.2 Low-Rate Condition for IEEE 802.11g - 2.4 GHz

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V, Output power setting = 17 dBm, 6 Mbps mode unless otherwise specified.

Table 24: Low-Rate Condition for IEEE 802.11g - 2.4 GHz

Items	Contents			
	Minimum	Typical	Maximum	Unit
DC Characteristics				
DC Current				
• Tx Mode		160	290	mA
• Rx Mode		20		mA
Tx Characteristics				
Output Power	15	17	19	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)			-5	dB
Frequency Tolerance	-20		20	ppm
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
Rx Characteristics				
Minimum Input Level (FER ≤ 10%)		-94	-82	dBm
Maximum input Level (FER ≤ 10%)	-20			dBm
Adjacent Channel Rejection (PER ≤ 10%)	16			dB

14.3 DC/RF Characteristics for IEEE 802.11n - 2.4 GHz

Table 25: Characteristics Values for IEEE 802.11n - 2.4 GHz

Contents	Items
Specification	IEEE 802.11n
Mode	OFDM
Channel Frequency	2412 to 2472 MHz
Data rate	6.5, 13, 19.5, 26, 39, 52, 58.5, 65 Mbps

14.3.1 High-Rate Condition for IEEE 802.11n - 2.4 GHz

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V, Output power setting = 13 dBm, MCS7 unless otherwise specified.

Table 26: High-Rate Condition for IEEE 802.11n - 2.4 GHz

Items	Contents			
DC Characteristics	Minimum	Typical	Maximum	Unit
DC Current				
• Tx Mode		165	220	mA
• Rx Mode		20		mA
Tx Characteristics	Minimum	Typical	Maximum	Unit
Output Power	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 ~ -45 dBr)	0			dB
• 30 MHz to 33 MHz (-45 dBr)	0			dB
Constellation Error (EVM)			-27	dB
Frequency Tolerance	-20		20	ppm
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
Rx Characteristics	Minimum	Typical	Maximum	Unit
Minimum Input Level (PER ≤ 10%)		-75	-64	dBm
Maximum Input Level (PER ≤ 10%)	-20			
Adjacent Channel Rejection (PER ≤ 10%)	-2			dB

14.3.2 Low-Rate Condition for IEEE 802.11n - 2.4 GHz

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V, Output power setting = 17 dBm, MCS0 unless otherwise specified.

Table 27: Low-Rate Condition for IEEE 802.11n - 2.4 GHz

Items	Contents			
	Minimum	Typical	Maximum	Unit
DC Characteristics				
DC Current				
• Tx Mode		150	290	mA
• Rx Mode		20	30	mA
Tx Characteristics				
Output Power	15	17	19	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)			-5	dB
Frequency Tolerance	-20		20	ppm
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
Rx Characteristics				
Minimum Input Level (PER ≤ 10%)		-94	-82	dBm
Maximum Input Level (PER ≤ 10%)	-20			
Adjacent Channel Rejection (PER ≤ 10%)	16			dB

14.4 DC/RF Characteristics for IEEE 802.11a - 5 GHz

Table 28: Characteristics Values for IEEE 802.11a - 5 GHz

Contents	Items
Specification	IEEE 802.11a
Mode	OFDM
Channel Frequency	5180 to 5825 MHz
Data rate	6, 9, 12, 18, 24, 36, 48, 54 Mbps

14.4.1 High-Rate Condition for IEEE 802.11a – 5 GHz

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V, Output power setting = 13 dBm, 54 Mbps unless otherwise specified.

Table 29: High-Rate Condition for IEEE 802.11a - 5 GHz

Items	Contents			
DC Characteristics	Minimum	Typical	Maximum	Unit
DC Current				
• Tx Mode		260	370	mA
• Rx Mode		20		mA
Tx Characteristics	Minimum	Typical	Maximum	Unit
Output Power	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)			-25	dB
Frequency Tolerance	-20		20	ppm
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 - 5150 MHz (BW = 1 MHz)			-30	dBm
• 5350 - 5470 MHz (BW = 1 MHz)			-30	dBm
• 5725 - 26000 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%)	-30			
Adjacent Channel Rejection (PER ≤ 10%)	-1			dB

14.4.2 Low-Rate Condition for IEEE 802.11a – 5 GHz

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V, Output power setting = 16 dBm, 6 Mbps unless otherwise specified.

Table 30: Low-Rate Condition for IEEE 802.11a - 5 GHz

Items	Contents			
	Minimum	Typical	Maximum	Unit
DC Characteristics				
DC Current				
• Tx Mode		240	450	mA
• Rx Mode		20		mA
Tx Characteristics				
Output Power	14	16	18	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)			-5	dB
Frequency Tolerance	-20		20	ppm
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 - 5150 MHz (BW = 1 MHz)			-30	dBm
• 5350 - 5470 MHz (BW = 1 MHz)			-30	dBm
• 5725 - 26000 MHz (BW = 1 MHz)			-30	dBm
Rx Characteristics				
Minimum Input Level (PER ≤ 10%)		-91	-82	dBm
Maximum Input Level (PER < 10%)	-30			
Adjacent Channel Rejection (PER ≤ 10%)	16			dB

14.5 DC/RF Characteristics for IEEE 802.11n - 5 GHz

Table 31: Characteristics Values for IEEE 802.11n - 5 GHz

Contents	Items
Specification	IEEE 802.11n (HT20)
Mode	OFDM
Channel Frequency	5180 to 5825 MHz
Data rate	6.5, 13, 19.5, 26, 39, 52, 58.5, 65 Mbps

14.5.1 High-Rate Condition for IEEE 802.11n – 5 GHz

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V, Output power setting = 12 dBm, MCS7 unless otherwise specified.

