

W-LAN+Bluetooth Combo Module Data Sheet

Qualcomm Chipset QCA6390
for IEEE802.11a/b/g/n/ac/ax 2*2 MIMO + BT 5.1

Sample P/N : LBEE58D1VF-TEMP

The revision history of the product specification

Revised No.	Revised Date	Note
-	2019.3.5	Initial Release
A	2019.3.29	2.1 Block Diagram Updated 3. ABSOLUTE MAXIMUM RATINGS Updated 4. OPERATING CONDITION Updated 5.1 Dimensions Update and <PIN SHAPE> 5.2 Pin Layput updated 9. LAND PATTERN (TOP VIEW) Updated Added 5.3. Module PIN Descriptions Added 6. POWER OF SEQUENCE
B	2019.5.29	5.1 UBM sizu Updated 2. Weight Updated
C	2019.6.3	5. Added Marking information(Tentative) 10. Added Dimensions of Tape(Tentative)
D	2019.7.1	2.1 Changed block diagram (remove xtal inside module) 5.1 Changed pin shape 5.2 Changed pin shape and pin description (XTALO->XTALI) 5.3 Changed pin description (XTALO->XTALI) 9 Changed pin shape
E	2019.8.23	3. ABSOLUTE MAXIMUM RATINGS updated 4. OPERATING CONDITION updated
F	2019.9.10	7. REFERENCE CIRCUIT Added the latest circuit 10.TAPE AND REEL PACKING (1) Dimensions of Tape (Plastic tape Change tape dimensions for MP (4) Leader and Tail tape Changed packaging unit to 2000pcs/reel for MP
G	2019.12.15	8. ELECTRICAL CHARACTERISTICS Updated the value
H	2019.12.26	5.3 Revised pin description for terminal P1 and P2.

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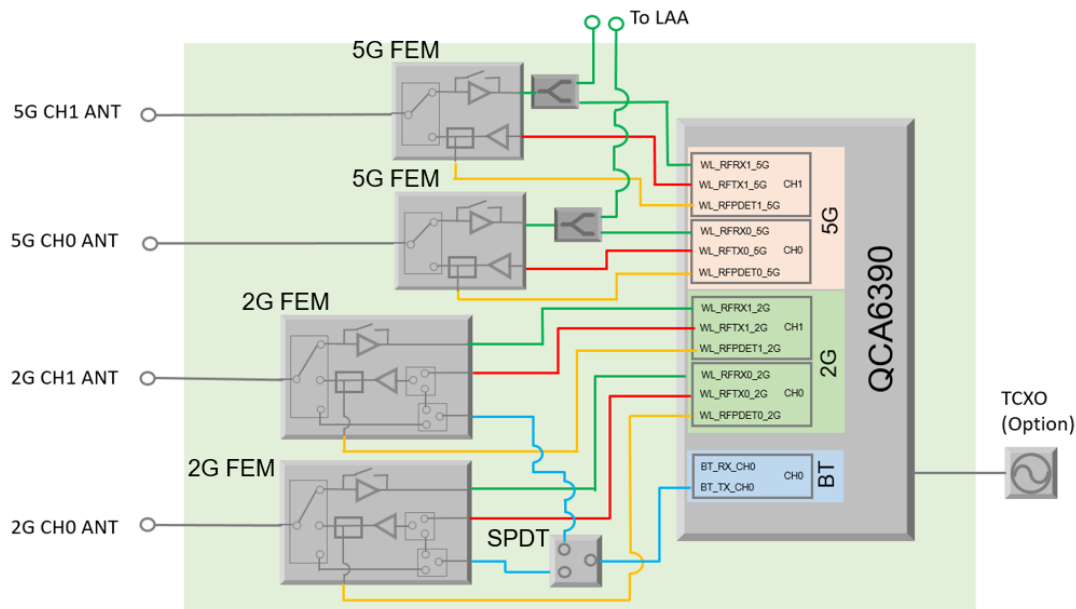
1. SCOPE

This specification is applied to the IEEE802.11a/b/g/n/ac/ax W-LAN + BT5.1 combo module.

