

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

**Infineon for 802.11 b/g/n/Bluetooth 5.2 Chipset +  
STMicroelectronics MCU**

**Tentative P/N : LBEE5PA1LD-TEMP**

## The revision history of the product specification

Issued Date	Revision Code	Revision Page	Changed Items	Change Reason
Jun.13.2016	-	-	First Issue	
Oct.5.2016	A	P4~9 P11 P12 P19	5.Dimensions, Marking and Terminal Configurations 8.2.With nRESET control 8.3. nRESET Circuit 11.1 Schematic	The pin assignment is changed on ES2 Corrected Corrected The pin assignment is changed on ES2
Dec.6.2016	B	P8 P20	5.3 internal connection 12. Tape and Reel Packing	Added Added
Dec.13.2016	C	P19	11.1 Schematic 11.2. Boot mode selection pins	Corrected Pin name Corrected Pin Number
Jan. 6. 2017	D	P3	Part Number	Corrected Part Number
Feb. 21. 2017	E	P3	IC Part Number	Changed
Mar.24.2017	F	P8 P9 P10 P13~18	5.3 internal connection 5.4 Alternate functions table 7.Operation Condition Low Datarate condition	Corrected Corrected Updated Added
Mar.30, 2017	G	P10	7.Operation Condition	Updated Operating Temperature Range
Jul.1.2017	H	P3 P4 P31	Certification information Marking information APPENDIX	Updated Updated Added
Jul.12.2017	I	P10	7. Operating Condition	Updated Specification Temperature Range
Jan.9.2018	J	P11 P32	7.Operatin Condition APPENDIX	Added comment"a" Corrected
Oct.15.2018	K		Updated BT version to BT4.2	Updated
Jun.3.2019	L	P13 P29	9. RF Characteristics 14. PRECONDITION TO USE OUR PRODUCTS	Corrected Updated
Jun.15.2021	M	Cover P3	Bluetooth version, IC vendor name, ETSI standard version	Updated
Dec.15.2021	N	P19 P20	Bluetooth version	Updated

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

## 1. Scope

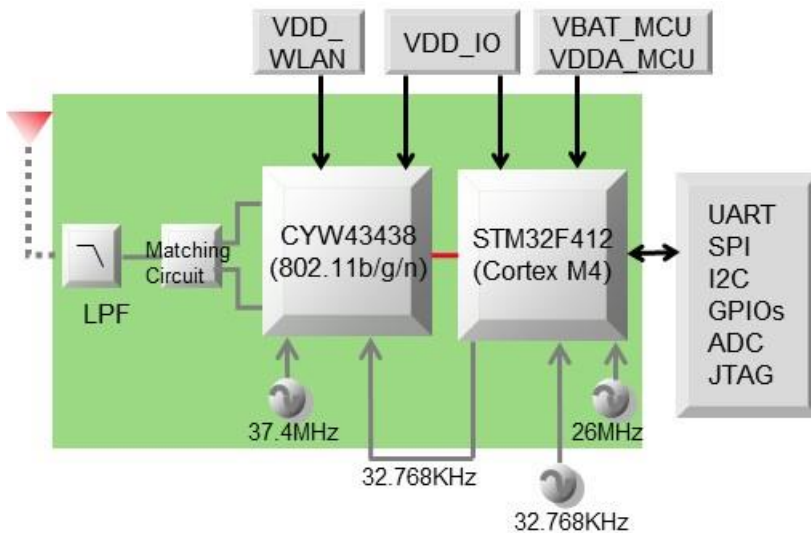
This specification is applied to the IEEE802.11b/g/n W-LAN/Bluetooth 5.2+ STM32F412 MCU complete module.

- IC : Infineon/CYW43438 + STMicroelectronics/STM32F412
- RoHS : This module is compliant with the RoHS directive.
- MSL : 3
- MAC/BD address : MAC/BD address is embedded

## 2. Part Number

Sample Part Number
LBEE5PA1LD-TEMP

## 3. Block Diagram



## 4. Certification Information

### 4.1. USA/Canada

FCC ID : VPYLB1LD

IC : 772C-LB1LD

\*Please follow user/installation manual of Appendix

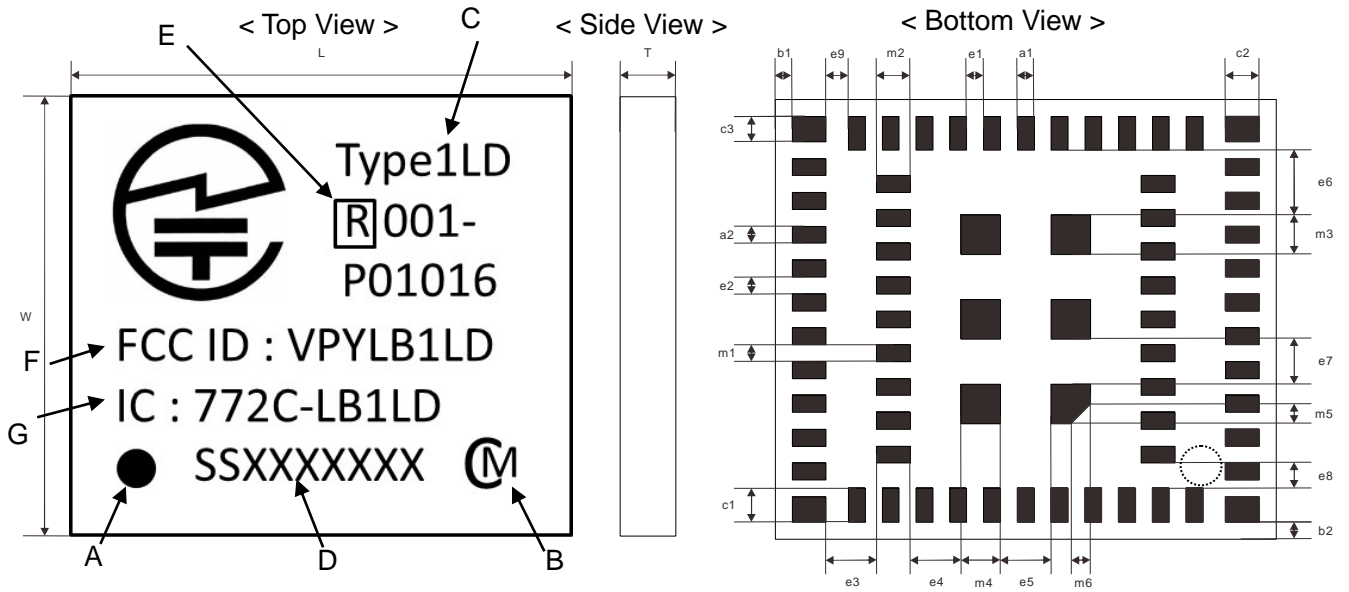
### 4.2. Europe

EN300328 v2.2.2 conducted test report is prepared.

### 4.3. Japan

Japanese type certification is prepared.

**5. Dimensions, Marking and Terminal Configurations**  
**5.1. Dimensions and Marking**



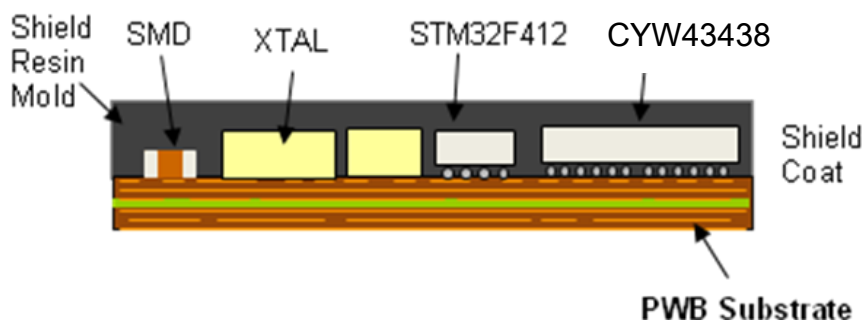
Marking	Meaning
A	Pin 1 Marking
B	Murata Logo
C	Module Type
D	Inspection Number
E	Telec certification No.
F	FCC ID certification No.
G	IC certification No.

Mark	Dimensions	Mark	Dimensions	Mark	Dimensions
L	8.9 +/- 0.2	W	7.8 +/- 0.2	T	1.2 max.
a1	0.3 +/- 0.1	a2	0.3 +/- 0.1	b1	0.3 +/- 0.2
b2	0.3 +/- 0.2	c1	0.6 +/- 0.1	c2	0.6 +/- 0.1
c3	0.45 +/- 0.10	e1	0.3 +/- 0.1	e2	0.3 +/- 0.1
e3	0.9 +/- 0.1	e4	0.9 +/- 0.1	e5	0.9 +/- 0.1
e6	1.15 +/- 0.10	e7	0.8 +/- 0.1	e8	0.45 +/- 0.10
e9	0.4 +/- 0.1	m1	0.3 +/- 0.1	m2	0.6 +/- 0.1
m3	0.7 +/- 0.1	m4	0.7 +/- 0.1	m5	0.35 +/- 0.1
m6	0.35 +/- 0.10				

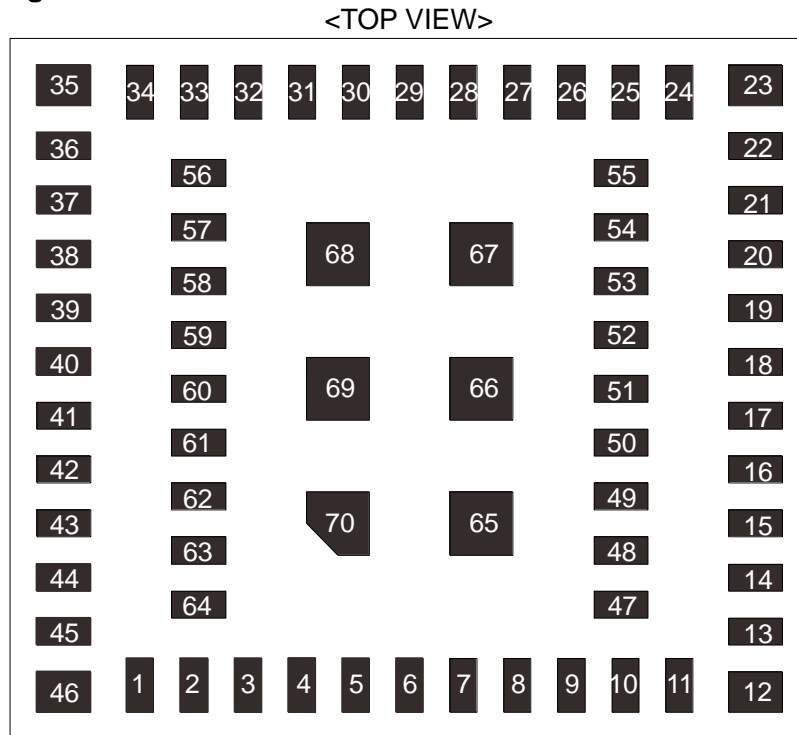
(unit : mm)