Table 32: High-Rate Condition for IEEE 802.11n - 5 GHz

Items	Contents			
DC Characteristics	Minimum	Typical	Maximum	Unit
DC Current				
• Tx Mode		250	340	mA
• Rx Mode		20		mA
Tx Characteristics	Minimum	Typical	Maximum	Unit
Output Power	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)			-27	dB
Frequency Tolerance	-20		20	ppm
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 - 5150 MHz (BW = 1 MHz)			-30	dBm
• 5350 - 5470 MHz (BW = 1 MHz)			-30	dBm
• 5725 - 26000 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%)	-30			dBm
Adjacent Channel Rejection (PER ≤ 10%)	-2			dB

14.5.2 Low-Rate Condition for IEEE 802.11n – 5 GHz

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V, Output power setting = 16 dBm, MCS0 unless otherwise specified.

Table 33: Low-Rate Condition for IEEE 802.11n - 5 GHz

Items	Contents			
	Minimum	Typical	Maximum	Unit
DC Characteristics				
DC Current				
• Tx Mode		230	450	mA
• Rx Mode		20	30	mA
Tx Characteristics				
Output Power	14	16	18	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)			-5	dB
Frequency Tolerance	-20		20	ppm
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 - 5150 MHz (BW = 1 MHz)			-30	dBm
• 5350 - 5470 MHz (BW = 1 MHz)			-30	dBm
• 5725 - 26000 MHz (BW = 1 MHz)			-30	dBm
Rx Characteristics				
Minimum Input Level (PER ≤ 10%)		-91	-82	dBm
Maximum Input Level (PER ≤ 10%)	-30			dBm
Adjacent Channel Rejection (PER ≤ 10%)	16			dB

14.6 DC/RF Characteristics for IEEE 802.11ac - 5 GHz

Table 34: Characteristics Values for IEEE 802.11ac - 5 GHz

Contents	Items
Specification	IEEE 802.11ac (VHT20)
Mode	OFDM
Channel Frequency	5180 to 5825 MHz
Data rate	6.5, 13, 19.5, 26, 39, 52, 58.5, 65, 78 Mbps

14.6.1 High-Rate Condition for IEEE 802.11ac – 5 GHz

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V, Output power setting = 10 dBm, MCS7 unless otherwise specified.

Table 35: High-Rate Condition for IEEE 802.11ac - 5 GHz

Items	Contents			
	Minimum	Typical	Maximum	Unit
DC Characteristics				
DC Current				
• Tx Mode		230	310	mA
• Rx Mode		20		mA
Tx Characteristics	Minimum	Typical	Maximum	Unit
Output Power	8	10	12	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)			-32	dB
Frequency Tolerance	-20		20	ppm
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 - 5150 MHz (BW = 1 MHz)			-30	dBm
• 5350 - 5470 MHz (BW = 1 MHz)			-30	dBm
• 5725 - 26000 MHz (BW = 1 MHz)			-30	dBm
Rx Characteristics	Minimum	Typical	Maximum	Unit
Minimum Input Level (PER ≤ 10%)		-70	-59	dBm
Maximum Input Level (PER ≤ 10%)	-30			dBm
Adjacent Channel Rejection (PER ≤ 10%)	-2			dB

14.6.2 Low-Rate Condition for IEEE 802.11ac – 5 GHz

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V, Output power setting = 16 dBm, MCS0 unless otherwise specified.

Table 36: Low-Rate Condition for IEEE 802.11ac - 5 GHz

Items	Contents			
	Minimum	Typical	Maximum	Unit
DC Characteristics				
DC Current				
• Tx Mode		230	450	mA
• Rx Mode		20	30	mA
Tx Characteristics				
Output Power	14	16	18	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)			-5	dB
Frequency Tolerance	-20		20	ppm
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 - 5150 MHz (BW = 1 MHz)			-30	dBm
• 5350 - 5470 MHz (BW = 1 MHz)			-30	dBm
• 5725 - 26000 MHz (BW = 1 MHz)			-30	dBm
Rx Characteristics				
Minimum Input Level (PER ≤ 10%)		-91	-82	dBm
Maximum Input Level (PER ≤ 10%)	-30			dBm
Adjacent Channel Rejection (PER ≤ 10%)	16			dB