2. KEY FEATURE

- Qualcomm QCA6390 inside
- Compliant with IEEE802.11a/b/g/n/ac/ax
- Supports W-LAN 2*2 MU-MIMO
- DBS(Dual band simultaneous) with dual MAC, up to 1774.5Mbps data rate (2*2 + 2*2, 11ax DBS)
- Compliant with BT specification
- 5G Rx Splitters inside for ANT sharing w/LAA
- Surface mount type 8.75 x 7.0 mm (Typical), H = 1.1 mm (Max)
- Extreme size efficient dual side mount structure with conformal shield.
- Weight : 0.19g
- MSL : 3

2.1. Block Diagram



2.2. Ordering Information

Ordering Part Number	Description
LBEE58D1VF-TEMP	In case of sample order
LBEE58D1VF-TEMP-D	EVK

2.3. RoHS Compliance

This module is compliant with the RoHS directive.

3. ABSOLUTE MAXIMUM RATINGS

Parameter		min.	max.	Unit
Storage Temperature		-40	85	deg.C
Supply Voltage	RFA0P8_LDO_IN	-0.3	Vddx+0.2	V
	RFA12_LDO_IN	-0.3	Vddx+0.2	V
	RFA17_LDO_IN	-0.3	Vddx+0.2	V
	PCIE0P92_LDO_IN	-0.3	Vddx+0.2	V
	PCIE18_LDO_IN	-0.3	Vddx+0.2	V
	CX_MX_BT_LDO_IN	-0.3	Vddx+0.2	V
	AON_RFACMN_LDO_IN	-0.3	Vddx+0.2	V
	VDD18_DIG_IO	-0.3	Vddx+0.2	V
	VPH_PA_2G_CH0, VPH_PA_2G_CH1, VPH_PA_5G_CH0, VPH_PA_5G_CH1	-0.3	5.25	V

* Vddx is the supply voltage associated with the input or output pin to which the test voltage is applied.

* 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.