**Structure**

**Cross-Sectional Diagram**



## 5.2. Terminal Configurations



No.	Terminal Name	No.	Terminal Name	No.	Terminal Name
1	PC15/OSC32_OUT	23	GND	45	VBAT_MCU
2	PC14/OSC32_IN	24	PA9/USART1_TX	46	GND
3	GND	25	PA10/USART1_RX	47	GND
4	VDD_WLAN	26	PA11/USART1_CTS	48	GND
5	GND	27	PA12/USART1_RTS	49	PC5
6	BT_PCM_CLK	28	PB15/SPI2_MOSI	50	WL_GPIO_1
7	BT_PCM_IN	29	PB14/SPI2_MISO	51	WL_GPIO_2
8	BT_PCM_OUT	30	PB13/SPI2_SCK	52	WLRG_GPIO
9	BT_PCM_SYNC	31	PB12/SPI2_NSS	53	CLK_REQ
10	GND	32	nRESET	54	PB9
11	RF_OUT	33	GND	55	PB10
12	GND	34	VDD_IO	56	PB8/I2S5_SD
13	GND	35	GND	57	PB1/I2S5_WS
14	PC1/WAKE	36	PC7/USART6_RX	58	PB0/I2S5_CK
15	WL_GPIO_0_HOST_WAKE	37	PC6/USART6_TX	59	PC4
16	LPO_IN	38	BOOT0	60	PB5/I2C1_SMBA
17	PA8/MCO_1	39	PA7/SPI1_MOSI	61	PB6/I2C1_SCL
18	PB3/JTDO	40	PA5/SPI1_SCK	62	PB7/I2C1_SDA
19	PB4/JTRST	41	PA4/SPI1_NSS	63	PB2/BOOT1
20	PA13/JTMS	42	PA6/SPI1_MISO	64	GND
21	PA14/JTCK	43	VSSA/VREF-	65~70	GND
22	PA15/JTDI	44	VDDA_MCU	-	-

No.	Terminal Name	Type	Connection to MCU	Connection to WLAN IC	Description
1	PC15/OSC32_OUT	I/O	PC15/OSC32_OUT		
2	PC14/OSC32_IN	I/O	PC14/OSC32_IN		
3	GND	-	GND	GND	Ground
4	VDD_WLAN	I		LDO_VBAT5V SR_VBAT5V	Power supply to WLAN IC
5	GND	-	GND	GND	Ground
6	BT_PCM_CLK	I/O		BT_PCM_CLK	
7	BT_PCM_IN	I		BT_PCM_IN	
8	BT_PCM_OUT	O		BT_PCM_OUT	
9	BT_PCM_SYNC	I/O		BT_PCM_SYNC	
10	GND	-	GND	GND	Ground
11	RF_OUT	I/O		RF_OUT	
12	GND	-	GND	GND	Ground
13	GND	-	GND	GND	Ground
14	PC1/WAKE	I/O	PC1		
15	WL_GPIO_0_HOST_WAKE	I/O		GPIO_0	
16	LPO_IN	I		LPO_IN	
17	PA8/MCO_1	I/O	PA8		
18	PB3/JTDO	I/O	PB3		
19	PB4/JTRST	I/O	PB4		
20	PA13/JTMS	I/O	PA13		
21	PA14/JTCK	I/O	PA14		
22	PA15/JTDI	I/O	PA15		
23	GND	-	GND	GND	Ground
24	PA9/USART1_TX	I/O	PA9		
25	PA10/USART1_RX	I/O	PA10		
26	PA11/USART1_CTS	I/O	PA11		
27	PA12/USART1_RTS	I/O	PA12		

28	PB15/SPI2_MOSI	I/O	PB15		
29	PB14/SPI2_MISO	I/O	PB14		
30	PB13/SPI2_SCK	I/O	PB13		
31	PB12/SPI2_NSS	I/O	PB12		
32	nRESET	I/O	NRST		
33	GND	-	GND	GND	Ground
34	VDD_IO	I	VDD	WCC_VDDIO	Power supply to WLAN IC and MCU
35	GND	-	GND	GND	Ground
36	PC7/USART6_RX	I/O	PC7		
37	PC6/USART6_TX	I	PC6		
38	BOOT0	I	BOOT0		Internal 10kohm pull down
39	PA7/SPI1_MOSI	I/O	PA7		
40	PA5/SPI1_SCK	I/O	PA5		
41	PA4/SPI1_NSS	I/O	PA4		
42	PA6/SPI1_MISO	I/O	PA6		
43	VSSA/VREF-	I	VSSA/VREF-		
44	VDDA_MCU	I	VDDA/VREF+		Power supply to MCU
45	VBAT_MCU	I	VBAT		Power supply to MCU
46	GND	-	GND	GND	Ground
47	GND	-	GND	GND	Ground
48	GND	-	GND	GND	Ground
49	PC5	I/O	PC5		
50	WL_GPIO_1	I/O		GPIO_1	
51	WL_GPIO_2	I/O		GPIO_2	
52	WLRF_GPIO	I/O		WLRF_GPIO	Test pin. Not connected in normal operation.
53	CLK_REQ	O		CLK_REQ	Asserts CLK_REQ when WLAN directs the host to turn on the reference clock. The CLK_REQ polarity is active-high.
54	PB9	I/O	PB9		
55	PB10	I/O	PB10		



56	PB8/I2S5_SD	I/O-	PB8		
57	PB1/I2S5_WS	I/O	PB1		
58	PB0/I2S5_CK	I/O	PB0		
59	PC4	I/O	PC4		
60	PB5/I2C1_SMBA	I/O	PB5		
61	PB6/I2C1_SCL	I/O	PB6		
62	PB7/I2C1_SDA	I/O	PB7		
63	PB2/BOOT1	I/O	PB2		Connect to Ground except GPIO used
64	GND	-	GND	GND	Ground
65 -70	GND	-	GND	GND	Ground

### 5.3. Internal connection (STM32F412-CYW43438)

STM32F412	CYW43438	STM32F412	X'tal (26MHz)
PA0	BT_UART_RTS_N	PH0	OSC_IN
PA1	BT_UART_CTS_N	PH1	OSC_OUT
PA2	BT_UART_RXD		
PA3	BT_UART_TXD		
PC0	BT_HOST_WAKE		
PC2	BT_REG_ON		
PC3	BT_DEV_WAKE		
PC8	SDIO_D0		
PC9	SDIO_D1		
PC10	SDIO_D2		
PC11	SDIO_D3		
PC12	SDIO_CK		
PC13	WL_REG_ON		
PD2	SDIO_CMD		

\*Murata platform file follow this connection.

### 5.4. Alternate functions table

The Items in **Bold Letters** are the murata platform file settings.