14.7 DC/RF Characteristics for Bluetooth

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V

Table 37: DC/RF Characteristics for Bluetooth

Items	Contents			
Bluetooth specification (power class)	Version 5.4 + EDR (Class1)			
Channel frequency (spacing)	2402 to 2480 MHz (1 MHz)			
Current Consumption	Minimum	Typical	Maximum	Unit
• Tx = Rx = DH5		25	40	mA
• Tx = Rx = 2DH5		25	35	mA
• Tx = Rx = 3DH5		25	35	mA
Transmitter	Minimum	Typical	Maximum	Unit
Output Power (at DH5)	6	9.5	13	dBm
Output Power (at 2DH5, 3DH5)	2	5.5	9	dBm
Frequency range	2400		2483.5	MHz
20 dB bandwidth			1	MHz
Adjacent Channel Power				
• [M-N] = 2			-20	dBm
• [M-N] ≥ 3			-40	dBm
Modulation Characteristics				
• Modulation $\Delta f_{1\text{avg}}$	140		175	kHz
• Modulation $\Delta f_{2\text{max}}$	115			kHz
• Modulation $\Delta f_{2\text{avg}} / \Delta f_{1\text{avg}}$	0.8			
Carrier Frequency Drift				
• 1slot	-25		25	kHz
• 3slot / 5slot	-40		40	kHz
• Maximum drift rate			20	kHz/50 μ s
EDR Relative Power	-4		1	dB
EDR Carrier Frequency Stability and Modulation Accuracy				
• ω_i	-75		75	kHz
• $\omega_i + \omega_o$	-75		75	kHz
• ω_o	-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

Items	Contents			
• 470 - 862 MHz (BW = 100 kHz)			-54	dBm
• 862 - 1000 MHz (BW = 100 kHz)			-36	dBm
• 1000 - 5150 MHz (BW = 1 MHz)			-30	dBm
• 5350 - 5470 MHz (BW = 1 MHz)			-30	dBm
• 5725 - 26000 MHz (BW = 1 MHz)			-30	dBm
Receiver	Minimum	Typical	Maximum	Unit
BDR Sensitivity (BER ≤ 0.1%)		-93	-80	dBm
EDR Sensitivity (BER ≤ 0.007%) @ 8DPSK		-92	-77	dBm
Maximum Input Level (BER < 0.1%)	-20			dBm



Adjacent Channel Power: Up to three spurious responses within Bluetooth limits are allowed.

14.8 DC/RF Characteristics for Bluetooth Low Energy

Conditions: 25 °C, VBAT = 3.3V, VDDIO = 1.8V, 1Mbps

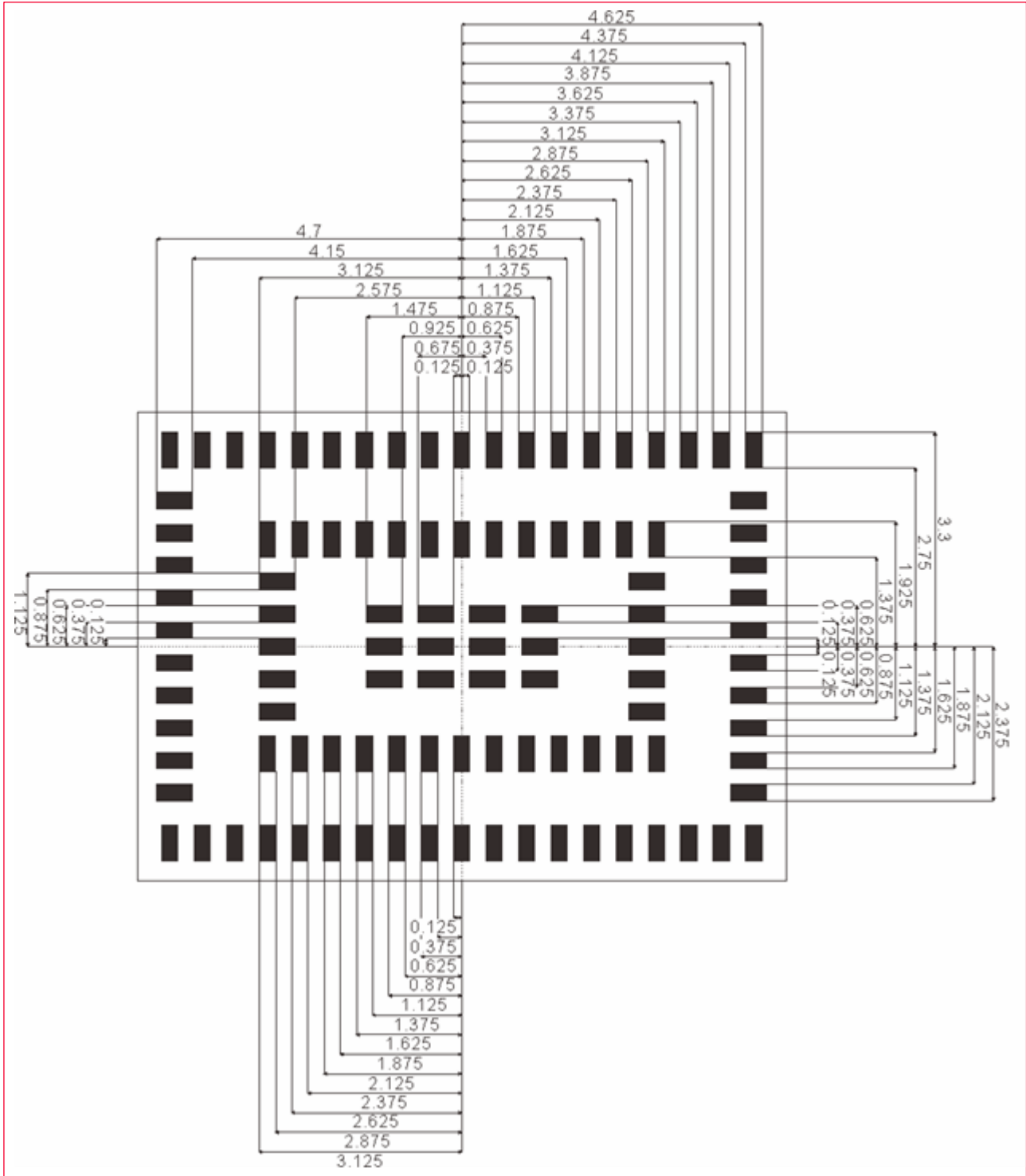
Table 38: DC/RF Characteristics for Bluetooth Low Energy