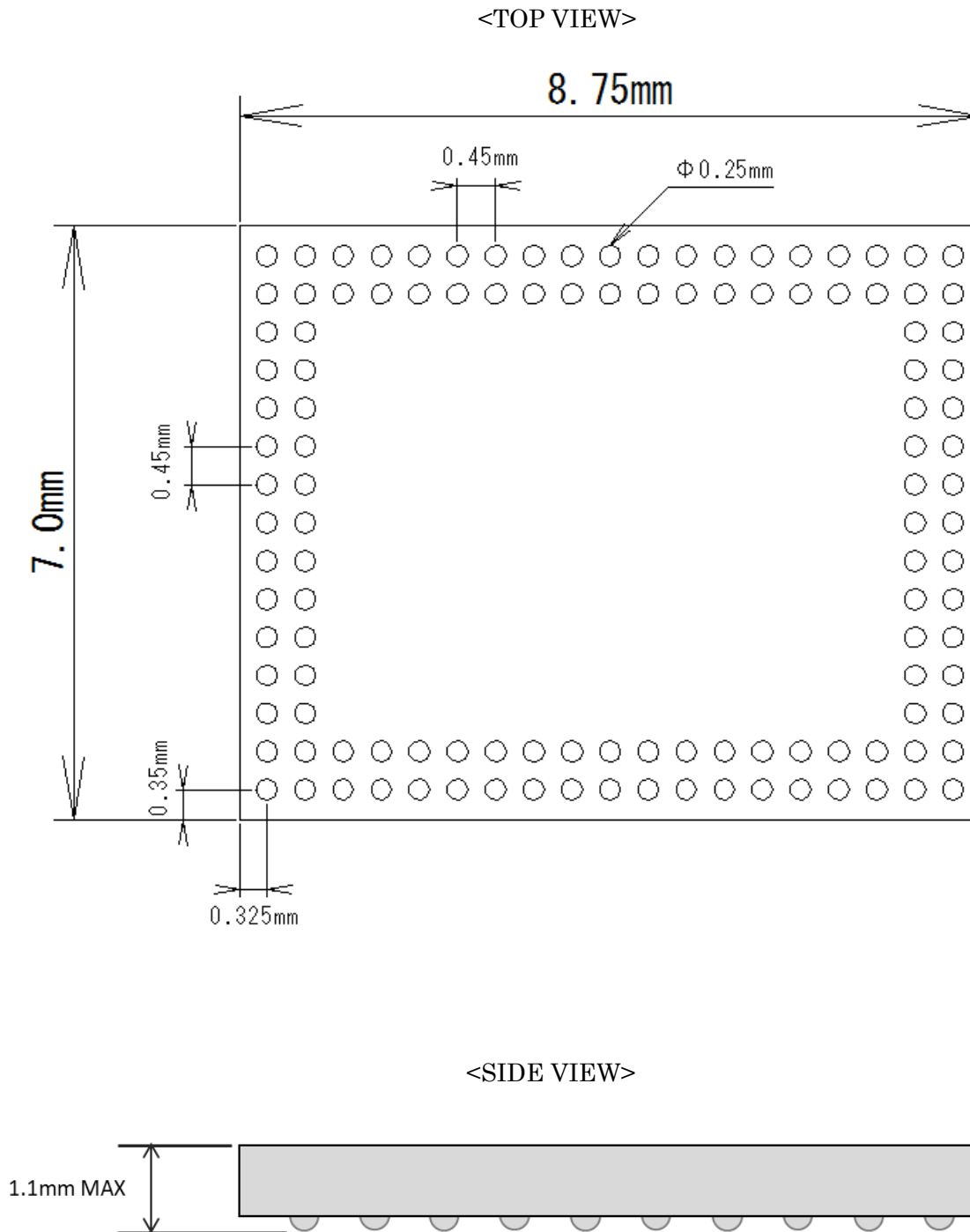
4. OPERATING CONDITION

Parameter		min.	typ.	max.	unit
Operating Temperature ^{*1}		-20	25	+75	deg.C
Supply Voltage	RFA0P8_LDO_IN	0.9	0.95	1.0	V
	RFA12_LDO_IN	1.3	1.38	1.42	V
	RFA17_LDO_IN	1.9	2.0	2.1	V
	PCIE0P92_LDO_IN	1.28	1.35	1.45	V
	PCIE18_LDO_IN	1.9	2.0	2.1	V
	CX_MX_BT_LDO_IN	0.9	0.95	1.0	V
	AON_RFACMN_LDO_IN	0.9	0.95	1.89	V
	VDD18_DIG_IO	1.71	1.8	1.89	V
	VPH_PA_2G_CH0, VPH_PA_2G_CH1, VPH_PA_5G_CH0, VPH_PA_5G_CH1	3.0	3.85	4.6	V

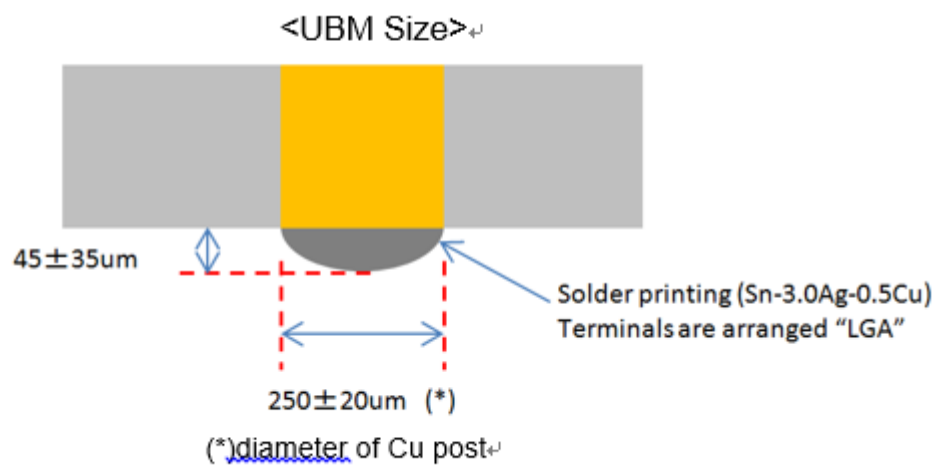
* Functionality is guaranteed but specifications require derating at extreme temperatures.