MCU Pin	Module Pin	Alternate Function													Additional Function
		AF0	AF1	AF2	AF3	AF4	AF5	AF6	AF7	AF8	AF9	AF10	AF12	AF15	
PA4	Pin 41	-	-	-	-	-	<b>SPI1_NSS//2S1_WS</b>	SPI3_NSS//2S3_WS	USART2_CK	DFSDM_DATIN1	-	-	FSMC_D6	EVENTOUT	ADC1_4
PA5	Pin 40	-	TIM2_CH1/TIM2_ETR	-	TIM8_CH1N	-	<b>SPI1_SCK//2S1_CK</b>	-	-	DFSDM_CKIN1	-	-	FSMC_D7	EVENTOUT	ADC1_5
PA6	Pin 42	-	TIM1_BKIN	TIM3_CH1	TIM8_BKIN	-	<b>SPI1_MISO</b>	I2S2_MCK	-	-	TIM13_CH1	QUADSPI_BK2_IO0	SDIO_CMD	EVENTOUT	ADC1_6
PA7	Pin 39	-	TIM1_CH1N	TIM3_CH2	TIM8_CH1N	-	<b>SPI1_MOSI//2S1_SD</b>	-	-	-	TIM14_CH1	QUADSPI_BK2_IO1	-	EVENTOUT	ADC1_7
PA8	Pin 17	<b>MCO_1</b>	TIM1_CH1	-	-	I2C3_SCL	-	-	USART1_CK	-	-	USB_FS_SOF	SDIO_D1	EVENTOUT	-
PA9	Pin 24	-	TIM1_CH2	-	-	I2C3_SMBA	-	-	<b>USART1_TX</b>	-	-	USB_FS_VBUS	SDIO_D2	EVENTOUT	-
PA10	Pin 25	-	TIM1_CH3	-	-	-	-	SPI5_MOSI//I2S5_SD	<b>USART1_RX</b>	-	-	USB_FS_ID	-	EVENTOUT	-
PA11	Pin 26	-	TIM1_CH4	-	-	-	-	SPI4_MISO	<b>USART1_CTS</b>	USART6_TX	CAN1_RX	USB_FS_DM	-	EVENTOUT	-
PA12	Pin 27	-	TIM1_ETR	-	-	-	-	SPI5_MISO	<b>USART1_RTS</b>	USART6_RX	CAN1_TX	USB_FS_DP	-	EVENTOUT	-
PA13	Pin 20	<b>JTMSSWDO</b>	-	-	-	-	-	-	-	-	-	-	-	EVENTOUT	-
PA14	Pin 21	<b>JTCKSWCLK</b>	-	-	-	-	-	-	-	-	-	-	-	EVENTOUT	-
PA15	Pin 22	<b>JTDI</b>	TIM2_CH1/TIM2_ETR	-	-	-	SPI1_NSS//2S1_WS	SPI3_NSS//2S3_WS	USART1_TX	-	-	-	-	EVENTOUT	-
PB0	Pin 58	-	TIM1_CH2N	TIM3_CH3	TIM8_CH2N	-	-	<b>SPI5_SCK//2S5_CK</b>	-	-	-	-	-	EVENTOUT	ADC1_8
PB1	Pin 57	-	TIM1_CH3N	TIM3_CH4	TIM8_CH3N	-	-	<b>SPI5_NSS//2S5_WS</b>	-	DFSDM_DATIN0	QUADSPI_CLK	-	-	EVENTOUT	ADC1_9
PB2	Pin 63	-	-	-	-	-	-	DFSDM_CKIN0	-	-	QUADSPI_CLK	-	-	EVENTOUT	<b>BOOT1</b>
PB3	Pin 18	<b>JTDOSWO</b>	TIM2_CH2	-	-	I2CFMP1_SDA	SPI1_SCK//2S1_CK	SPI3_SCK//2S3_CK	USART1_RX	-	I2C2_SDA	-	-	EVENTOUT	-
PB4	Pin 19	<b>JTRST</b>	-	TIM3_CH1	-	-	SPI1_MISO	SPI3_MISO	I2S3ext_SD	-	I2C3_SDA	-	SDIO_D0	EVENTOUT	-
PB5	Pin 60	-	-	TIM3_CH2	-	<b>I2C1_SMB_A</b>	SPI1_MOSI//I2S1_SD	SPI3_MOSI//I2S3_SD	-	-	CAN2_RX	-	SDIO_D3	EVENTOUT	-
PB6	Pin 61	-	-	TIM4_CH1	-	<b>I2C1_SCL</b>	-	-	USART1_TX	-	CAN2_TX	QUADSPI_BK1_NCS	SDIO_D0	EVENTOUT	-
PB7	Pin 62	-	-	TIM4_CH2	-	<b>I2C1_SDA</b>	-	-	USART1_RX	-	-	-	FSMC_NL	EVENTOUT	-
PB8	Pin 56	-	-	TIM4_CH3	TIM10_CH1	I2C1_SCL	-	<b>SPI5_MOSI//I2S5_SD</b>	-	CAN1_RX	I2C3_SDA	-	SDIO_D4	EVENTOUT	-
PB9	Pin 54	-	-	TIM4_CH4	TIM11_CH1	I2C1_SDA	SPI2_NSS//2S2_WS	-	-	CAN1_TX	I2C2_SDA	-	SDIO_D5	EVENTOUT	-
PB10	Pin 55	-	TIM2_CH3	-	-	I2C2_SCL	SPI2_SCK//2S2_CK	I2S3_MCK	USART3_TX	-	I2CFMP1_SCL	-	SDIO_D7	EVENTOUT	-
PB12	Pin 31	-	TIM1_BKIN	-	-	I2C2_SMBA	<b>SPI2_NSS//2S2_WS</b>	SPI4_NSS//2S4_WS	SPI3_SCK//2S3_CK	USART3_CK	CAN2_RX	DFSDM_DATIN1	FSMC_D13/FSMC_DA13	EVENTOUT	-
PB13	Pin 30	-	TIM1_CH1N	-	-	I2CFMP1_S_MBA	<b>SPI2_SCK//2S2_CK</b>	SPI4_SCK//2S4_CK	-	USART3_CTS	CAN2_TX	DFSDM_CKIN1	-	EVENTOUT	-
PB14	Pin 29	-	TIM1_CH2N	-	TIM8_CH2N	I2CFMP1_SDA	<b>SPI2_MISO</b>	I2S2ext_SD	USART3_RTS	DFSDM_DATIN2	TIM12_CH1	FSMC_D0	SDIO_D6	EVENTOUT	-
PB15	Pin 28	RTC_50Hz	TIM1_CH3N	-	TIM8_CH3N	I2CFMP1_SCL	<b>SPI2_MOSI//I2S2_SD</b>	-	-	DFSDM_CKIN2	TIM12_CH2	-	SDIO_CK	EVENTOUT	-
PC1	Pin 14	-	-	-	-	-	-	-	-	-	-	-	-	EVENTOUT	<b>ADC1_11, WKUP3</b>
PC4	Pin 59	-	-	-	-	-	I2S1_MCK	-	-	-	-	QUADSPI_BK2_IO2	FSMC_NE4	EVENTOUT	ADC1_14
PC5	Pin 49	-	-	-	-	I2CFMP1_S_MBA	-	-	USART3_RX	-	-	QUADSPI_BK2_IO3	FSMC_NOE	EVENTOUT	ADC1_15
PC6	Pin 37	-	-	TIM3_CH1	TIM8_CH1	I2CFMP1_SCL	I2S2_MCK	DFSDM_CKIN3	-	<b>USART6_TX</b>	-	FSMC_D1	SDIO_D6	EVENTOUT	-
PC7	Pin 36	-	-	TIM3_CH2	TIM8_CH2	I2CFMP1_SDA	SPI2_SCK//2S2_CK	I2S3_MCK	-	<b>USART6_RX</b>	-	DFSDM_DATIN3	SDIO_D7	EVENTOUT	-
PC14	Pin 2	-	-	-	-	-	-	-	-	-	-	-	-	EVENTOUT	<b>OSC32_IN</b>
PC15	Pin 1	-	-	-	-	-	-	-	-	-	-	-	-	EVENTOUT	<b>OSC32_OUT</b>

(\*)PC14 and PC15 are supplied through the power switch. Since the switch only sinks a limited amount of current (3 mA), the use of GPIOs PC14 and PC15 in output mode is limited: - The speed should not exceed 2 MHz with a maximum load of 30 pF. - These I/Os must not be used as a current source (e.g. to drive an LED).

## 6. Absolute Maximum Rating

		min.	max.	unit
Storage Temperature		-40	85	deg.C
Supply Voltage	VDD_WLAN	-0.3	6.0	V
	VDD_IO	-0.3	3.9	V
	VBAT_MCU	-0.3	4.0	V
	VDDA_MCU	-0.4	4.0	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 is set within operating condition

## 7. Operating Condition

		min.	typ.	max.	Unit
Operating Temperature Range		-40		85	deg.C
Specification Temperature Range		-20		70	deg.C
Supply Voltage	VDD_WLAN	3.2		4.8 <sup>a</sup>	V
	VDD_IO <sup>b</sup>	1.8	3.3	3.6	V
	VBAT_MCU <sup>b</sup>	1.8	3.3	3.6	V
	VDDA_MCU <sup>b</sup>	1.8	3.3	3.6	V

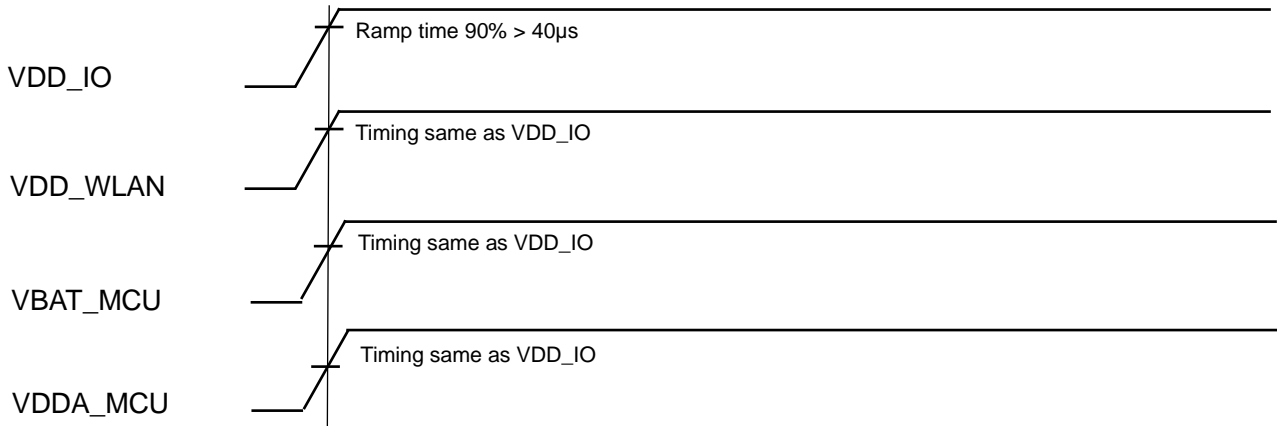
\*a: Maximum continuous voltage is 4.8V. Voltages up to 6.0V for up to 10 seconds, cumulative duration over the lifetime of the device are allowed. Voltages as high as 5.0V for up to 250 seconds, cumulative duration over the lifetime of the device are allowed.

\*b: MCU behavior depends on input voltage. Please refer to Datasheet of STM32F412.

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

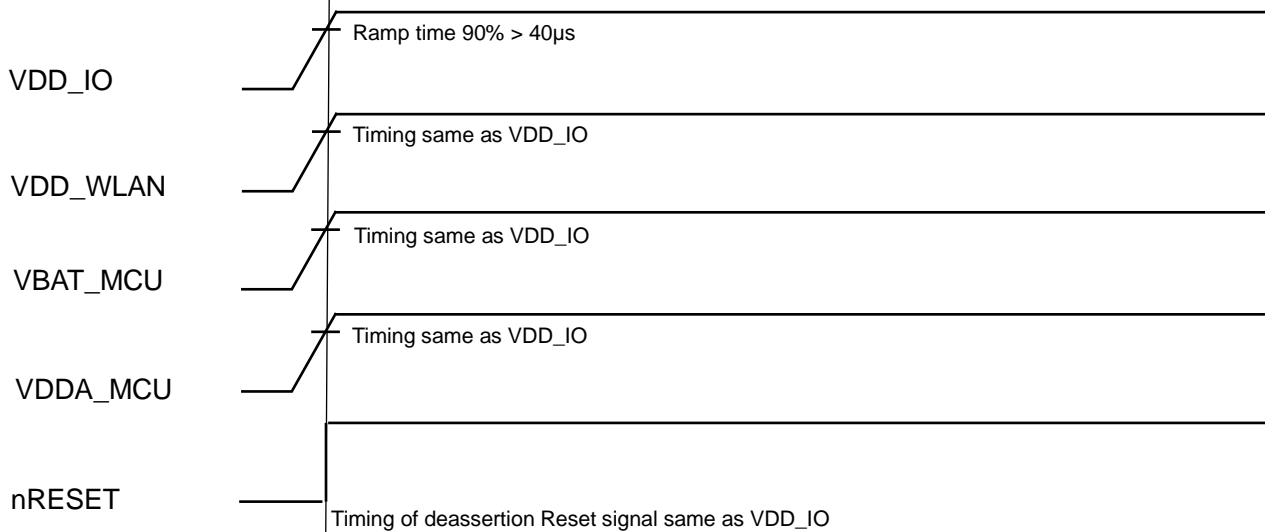
## 8. Power Up Sequence

### 8.1. Without nRESET control



\*Power down sequence is opposite sequence of power up.