Items	Contents			
Bluetooth specification (power class)	Version 5.4 (LE)			
Channel frequency (spacing)	2402 to 2480 MHz (2 MHz)			
Number of RF Channel	40			
Current Consumption	Minimum	Typical	Maximum	Unit
Tx Mode		22	35	mA
Rx Mode		4	20	mA
Items/Conditions	Minimum	Typical	Maximum	Unit
Center Frequency	2402		2480	MHz
Channel Spacing		2		MHz
Number of RF channel		40		
Output power	2		9	dBm
Modulation Characteristics				
• $\Delta f_{1\text{avg}}$	225		275	kHz
• $\Delta f_{2\text{max}}$ (at 99.9%)	185			kHz
• $\Delta f_{2\text{avg}} / \Delta f_{1\text{avg}}$	0.8			
Carrier Frequency Offset and Drift				
• Frequency offset (f_n); $n = 0, 1, 2, 3 \dots k$	-150		150	kHz
• Frequency drift ($ f_0 - f_n $); $n = 2, 3, 4 \dots k$			50	kHz
Drift Rate				
• $ f_1 - f_0 $			23	kHz
• $ f_n - f_{n-5} $; $n = 6, 7, 8 \dots k$			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%)		-96	-70	dBm
Maximum Input Signal Level (PER < 30.8%)	-10			dBm
PER Report Integrity (-30 dBm input)	50		65.4	%

15 Land Pattern

Figure 16 shows the top view of land pattern of Type 2GF module.

Figure 16: Land Pattern



To avoid the short-circuit between the side shielding and a solder on the module land after the reflow, please locate the module land away from module outline as above figure.

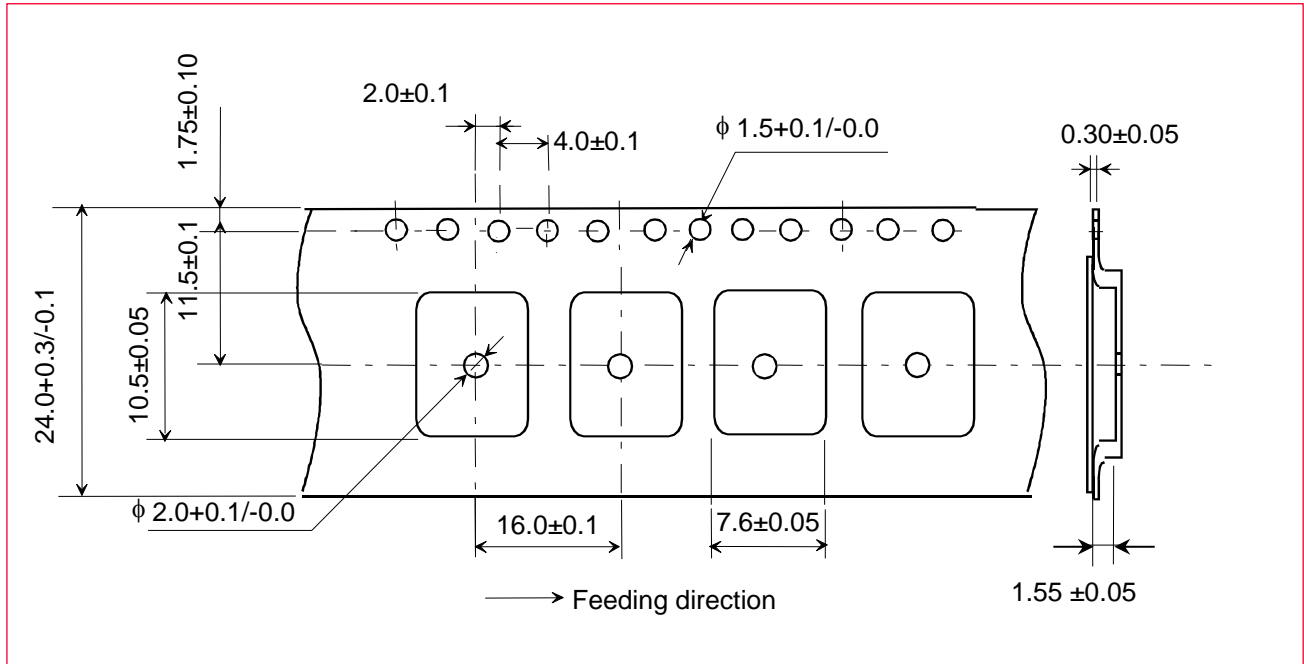
16 Tape and Reel Packing

This section has the tap and reel packing details.

16.1 Dimensions of Tape (Plastic Tape)

Figure 17 shows the tape and reel packing.