5. DIMENSIONS, MARKING AND TERMINAL CONFIGURATIONS

5.1. Dimensions

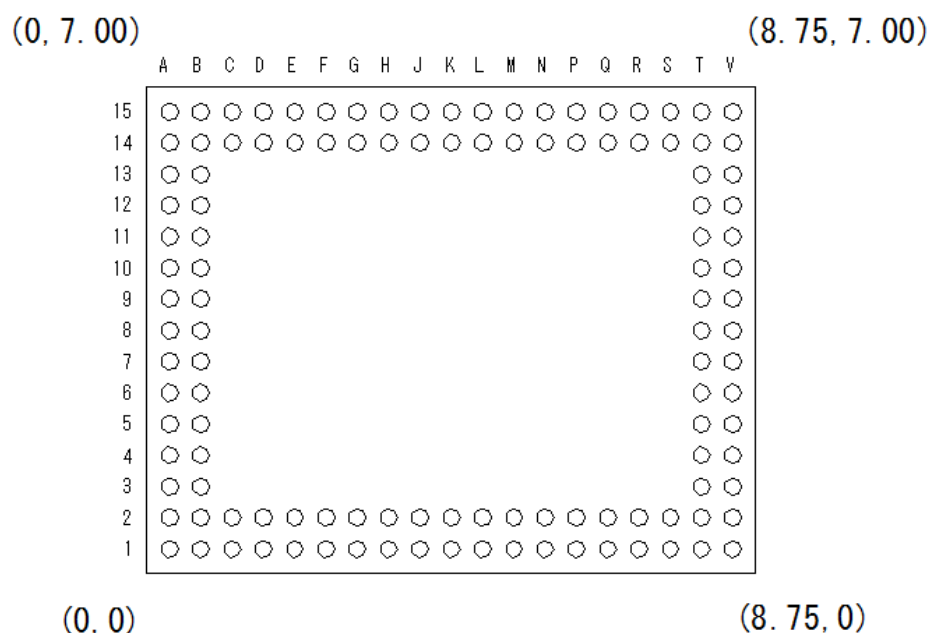


(Marking information)



5.2. Pin Layout

<TOP VIEW>



Address	X	Y	Net Name
A1	0.325	0.35	GND
A2	0.325	0.8	PCIE_TXN
A3	0.325	1.25	GND
A4	0.325	1.7	PCIE_RXP
A5	0.325	2.15	GND
A6	0.325	2.6	PCIE_REFCLKN
A7	0.325	3.05	GND
A8	0.325	3.5	WLAN_SW_CTRL
A9	0.325	3.95	CLK_OUT_REF
A10	0.325	4.4	PCIE0P92_LDO_IN
A11	0.325	4.85	GND
A12	0.325	5.3	RFA0P8_LDO_IN
A13	0.325	5.75	CX_MX_BT_LDO_IN
A14	0.325	6.2	VDD18_DIG_IO
A15	0.325	6.65	GND
B1	0.775	0.35	GND
B2	0.775	0.8	PCIE_TXP
B3	0.775	1.25	GND
B4	0.775	1.7	PCIE_RXN
B5	0.775	2.15	GND
B6	0.775	2.6	PCIE_REFCLKP
B7	0.775	3.05	GND
B8	0.775	3.5	PCIE_CLKREQ#
B9	0.775	3.95	WL_LED/PCIE_BAR_SIZE0
B10	0.775	4.4	GND
B11	0.775	4.85	PCIE18_LDO_IN
B12	0.775	5.3	GND
B13	0.775	5.75	CX_MX_BT_LDO_IN