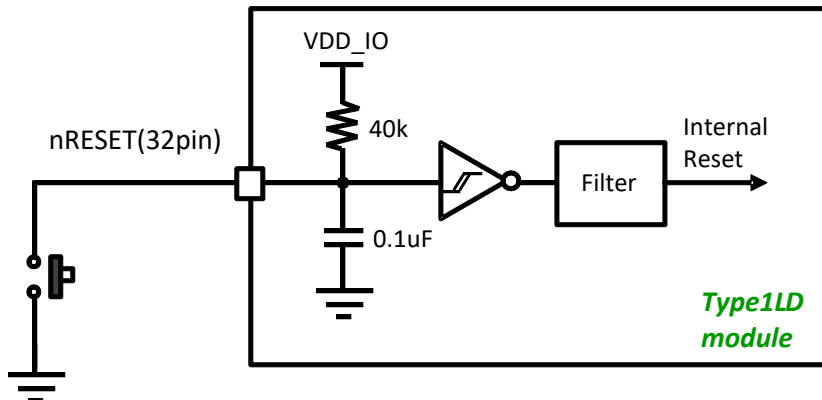
### 8.2. With nRESET control



\*Power down sequence is opposite sequence of power up.

\*nRESET pin must be controlled by Open Drain.

### 8.3. nRESET Circuit



- (1) The reset network protects the device against parasitic resets.
- (2) The use must ensure that the level on the nRESET pin can go below the  $V_{IL}(NRST)$  max level specified in below table. Otherwise the reset is not taken into account by the device.
- (3) nRESET pin must be controlled by Open Drain. High signal must not input to this pin.

Symbol	Parameter	Min	Typ	Max	Unit
VIL	nRESET I/O input low level voltage	-	-	$0.1V_{DD\_IO}+0.1$	V

## 9. RF Characteristics

### 9.1. RF Characteristics for IEEE802.11b

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

#### 9.1.1. High Rate Condition for IEEE802.11b - 2.4GHz

Conditions

25deg.C, VDD\_WLAN=3.3V, VDD\_IO= 3.3V, Output power setting=17dBm, 11Mbps mode

Items	Contents			
	min.	Typ.	max.	Unit
- DC Characteristics -				
1. DC current				
1) Tx mode (1024byte, 20usec interval) *1	-	330	410	mA
2) Rx mode	-	55	100	mA
- Tx Characteristics *1 -				
	min.	Typ.	max.	Unit
2. Output Power	15.0	17.0	19.0	dBm
3. Spectrum Mask Margin				
1) 1st side lobes(-30dBr)	0	10	-	dB
2) 2nd side lobes(-50dBr)	0	6	-	dB
4. Power-on and Power-down ramp	-	-	2.0	usec
5. RF Carrier Suppression	15	-	-	dB
6. Modulation Accuracy (EVM)	-	18	35	%
7. Outband Spurious Emissions				
1) 30MHz to 1GHz (BW=100kHz)	-	-	-36	dBm
2) 1GHz to 12.75GHz (BW=100kHz)	-	-	-30	dBm
3) 1.8GHz to 1.9GHz (BW=100kHz)	-	-	-47	dBm
4) 5.15GHz to 5.3GHz (BW=100kHz)	-	-	-47	dBm
- Rx Characteristics -				
	min.	typ.	max.	Unit
8. Minimum Input Level Sensitivity				
1) 11Mbps (FER ≤ 8%)	-	-89	-76	dBm
9. Maximum Input Level (FER ≤ 8%)	-10	-	-	dBm
10. Adjacent Channel Rejection (FER ≤ 8%)	35	-	-	dB

\*1: Defined when output power setting is 17dBm at Murata module antenna pad

### 9.1.2. Low Rate Condition for IEEE802.11b - 2.4GHz

Conditions

25deg.C, VDD\_WLAN=3.3V, VDD\_IO= 3.3V, Output power setting=17dBm, 1Mbps mode

Items	Contents			
	min.	Typ.	max.	Unit
- DC Characteristics -				
1. DC current				
1) Tx mode (1024byte, 20usec interval) *2	-	330	410	mA
2) Rx mode	-	55	100	mA
- Tx Characteristics *2 -				
	min.	Typ.	max.	Unit
2. Output Power	15.0	17.0	19.0	dBm
3. Spectrum Mask Margin				
1) 1st side lobes(-30dBr)	0	12	-	dB
2) 2nd side lobes(-50dBr)	0	5	-	dB
4. Power-on and Power-down ramp	-	-	2.0	usec
5. RF Carrier Suppression	15	-	-	dB
6. Modulation Accuracy (EVM)	-	14	35	%
7. Outband Spurious Emissions				
1) 30MHz to 1GHz (BW=100kHz)	-	-	-36	dBm
2) 1GHz to 12.75GHz (BW=100kHz)	-	-	-30	dBm
3) 1.8GHz to 1.9GHz (BW=100kHz)	-	-	-47	dBm
4) 5.15GHz to 5.3GHz (BW=100kHz)	-	-	-47	dBm
- Rx Characteristics -				
	min.	typ.	max.	Unit
8. Minimum Input Level Sensitivity				
1) 1Mbps (FER ≤ 8%)	-	-96	-80	dBm
9. Maximum Input Level (FER ≤ 8%)	-4	-	-	dBm
10. Adjacent Channel Rejection (FER ≤ 8%)	35	-	-	dB

\*2: Defined when output power setting is 17dBm at Murata module antenna pad

## 9.2. RF Characteristics for IEEE802.11g

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

### 9.2.1. High Rate Condition for IEEE802.11g - 2.4GHz

Conditions:

25deg.C, VDD\_WLAN=3.3V, VDD\_IO= 3.3V, Output power setting=13dBm, 54Mbps mode

Items	Contents			
- DC Characteristics -	min.	Typ.	max.	Unit
1. DC current				
1) Tx mode (1024byte, 20usec interval) *3	-	250	330	mA
2) Rx mode	-	55	100	mA
- Tx Characteristics*3 -	min.	typ.	max.	unit
2. Output Power	11.0	13.0	15.0	dBm
3. Spectrum Mask Margin				
1) 9MHz to 11MHz (0~ -20dBr)	0	10	-	dB
2) 11MHz to 20MHz (-20~ -28dBr)	0	10	-	dB
3) 20MHz to 30MHz (-28~ -40dBr)	0	10	-	dB
4) 30MHz to 33MHz (-40dBr)	0	10	-	dB
4. Constellation Error (EVM)	-	-34	-25	dB
5. Outband Spurious Emissions				
1) 30MHz to 1GHz (BW=100kHz)	-	-	-36	dBm
2) 1GHz to 12.75GHz (BW=100kHz)	-	-	-30	dBm
3) 1.8GHz to 1.9GHz (BW=100kHz)	-	-	-47	dBm
4) 5.15GHz to 5.3GHz (BW=100kHz)	-	-	-47	dBm
- Rx Characteristics -	min.	typ.	max.	Unit
6. Minimum Input Level Sensitivity				
1) 54Mbps (PER ≤ 10%)	-	-76	-65	dBm
7. Maximum Input Level (PER ≤ 10%)	-20	-	-	dBm
8. Adjacent Channel Rejection (PER ≤ 10%)	-1	-	-	dB

\*3: Defined when output power setting is 13dBm at Murata module antenna pad



### 9.2.2. Low Rate Condition for IEEE802.11g - 2.4GHz

Conditions:

25deg.C, VDD\_WLAN=3.3V, VDD\_IO= 3.3V, Output power setting=17dBm, 6Mbps mode

Items	Contents			
	min.	Typ.	max.	Unit
- DC Characteristics -				
1. DC current				
1) Tx mode (1024byte, 20usec interval) *3	-	320	400	mA
2) Rx mode	-	55	100	mA
- Tx Characteristics*3 -	min.	typ.	max.	unit
2. Output Power	15.0	17.0	19.0	dBm
3. Spectrum Mask Margin				
1) 9MHz to 11MHz (0~ -20dBr)	0	10	-	dB
2) 11MHz to 20MHz (-20~ -28dBr)	0	10	-	dB
3) 20MHz to 30MHz (-28~ -40dBr)	0	10	-	dB
4) 30MHz to 33MHz (-40dBr)	0	10	-	dB
4. Constellation Error (EVM)	-	-29	-5	dB
5. Outband Spurious Emissions				
1) 30MHz to 1GHz (BW=100kHz)	-	-	-36	dBm
2) 1GHz to 12.75GHz (BW=100kHz)	-	-	-30	dBm
3) 1.8GHz to 1.9GHz (BW=100kHz)	-	-	-47	dBm
4) 5.15GHz to 5.3GHz (BW=100kHz)	-	-	-47	dBm
- Rx Characteristics -	min.	typ.	max.	Unit
6. Minimum Input Level Sensitivity				
1) 6Mbps (PER ≤ 10%)	-	-91	-82	dBm
7. Maximum Input Level (PER ≤ 10%)	-20	-	-	dBm
8. Adjacent Channel Rejection (PER ≤ 10%)	-1	-	-	dB

\*3: Defined when output power setting is 17dBm at Murata module antenna pad

### 9.3. RF Characteristics for IEEE802.11n

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

#### 9.3.1. High Rate Condition for IEEE802.11n - 2.4GHz

Conditions:

25deg.C, VDD\_WLAN=3.3V, VDD\_IO= 3.3V, Output power setting=12dBm, 65Mbps(MCS7) mode

Items	Contents			
	min.	Typ.	max.	Unit
- DC Characteristics -				
1. DC current				
1) Tx mode (1024byte, 20usec interval) *5	-	240	320	mA
2) Rx mode	-	55	100	mA
- Tx Characteristics*5 -				
	min.	typ.	max.	Unit
2. Output Power	10.0	12.0	14.0	dBm
3. Spectrum Mask Margin				
1) 9MHz to 11MHz (0 ~ -20dBr)	0	10	-	dB
2) 11MHz to 20MHz (-20 ~ -28dBr)	0	10	-	dB
3) 20MHz to 30MHz (-28 ~ -45dBr)	0	6	-	dB
4) 30MHz to 33MHz (-45dBr)	0	6	-	dB
4. Constellation Error (EVM)	-	-35	-27	dB
5. Outband Spurious Emissions				
1) 30MHz to 1GHz	-	-	-36	dBm
2) 1GHz to 12.75GHz	-	-	-30	dBm
3) 1.8GHz to 1.9GHz	-	-	-47	dBm
4) 5.15GHz to 5.3GHz	-	-	-47	dBm
- Rx Characteristics -				
	min.	typ.	max.	Unit
6. Minimum Input Level Sensitivity				
1) 65Mbps (PER ≤ 10%)	-	-73	-64	dBm
7. Maximum Input Level (PER ≤ 10%)	-20	-	-	dBm
8. Adjacent Channel Rejection (PER ≤ 10%)	-2	-	-	dB