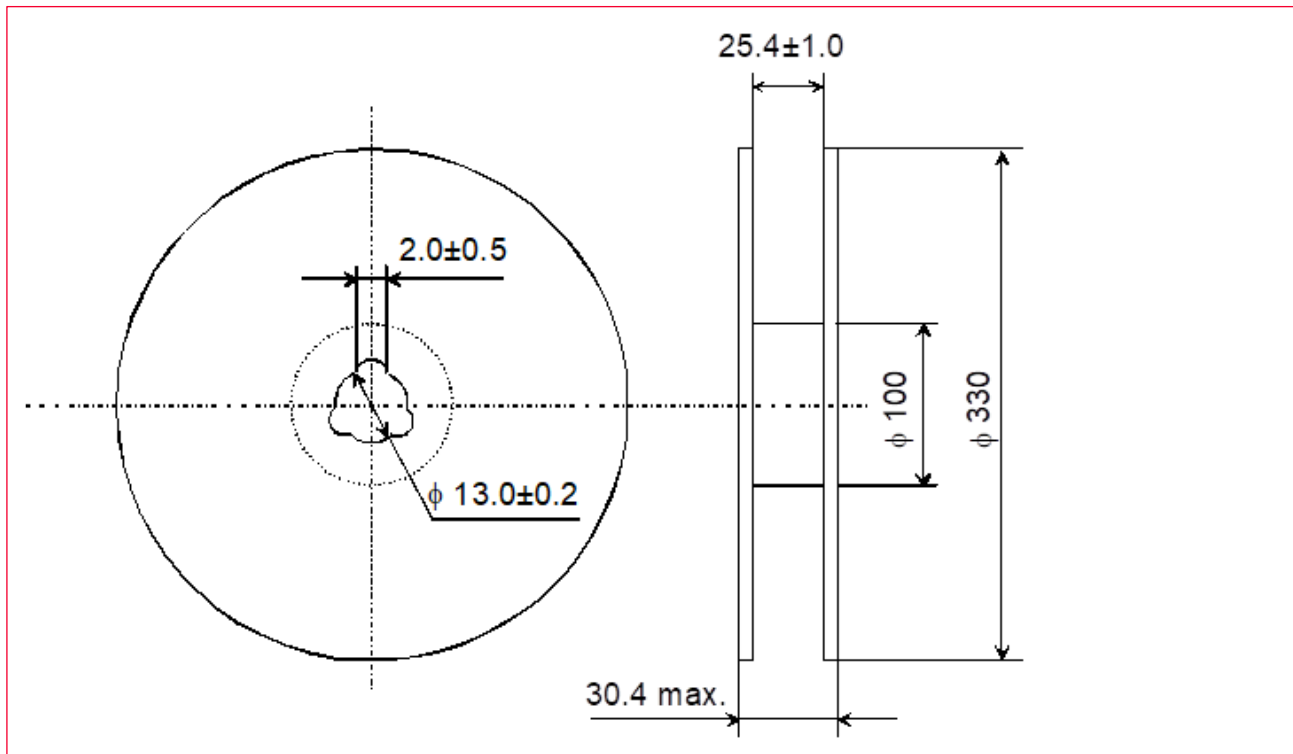
Figure 17: Tape and Reel Packing



16.2 Dimensions of Reel

Figure 18 shows the dimension of the reel.