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B14	0.775	6.2	GND
B15	0.775	6.65	RFA12_LDO_IN
C1	1.225	0.35	PCIE_WAKE#
C2	1.225	0.8	GND
C14	1.225	6.2	AON_RFACMN_LDO_IN
C15	1.225	6.65	GND
D1	1.675	0.35	LF_CLK_IN
D2	1.675	0.8	PCIE_RST#
D14	1.675	6.2	GND
D15	1.675	6.65	RFA17_LDO_IN
E1	2.125	0.35	BT_I2S0_SDO/EDL_MODE
E2	2.125	0.8	BT_I2S0_SCK/BT_SLIMBUS_CLK
E14	2.125	6.2	CLK_REQ_IN
E15	2.125	6.65	GND
F1	2.575	0.35	BT_I2S0_SDI/BT_SLIMBUS_DATA
F2	2.575	0.8	BT_I2S0_WS
F14	2.575	6.2	GND
F15	2.575	6.65	WLAN_EN
G1	3.025	0.35	BT_SENS_RXD
G2	3.025	0.8	BT_SENS_TXD/CPU_INIT_RESET
G14	3.025	6.2	GND
G15	3.025	6.65	BT_EN
H1	3.475	0.35	XTAL_GND
H2	3.475	0.8	XTAL_GND
H14	3.475	6.2	GND
H15	3.475	6.65	LAA_AS_EN
J1	3.925	0.35	XTALI
J2	3.925	0.8	XTAL_GND
J14	3.925	6.2	WL_PA_MUTE
J15	3.925	6.65	WL_TXEN
K1	4.375	0.35	XTAL_GND
K2	4.375	0.8	XTAL_GND
K14	4.375	6.2	LAA_TXEN
K15	4.375	6.65	LAA_RX
L1	4.825	0.35	BT_UART_CTS
L2	4.825	0.8	BT_UART_RXD
L14	4.825	6.2	GND
L15	4.825	6.65	GND
M1	5.275	0.35	BT_UART_TXD
M2	5.275	0.8	BT_UART_RTS
M14	5.275	6.2	GPS_COEX/PBL_BOOTSPED_0
M15	5.275	6.65	CLK_REQ_OUT/PBL_FAST_BOOT
N1	5.725	0.35	COEX_TXD/BOOT_FROM_ROM
N2	5.725	0.8	COEX_RXD
N14	5.725	6.2	WL_UART_RXD
N15	5.725	6.65	WL_UART_RTS/PBL_AUTH_EN
P1	6.175	0.35	HST_SLM_CH0_CTL0/CLK_REQ_0
P2	6.175	0.8	HST_SLM_CH0_CTL1/CLK_REQ_1
P14	6.175	6.2	GND
P15	6.175	6.65	WL_UART_TXD/WDOG_DISABLE
Q1	6.625	0.35	HST_SLM_CH1_CTL0/PBL_BOOTSPED_1

Q2	6.625	0.8	HST_SLM_CH1_CTL1/XO_TCXO_SEL
Q14	6.625	6.2	GND
Q15	6.625	6.65	GND
R1	7.075	0.35	GND
R2	7.075	0.8	GND
R14	7.075	6.2	GND
R15	7.075	6.65	GND
S1	7.525	0.35	5G_CH0_LTE-U_RX_AS
S2	7.525	0.8	GND
S14	7.525	6.2	GND
S15	7.525	6.65	2G_CH1
T1	7.975	0.35	GND
T2	7.975	0.8	GND
T3	7.975	1.25	VPH_PA_5G_CH0
T4	7.975	1.7	GND
T5	7.975	2.15	GND
T6	7.975	2.6	GND
T7	7.975	3.05	GND
T8	7.975	3.5	GND
T9	7.975	3.95	GND
T10	7.975	4.4	GND
T11	7.975	4.85	GND
T12	7.975	5.3	VPH_PA_5G_CH1
T13	7.975	5.75	GND
T14	7.975	6.2	GND
T15	7.975	6.65	GND
V1	8.425	0.35	GND
V2	8.425	0.8	GND
V3	8.425	1.25	VPH_PA_2G_CH0
V4	8.425	1.7	GND
V5	8.425	2.15	2G_CH0
V6	8.425	2.6	GND
V7	8.425	3.05	GND
V8	8.425	3.5	5G_CH0
V9	8.425	3.95	GND
V10	8.425	4.4	5G_CH1_LTE-U_RX_AS
V11	8.425	4.85	GND
V12	8.425	5.3	VPH_PA_2G_CH1
V13	8.425	5.75	GND
V14	8.425	6.2	5G_CH1
V15	8.425	6.65	GND