\*5: Defined when output power setting is 12dBm at Murata module antenna pad

### 9.3.2. Low Rate Condition for IEEE802.11n - 2.4GHz

Conditions:

25deg.C, VDD\_WLAN=3.3V, VDD\_IO= 3.3V, Output power setting=17dBm, 6.5Mbps(MCS0) mode

Items	Contents			
	min.	Typ.	max.	Unit
- DC Characteristics -				
1. DC current				
1) Tx mode (1024byte, 20usec interval) *6	-	310	390	mA
2) Rx mode	-	55	100	mA
- Tx Characteristics*6 -				
	min.	typ.	max.	Unit
2. Output Power	15.0	17.0	19.0	dBm
3. Spectrum Mask Margin				
1) 9MHz to 11MHz (0 ~ -20dBr)	0	9	-	dB
2) 11MHz to 20MHz (-20 ~ -28dBr)	0	9	-	dB
3) 20MHz to 30MHz (-28 ~ -45dBr)	0	6	-	dB
4) 30MHz to 33MHz (-45dBr)	0	6	-	dB
4. Constellation Error (EVM)	-	-29	-5	dB
5. Outband Spurious Emissions				
1) 30MHz to 1GHz	-	-	-36	dBm
2) 1GHz to 12.75GHz	-	-	-30	dBm
3) 1.8GHz to 1.9GHz	-	-	-47	dBm
4) 5.15GHz to 5.3GHz	-	-	-47	dBm
- Rx Characteristics -				
	min.	typ.	max.	Unit
6. Minimum Input Level Sensitivity				
1) 6.5Mbps (PER ≤ 10%)	-	-90	-82	dBm
7. Maximum Input Level (PER ≤ 10%)	-20	-	-	dBm
8. Adjacent Channel Rejection (PER ≤ 10%)	-2	-	-	dB

\*6: Defined when output power setting is 17dBm at Murata module antenna pad

#### 9.4. DC/RF Characteristics for Bluetooth

Normal conditions : 25 deg.C, VDD\_WLAN=3.3V, VDD\_IO= 3.3V

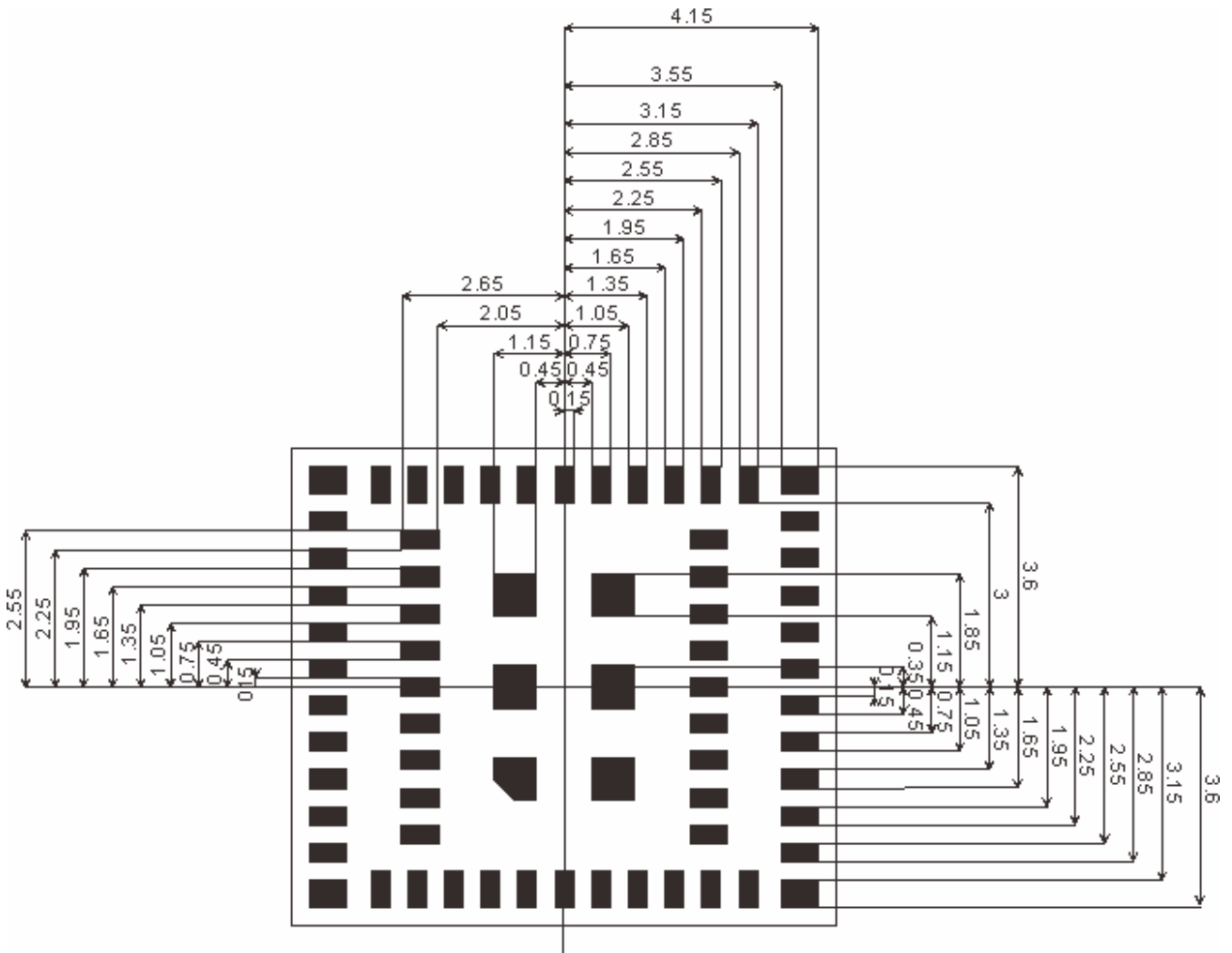
Items		Contents			
Power class		Class1			
Channel frequency (spacing)		2402 to 2480 MHz (1MHz)			
<b>Transmitter</b>		<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Output Power	BR	-	8.5	12	dBm
Frequency range		2400	-	2483.5	MHz
20dB bandwidth		-	-	1	MHz
Modulation characteristics					
(a) Modulation $\Delta f_{1avg}$		140	-	175	kHz
(b) Modulation $\Delta f_{2max}$		115	-	-	kHz
(c) Modulation $\Delta f_{2avg} / \Delta f_{1avg}$		0.8	-	-	
Carrier Frequency Drift					
(a) 1slot		-25	-	+25	kHz
(b) 3slot / 5slot		-40	-	+40	kHz
(c) Maximum drift rate		-20	-	+20	kHz/50 $\mu$ s
EDR Relative Power		-4	-	+1	dB
EDR Carrier Frequency Stability and Modulation Accuracy					
(a) $\omega_i$		-75	-	+75	kHz
(b) $\omega_i + \omega_o$		-75	-	+75	kHz
(c) $\omega_o$		-10	-	+10	kHz
(d) RMS DEVM ( $\pi/4$ DQPSK)		-	-	20	%
(e) Peak DEVM ( $\pi/4$ DQPSK)		-	-	35	%
(f) 99% DEVM ( $\pi/4$ DQPSK)		-	-	30	%
(g) RMS DEVM (8DPSK)		-	-	13	%
(h) Peak DEVM (8DPSK)		-	-	25	%
(i) 99% DEVM (8DPSK)		-	-	20	%
Spurious Emissions (BW=100kHz)					
(a) $10\text{MHz} \leq f < 2387\text{MHz}$		-	-	-36	dBm
(b) $2387\text{MHz} \leq f < 2400\text{MHz}$		-	-	-30	dBm
(c) $2483.5\text{MHz} < f \leq 2496.5\text{MHz}$		-	-	-47	dBm
(d) $2496.5\text{MHz} < f \leq 8\text{GHz}$		-	-	-47	dBm
<b>Receiver</b>		<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
Sensitivity (BER $\leq$ 0.1%)		-	-92	-70	dBm
Maximum Input Level (BER $\leq$ 0.1%)		-20	-	-	dBm
EDR Sensitivity (BER $\leq$ 0.007%)					
(a) 8DPSK		-	-88	-70	dBm

### 9.5. DC/RF Characteristics for Bluetooth (LE)

Normal conditions : 25 deg.C, VDD\_WLAN=3.3V, VDD\_IO= 3.3V

Items	Contents			
Channel frequency (spacing)	2402 to 2480 MHz (2MHz)			
Number of RF Channel	40			
Item / Condition	Min.	Typ.	Max.	Unit
Center Frequency	2402	-	2480	MHz
Channel Spacing	-	2	-	MHz
Number of RF channel	-	40	-	-
Output power	-	-	10	dBm
Modulation Characteristics				
1) $\Delta f_{1\text{avg}}$	225	-	275	kHz
2) $\Delta f_{2\text{max}}$ (at 99.9%)	185	-	-	kHz
3) $\Delta f_{2\text{avg}} / \Delta f_{1\text{avg}}$	0.8	-	-	-
Carrier frequency offset and drift				
1) Frequency offset	-150	-	150	kHz
2) Frequency drift	-	-	50	kHz
3) Drift rate	-	-	20	kHz
Receiver sensitivity (PER < 30.8%)	-	-96	-70	dBm
Maximum input signal level (PER < 30.8%)	-10	-	-	dBm
PER Report Integrity (-30dBm input)	50	-	65.4	%