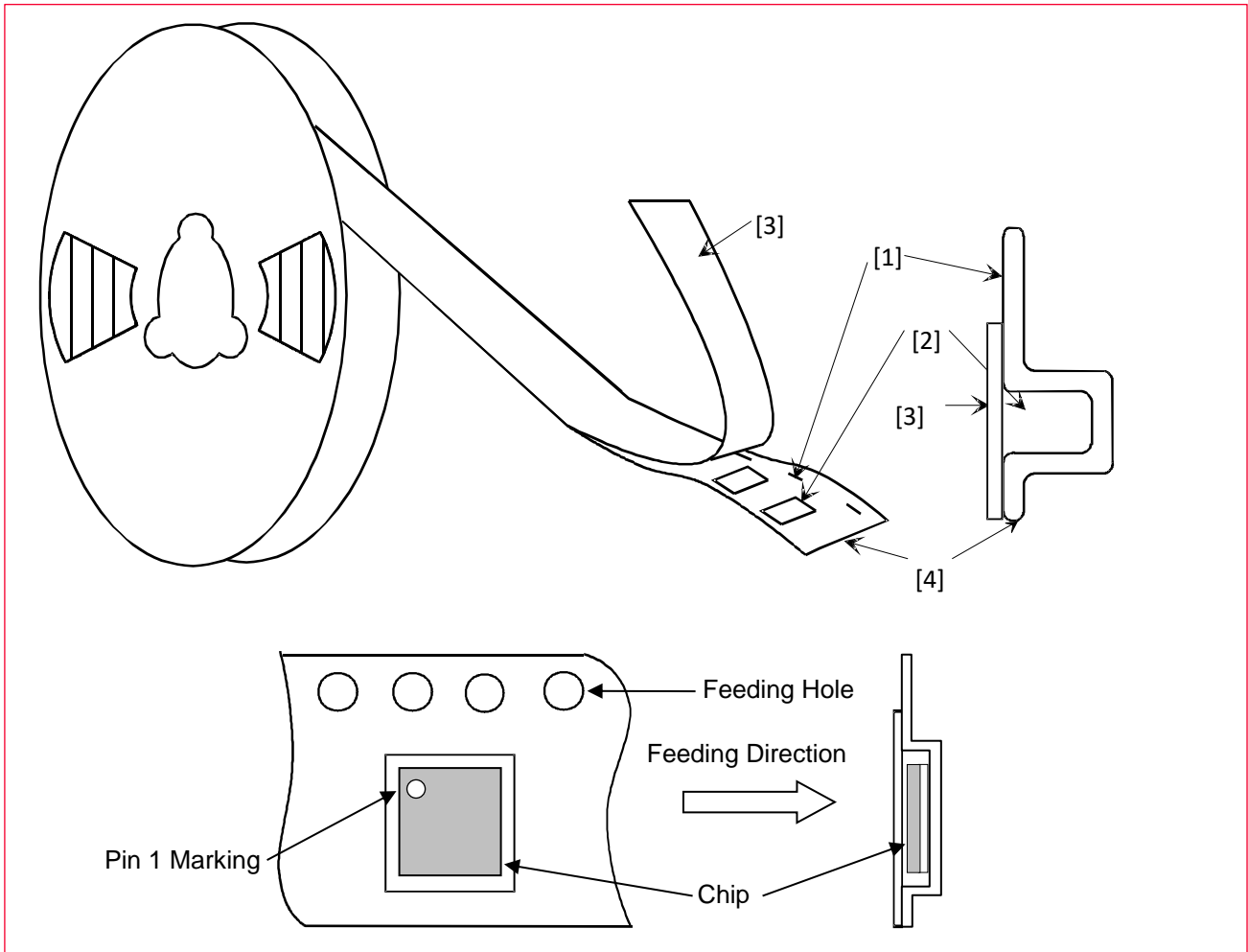
Figure 18: Dimension of Reel



16.3 Taping Diagram

Figure 19 shows the taping diagram.

Figure 19: Taping Diagram



The taping specifications are described in **Table 39**.