5.3. Module PIN Descriptions

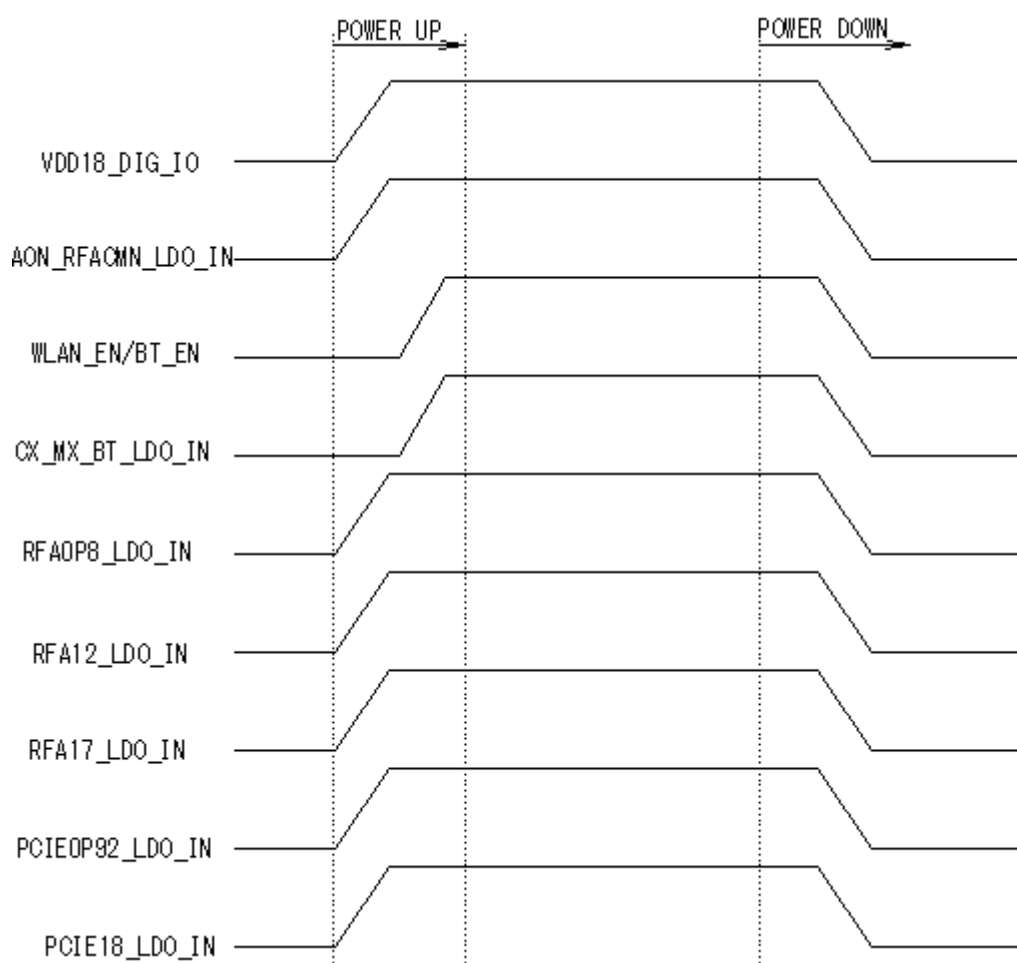
No.	Pin name	Type	System	Connection to IC pin name	Description
A1	GND	GND	-		
A2	PCIE_TXN	I/O		PCIE20_TXM	Transmitter Negative of PCIE
A3	GND	GND	-		
A4	PCIE_RXP	I/O		PCIE20_RXP	Receiver Positive of PCIE
A5	GND	GND	-		
A6	PCIE_REFCLKN	I		PCIE20_REFC LK_EPCLK_N	PCIe differential clock input (negative). 100ohm differential.
A7	GND	GND	-		
A8	WLAN_SW_CTRL	I/O	GPIO	GPIO_46	
A9	CLK_OUT_REF	I/O	GPIO	GPIO_55	
A10	PCIE0P92_LDO_IN	I		VDD13_PMU_ PCIE_I	1.3 V input for 0.92 V output LDO
A11	GND	GND	-		
A12	RFA0P8_LDO_IN	I		VDD09_PMU_ RFA_I	0.9 V input for 0.8 V output LDO
A13	CX_MX_BT_LDO_IN	I		VDD095_PMU	0.95 V input for BT LDO
A14	VDD18_DIG_IO	P			VDD for Digital I/O circuit
A15	GND	GND	-		
B1	GND	GND	-		
B2	PCIE_TXP	I/O		PCIE20_TXP	Transmitter Positive of PCIE
B3	GND	GND	-		
B4	PCIE_RXN	I/O		PCIE20_RXN	Receiver Negative of PCIE
B5	GND	GND	-		
B6	PCIE_REFCLKP	I	WL PCIe	PCIE20_REFC LK_EPCLK_P	PCIe differential clock input (positive). 100ohm differential.
B7	GND	GND	-		
B8	PCIE_CLKREQ#	I/O	GPIO	GPIO_59	
B9	WL_LED/PCIE_BAR_SIZE0	I/O	GPIO	GPIO_54	
B10	GND	GND	-		
B11	PCIE18_LDO_IN	P		VDD19_PMU_ PCIE_I	VDD PMU for LDO input in PCIE
B12	GND	GND	-		
B13	CX_MX_BT_LDO_IN	P		VDD095_PMU	0.95 V input for BT LDO
B14	GND	GND	-		
B15	RFA12_LDO_IN	P		VDD13_PMU_ RFA_I	1.3 V input for 1.2 V output LDO
C1	PCIE_WAKE#	I/O	GPIO	GPIO_58	