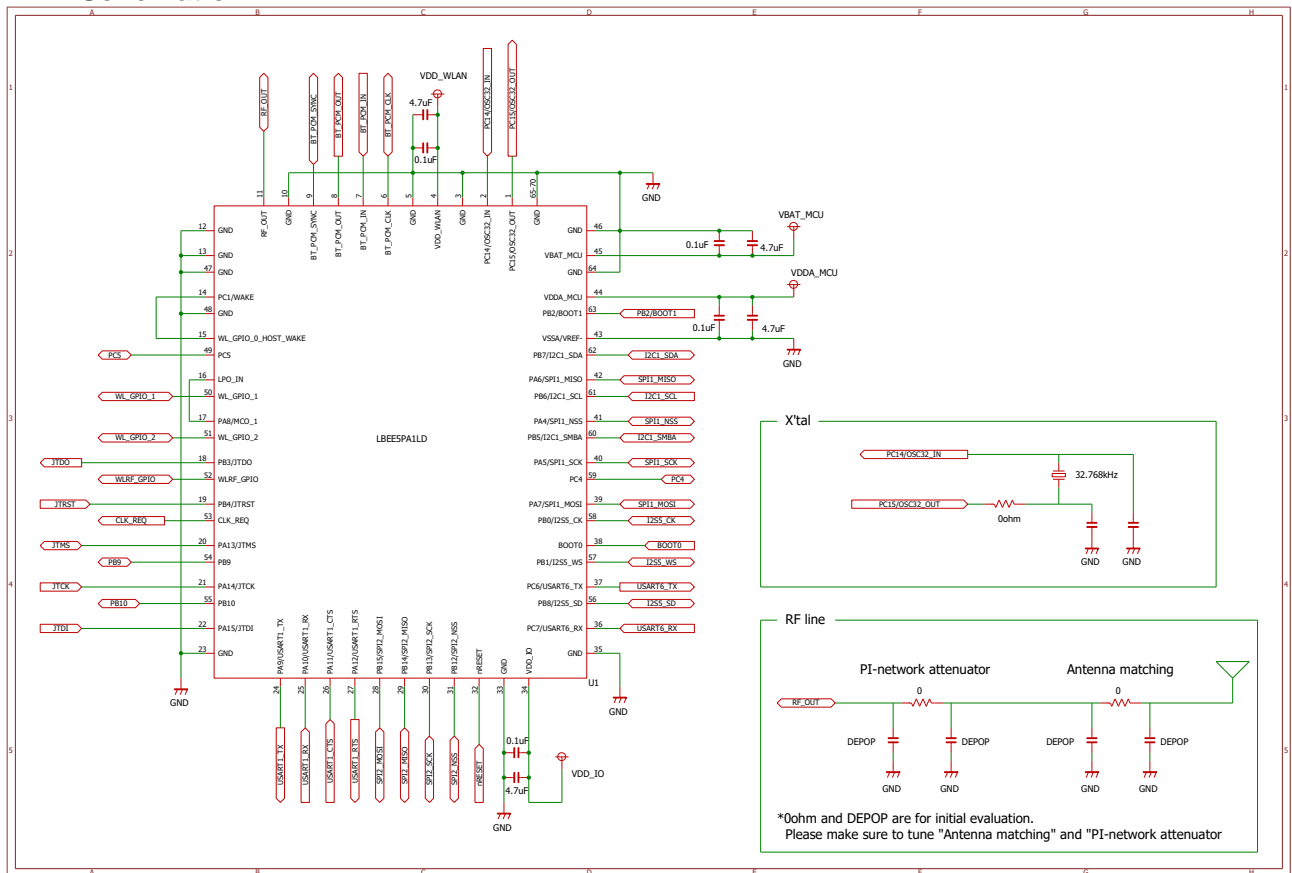
**10. Land Patterns (Top View)**



Unit : mm

## 11. Reference Circuit

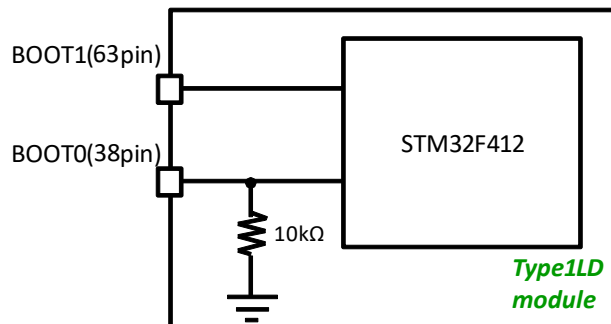
### 11.1. Schematic



### 11.2. Boot mode selection pins

Boot mode selection pins must be set as below table.

BOOT0 (No.38)	BOOT1 (No.63)	Boot mode	Aliasing
0	X	Main Flash memory	Main Flash memory is selected as the boot space.
1	0	System memory	System memory is selected as the boot space
1	1	Inhibition State	It is prohibited to set this status.

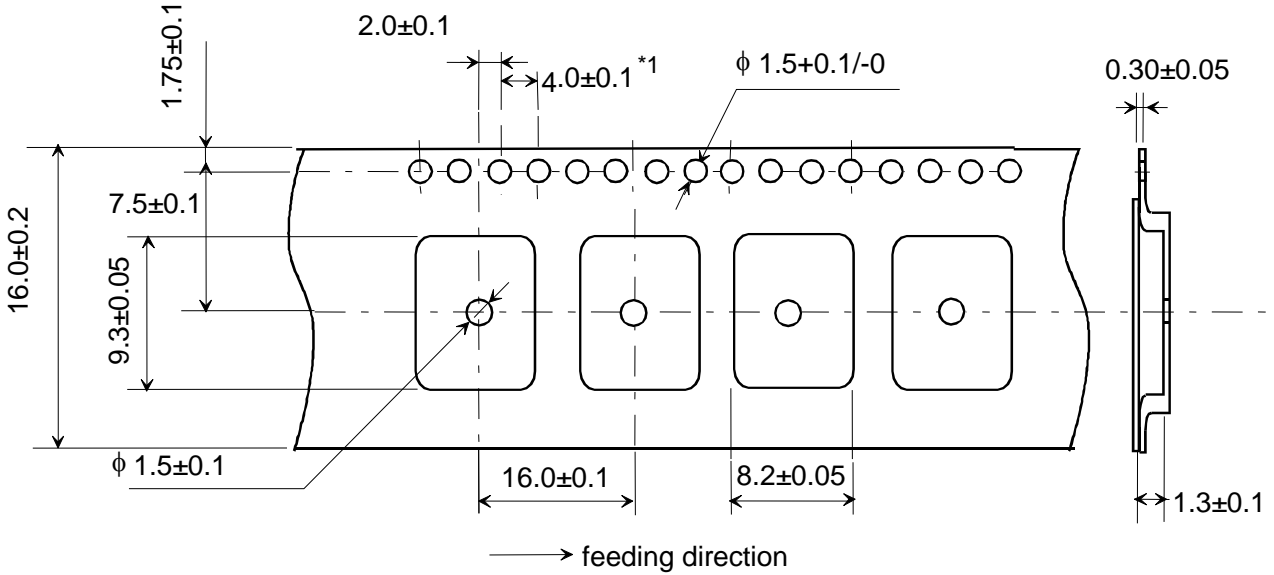


BOOT0 pin have an internal 10kohm pull-down resistor inside the module.

## 12. Tape and Reel Packing

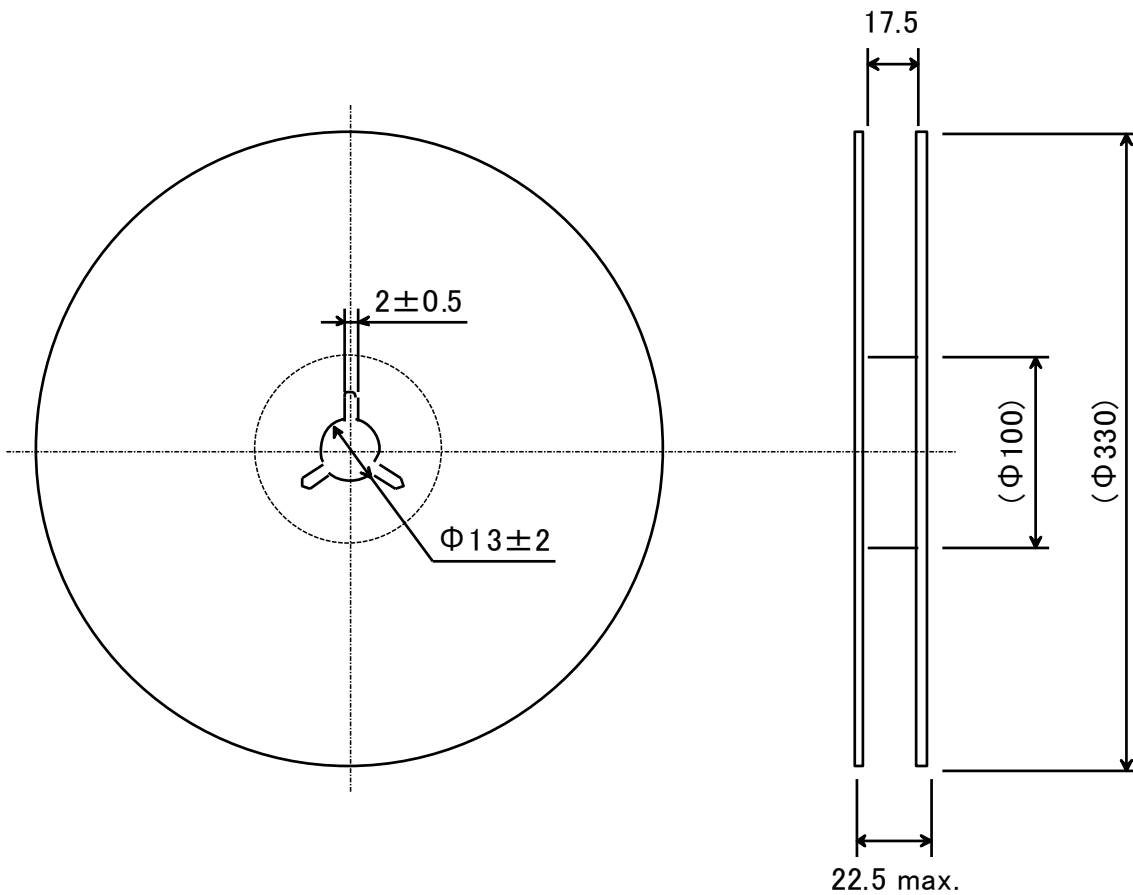
### (1) Dimensions of Tape (Plastic tape)