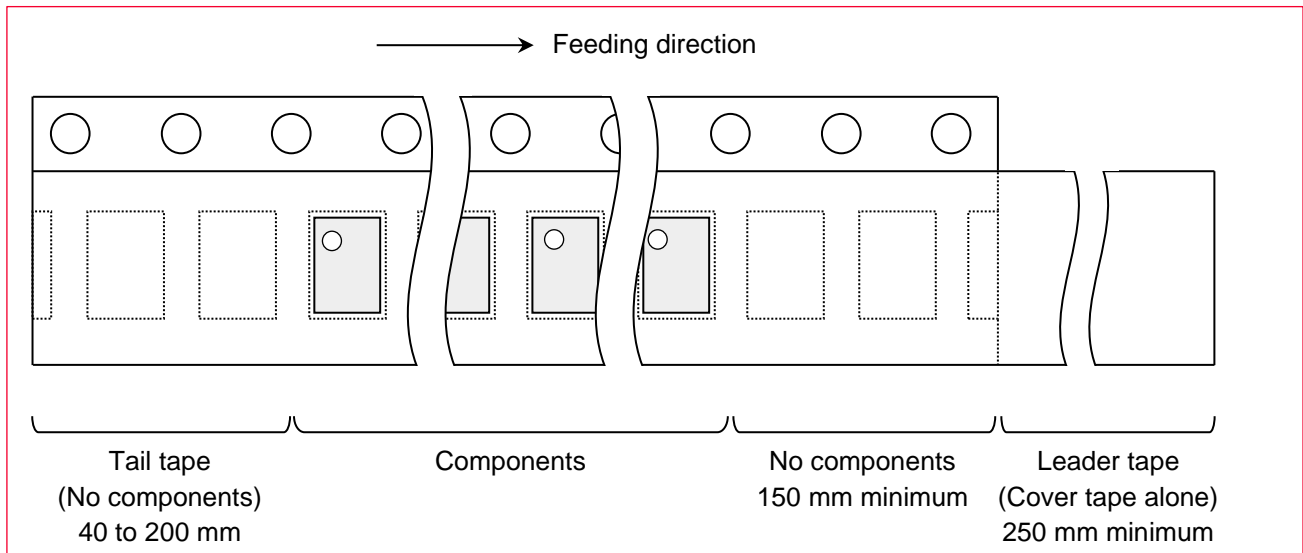
Table 39: Taping Specifications

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

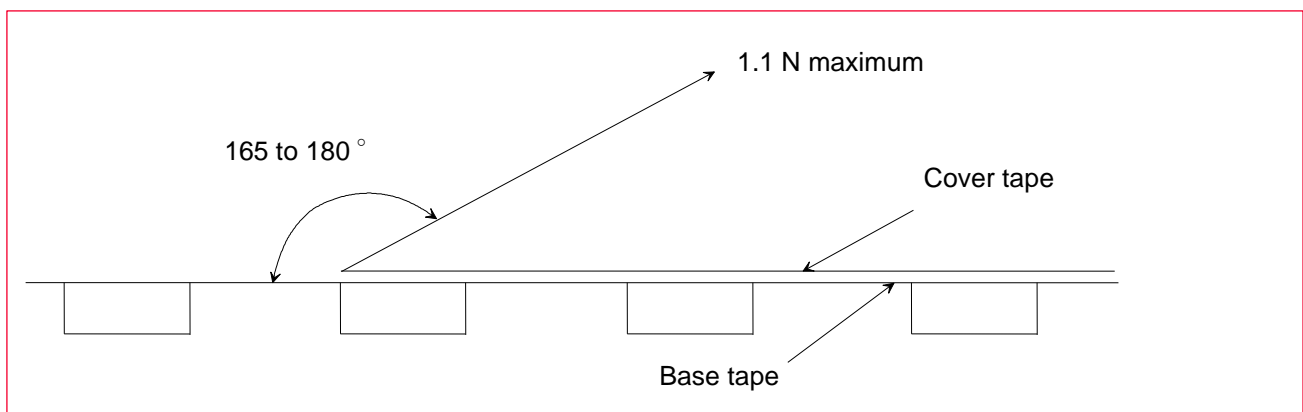
Figure 20 shows the leader and tail tape.

Figure 20: Leader and Tail Tape



- The tape for chips is wound clockwise, the feeding holes to the right side as the tape is pulled toward the user.
- The cover tape and base tape are not adhered at no components area for 250 mm minimum.
- Tear off strength against pulling of cover tape: 5 N minimum.
- Packaging unit: 1000 pcs./ reel
- material - Base tape: Plastic
- Real: Plastic
- Cover tape, cavity tape and reel are made the anti-static processing.
- Peeling off force: 1.1 N maximum in the direction of peeling as shown in **Figure 21**.

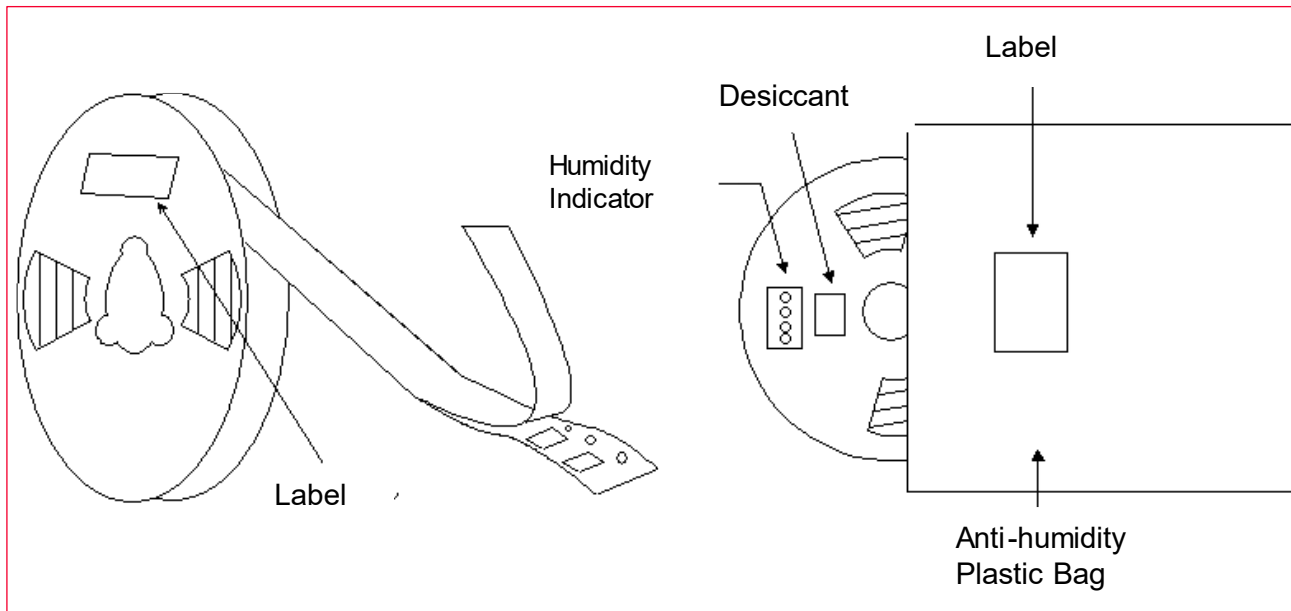
Figure 21: Peeling Force



16.5 Package (Humidity Proof Packaging)

Figure 22 shows the packaging diagram.

Figure 22: 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 may be deformed at the temperature over 40 °C

- The solderability of the product left idle for more than 6 months after receipt needs to be confirmed before it is used.
- The product *must be* stored in noncorrosive 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, *must not be* applied as that will damage the packing materials.

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

- After the packing is opened, the product *must be* stored at <30 °C / <60 %RH and the product *should be* used within 168 hours after opening.
- When the color of the indicator in the packing is changed, the product *should be* baked before soldering.
- **Baking condition:** 125 +5/-0 °C, 24 hours, 1 time



The products must 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 the products.

Handle with care if you suspect that products may have cracks or damages on their terminals. If there is any such damage, the characteristics of products may change. *Do not touch* products with bare hands as that may cause poor solderability and destroy solderability 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 per 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 in advance.

17.4 Notice for Chip Placer

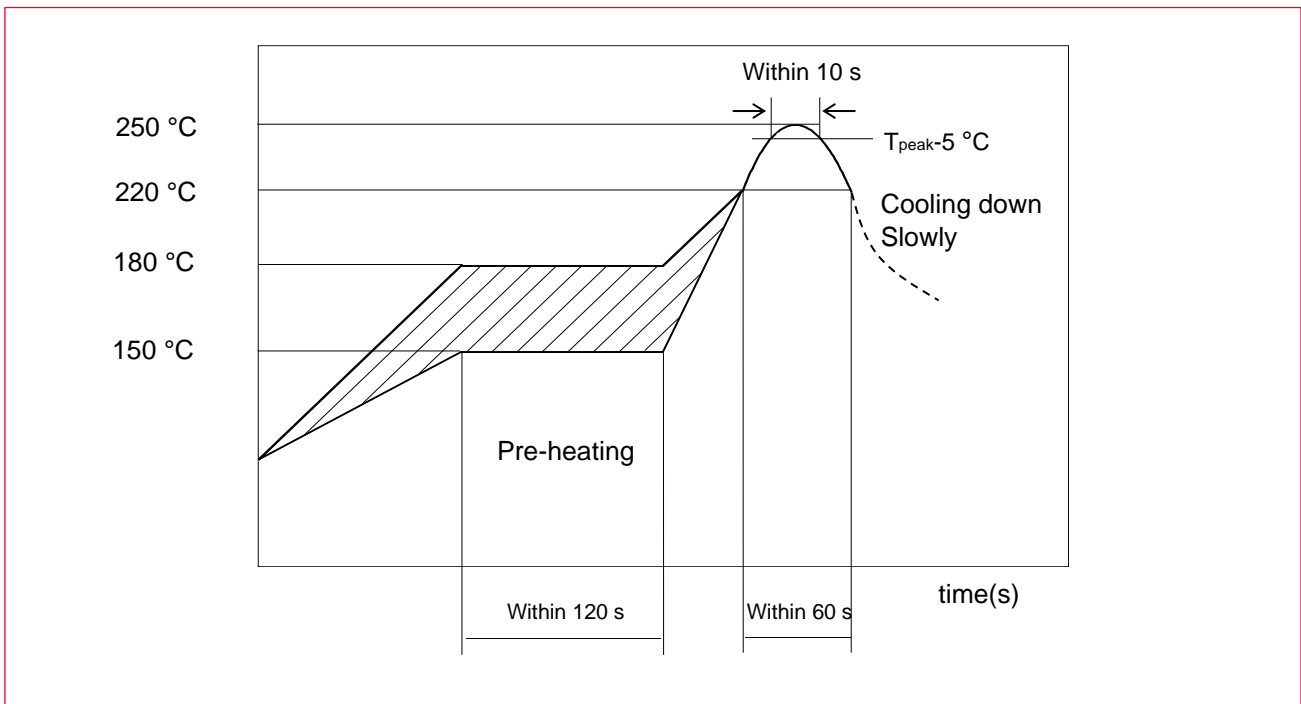
When placing products on the PCB, products may be stressed and broken by uneven forces from a worn-out chucking locating claw or a suction nozzle. To prevent products from damages, be sure to follow the specifications for the maintenance of the chip placer being used. For the positioning of products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

17.5 Soldering Conditions

The recommendation conditions of soldering are as in **Figure 23**.

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 23: 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

Since this Product is Moisture Sensitive, cleaning is not recommended. If any cleaning process is done the customer is responsible for any issues or failures caused such process.

17.7 Operational Environment Conditions

Murata products are designed to work for electronic products under normal environmental conditions (ambient temperature, humidity, and pressure). Therefore, there is no problem in using the products under the above-mentioned conditions. However, using the products under the following circumstances may damage products and cause electricity leakage and abnormal temperature may occur:

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



If there is any chance of using the products under the conditions listed above, consult with Murata before actual use.



Do not apply static electricity or excessive voltage while assembling and measuring the products, 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.

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Revision History

Revision	Date	Changed Item	Comment
1	2023.06.13	First Issue	
2 (A)	2024.02.05	<ul style="list-style-type: none"> Update 2 Key Features/ Weight: 0.266 g 14 DC/RF Characteristics 	DS format change
3 (B)	2024.07.17	<ul style="list-style-type: none"> 3 Ordering Information 4 Block Diagram 5 Certification Information 6 Dimensions, Markings and Terminal Configurations 7 Module Pin Descriptions 8. Absolute Maximum Ratings 9 Operating Conditions 13.2.3 SDIO BUS Timing Specifications in SDR Modes 16 Radio Regulatory Certification by Country for VPY LBEE5WV2GF 	<ul style="list-style-type: none"> Updated parts name Remove d-ANT Updated certification ID Changed pin name "SFL_xx" to "Reserved" Change pin name "VDDIO_SFL" to "Reserved" Add "Peak current" Change Max VBAT voltage Add SDR50 information Removed certification information
4 (C)	2024.12.26	<ul style="list-style-type: none"> 7.2 Pin Descriptions 14. Electrical Characteristics 	<ul style="list-style-type: none"> Changed pin name "RF_SW_CTRL_6" to "NC" Format change
5	Mar 31, 2025	<ul style="list-style-type: none"> 5.2 Radio Regulatory Certification by Country 13 DC/RF Characteristics 	<ul style="list-style-type: none"> Add Format change Updated (Base IC datasheet revision: E)



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