\*1. Cumulative tolerance of max.  $40.0 \pm 0.15$  every 10 pitches



(Unit : mm)

### (2) Dimensions of Reel



(unit : mm)



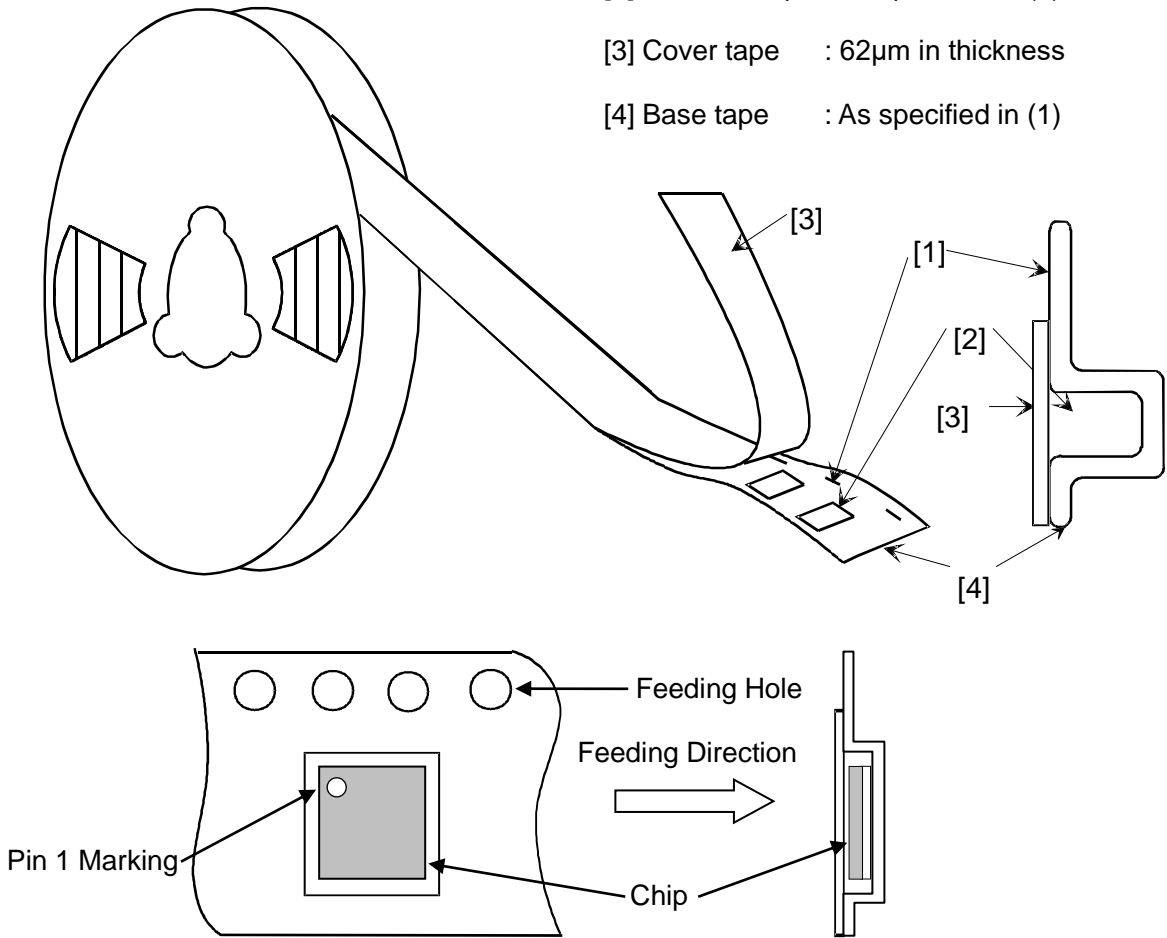
(3) Taping Diagrams

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

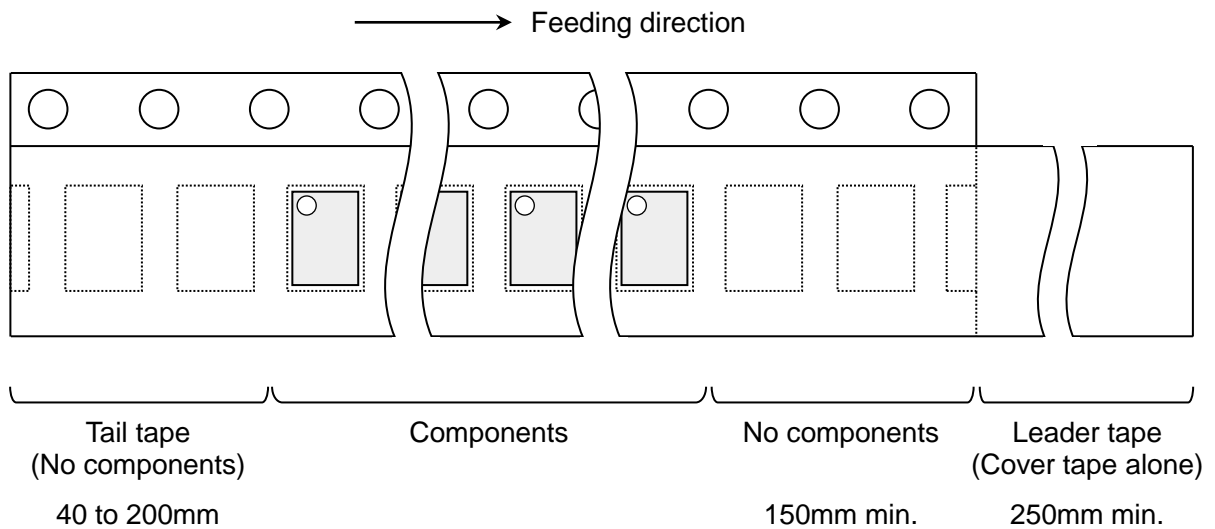
[2] Hole for chip : As specified in (1)

[3] Cover tape : 62μm in thickness

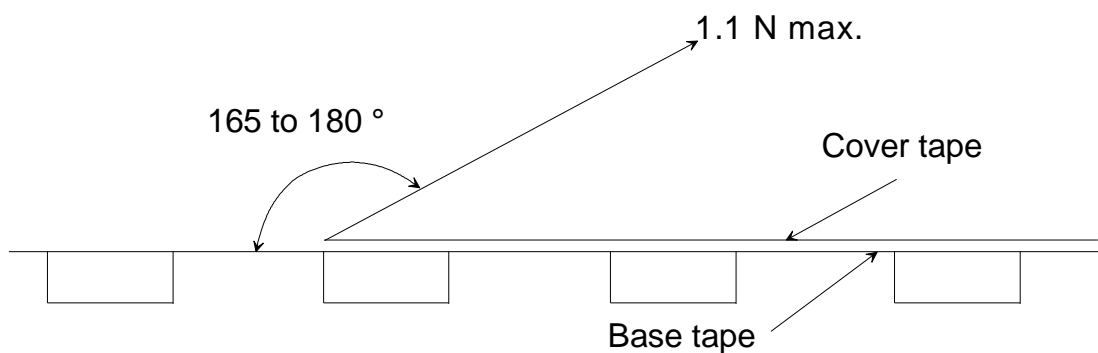
[4] Base tape : As specified in (1)



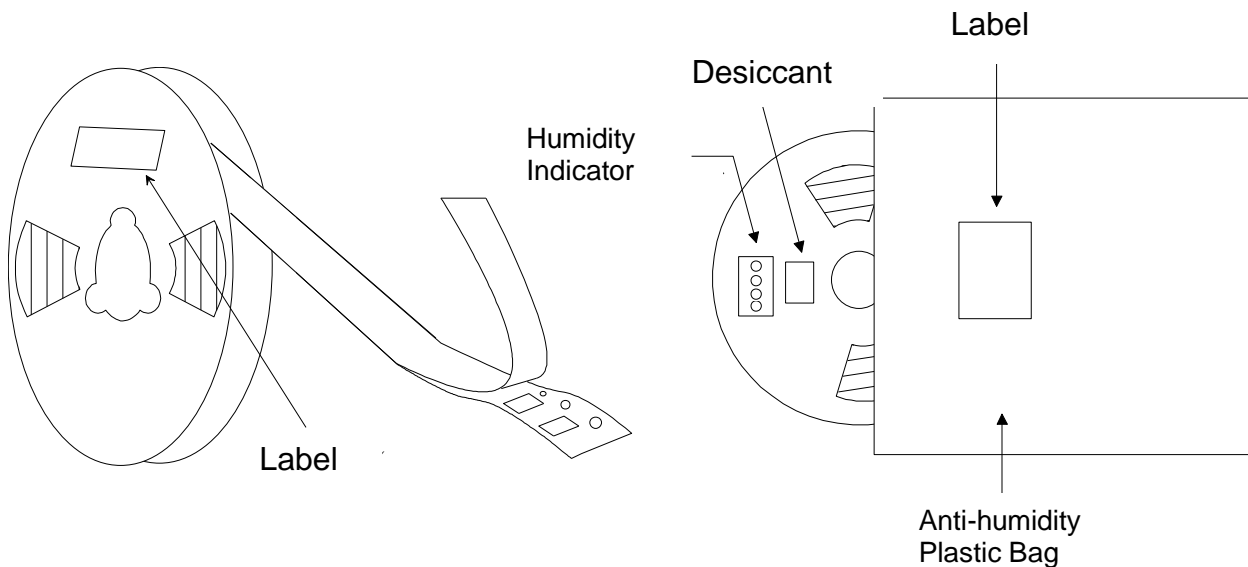
(4) Leader and Tail tape



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



- (11) Packaging (Humidity proof Packing)



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

## 13. NOTICE

### 13.1. Storage Conditions:

Please use this product within 6month after receipt.

- The product shall be stored without opening the packing under the ambient temperature from 5 to 35deg.C and humidity from 20 to 70%RH.  
(Packing materials, in particular, may be deformed at the temperature over 40deg.C.)
- The product left more than 6months after reception, it needs to be confirmed the solderbility before used.
- The product shall be stored in non corrosive gas (Cl<sub>2</sub>, NH<sub>3</sub>, SO<sub>2</sub>, No<sub>x</sub>, etc.).
- Any excess mechanical shock including, but not limited to, sticking the packing materials by sharp object and dropping the product, shall not be applied in order not to damage the packing materials.

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

- After the packing opened, the product shall be stored at  $\leq 30\text{deg.C}$  /  $\leq 60\%RH$  and the product shall be used within 168hours.
- When the color of the indicator in the packing changed, the product shall be baked before soldering.

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

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

### 13.2. Handling Conditions:

Be careful in handling or transporting products because excessive stress or mechanical shock may break products.

Handle with care if products may have cracks or damages on their terminals, the characteristics of products may change. Do not touch products with bear hands that may result in poor solder ability and destroy by static electrical charge.

### 13.3. Standard PCB Design (Land Pattern and Dimensions):

All the ground terminals should be connected to the ground patterns. Furthermore, the ground pattern should be provided between IN and OUT terminals. Please refer to the specifications for the standard land dimensions.

The recommended land pattern and dimensions is as Murata's standard. The characteristics of products may vary depending on the pattern drawing method, grounding method, land dimensions, land forming method of the NC terminals and the PCB material and thickness. Therefore, be sure to verify the characteristics in the actual set. When using non-standard lands, contact Murata beforehand.

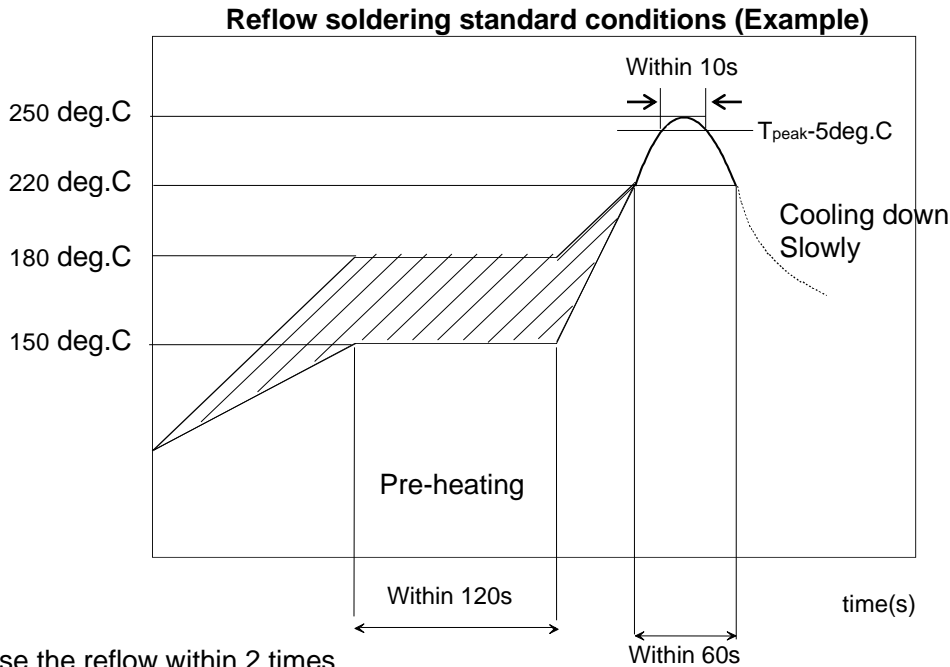
### 13.4. Notice for Chip Placer:

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.

### 13.5. Soldering Conditions:

The recommendation conditions of soldering are as in the following figure.

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



Please use the reflow within 2 times.

Use rosin type flux or weakly active flux with a chlorine content of 0.2 wt % or less.

### 13.6. Cleaning:

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

### 13.7. 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 (  $\text{Cl}_2$ ,  $\text{NH}_3$ ,  $\text{SO}_x$ ,  $\text{NO}_x$  etc.).
- In an atmosphere containing combustible and volatile gases.
- Dusty place.
- Direct sunlight place.
- Water splashing place.
- Humid place where water condenses.
- Freezing place.

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

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

### **13.8. 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.

### **13.9. Errata on MCU**

Please refer the errata documents of STM32F412 on the following site.

[http://www.st.com/content/st\\_com/en/products/microcontrollers/stm32-32-bit-arm-cortex-mcus/stm32f4-series/stm32f412/stm32f412rg.html](http://www.st.com/content/st_com/en/products/microcontrollers/stm32-32-bit-arm-cortex-mcus/stm32f4-series/stm32f412/stm32f412rg.html)

The site address may change without notices.

## **14. 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.

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

- Aircraft equipment.                      - Aerospace equipment                      - Undersea equipment.
- Power plant control equipment   - Medical equipment.
- Transportation equipment (vehicles, trains, ships, elevator, etc.).
- Traffic signal equipment.                      - Disaster prevention / crime prevention equipment.
- Burning / explosion control equipment
- Application of similar complexity and/ or reliability requirements to the applications listed in the above.

We expressly prohibit you from analyzing, breaking, reverse-engineering, remodeling altering, and reproducing our product. Our product cannot be used for the product which is prohibited from being manufactured, used, and sold by the regulations and laws in the world.

We do not warrant or represent that any license, either express or implied, is granted under any our patent right, copyright, mask work right, or our other intellectual property right relating to any combination, machine, or process in which our products or services are used. Information provided by us regarding third-party products or services does not constitute a license from us to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from us under our patents or other intellectual property.

Please do not use our products, our technical information and other data provided by us for the purpose of developing of mass-destruction weapons and the purpose of military use.

Moreover, you must comply with "foreign exchange and foreign trade law", the "U.S. export administration regulations", etc.

Please note that we may discontinue the manufacture of our products, due to reasons such as end of supply of materials and/or components from our suppliers.

By signing on specification sheet or approval sheet, you acknowledge that you are the legal representative for your company and that you understand and accept the validity of the contents herein. When you are not able to return the signed version of specification sheet or approval sheet within 30 days from receiving date of specification sheet or approval sheet, it shall be deemed to be your consent on the content of specification sheet or approval sheet. Customer acknowledges that engineering samples may deviate from specifications and may contain defects due to their development status. We reject any liability or product warranty for engineering samples. In particular we disclaim liability for damages caused by

- the use of the engineering sample other than for evaluation purposes, particularly the installation or integration in the product to be sold by you,
- deviation or lapse in function of engineering sample,
- improper use of engineering samples.

We disclaim any liability for consequential and incidental damages.

If you can't agree the above contents, you should inquire our sales.

# APPENDIX

## **User Manual**

Model Number : Type1LD

FCC ID and IC Number for this product is as follows.

FCC ID: VPYLB1LD  
IC : 772C-LB1LD

For OEM integration only – device cannot be sold to general public.  
Therefore we will ask OEM to include the following statements required  
by FCC/IC on the product and in the Installation manual Notice.  
Please describe the following warning on the final product which contains this module.

Contains Transmitter Module FCC ID:VPYLB1LD

or

Contains FCC ID: VPYLB1LD

Contains IC: 772C-LB1LD

This device complies with part 15 of FCC Rules and Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme à la partie 15 des règles de la FCC et aux normes des CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'appareil doit accepter tout brouillage subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

※When the product is small, as for these words mentioned above, the posting to a manual is possible.

### ●Please describe the following warning to the manual.

#### FCC CAUTION

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

### ●When installing it in a mobile equipment.

Please describe the following warning to the manual.

This equipment complies with FCC/IC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines and RSS-102 of the IC radio frequency (RF) Exposure rules. This equipment should be installed and operated keeping the radiator at least 20cm or more away from person's body.

Cet équipement est conforme aux limites d'exposition aux rayonnements énoncées pour un environnement non contrôlé et respecte les règles radioélectriques (RF) de la FCC lignes directrices d'exposition et d'exposition aux fréquences radioélectriques (RF) CNR-102 de l'IC. Cet équipement doit être installé et utilisé en gardant une distance de 20 cm ou plus entre le radiateur et le corps humain.

### ●When installing it in a portable equipment.

FCC : Class II permissive change application and SAR test are necessary.

IC : Class II permissive change application and SAR test are necessary.

Please contact Murata.

Note)

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

Mobile equipment : Equipment used at position in which the spaces between human body and antenna exceeded 20cm.

Preliminary

< Specification may be changed by Murata without notice >  
Murata Manufacturing Co., Ltd.



## Installation Manual

Model Number : Type1LD

### Contents

1. Operational Discription (Frequency, Output power)
2. Antenna Design

### 1.Operational Discription

- Operational Systems  
WLAN: 802.11b/g/n(HT20)  
Bluetooth: BR/EDR/LE
- Operating Frequencies  
WLAN: 2412 – 2462 MHz  
Bluetooth: 2402 – 2480 MHz
- Setting Output Powers  
WLAN: Show right table  
Bluetooth: BR=9dBm, EDR=5dBm, LE=8dBm

11b	
Rate	Output Power[dBm]
1Mbps	17
2Mbps	17
5.5Mbps	17
11Mbps	17

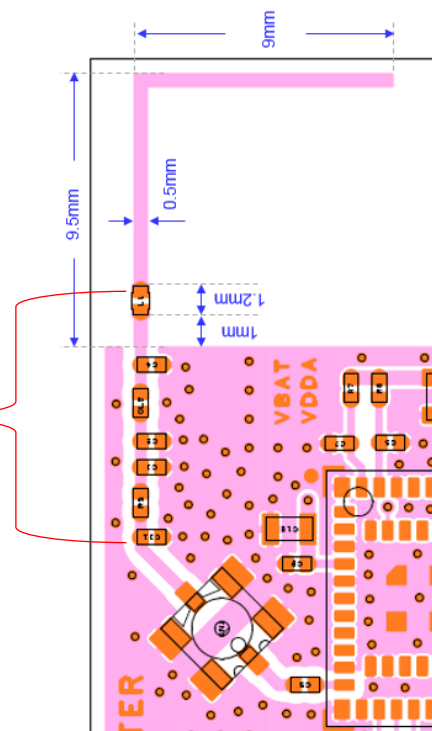
11g	
Rate	Output Power[dBm]
6Mbps	17
9Mbps	17
12Mbps	17
18Mbps	17
24Mbps	17
36Mbps	16
48Mbps	14
54Mbps	13

11n	
Rate	Output Power[dBm]
MCS0	17
MCS1	17
MCS2	17
MCS3	17
MCS4	17
MCS5	15
MCS6	13
MCS7	12

### 2. Antenna Discription

We got approval by the antenna in the pattern of the figure.  
When using our authorization ID, it is necessary to use an equivalent antenna pattern.

Used for tuning antenna gain  
\* Antenna peak gain should be 0 dBi or less



Preliminary

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Murata Manufacturing Co., Ltd.