C2	GND	GND	-		
C14	AON_RFACMN_LDO_IN	P		VDD_PMU_AON_I	
C15	GND	GND	-		
D1	LF_CLK_IN	I/O	GPIO	GPIO_14	
D2	PCIE_RST#	I/O	GPIO	GPIO_57	
D14	GND	GND	-		
D15	RFA17_LDO_IN	P		VDD19_PMU_RFA_I	1.9 V input for 1.7 V output LDO
E1	BT_I2S0_SDO/EDL_MODE	I/O	GPIO	GPIO_6	
E2	BT_I2S0_SCK/BT_SLIMBUS_CLK	I/O	GPIO	GPIO_7	
E14	CLK_REQ_IN	I		CLK_REQ_IN	clock request signal
E15	GND	GND	-		
F1	BT_I2S0_SDI/BT_SLIMBUS_DATA	I/O	GPIO	GPIO_4	
F2	BT_I2S0_WS	I/O	GPIO	GPIO_5	
F14	GND	GND	-		
F15	WLAN_EN	I		WLAN_EN	Enable WLAN
G1	BT_SENS_RXD	I/O	GPIO	GPIO_9	
G2	BT_SENS_TXD/CPU_INIT_RESET	I/O	GPIO	GPIO_8	
G14	GND	GND	-		
G15	BT_EN	I		BT_EN	Enable BT
H1	XTAL_GND	GND	-		
H2	XTAL_GND	GND	-		
H14	GND	GND	-		
H15	LAA_AS_EN	I		LAA_AS_EN	Enable LTE-U Antenna Sharing
J1	XTALI	I		XTALI	
J2	XTAL_GND	GND	-		
J14	WL_PA_MUTE	I/O	GPIO	GPIO_43	
J15	WL_TXEN	I/O	GPIO	GPIO_41	
K1	XTAL_GND	GND	-		
K2	XTAL_GND	GND	-		
K14	LAA_TXEN	I/O	GPIO	GPIO_40	
K15	LAA_RX	I/O	GPIO	GPIO_42	
L1	BT_UART_CTS	I/O	GPIO	GPIO_2	
L2	BT_UART_RXD	I/O	GPIO	GPIO_0	
L14	GND	GND	-		
L15	GND	GND	-		
M1	BT_UART_TXD	I/O	GPIO	GPIO_1	
M2	BT_UART_RTS	I/O	GPIO	GPIO_3	

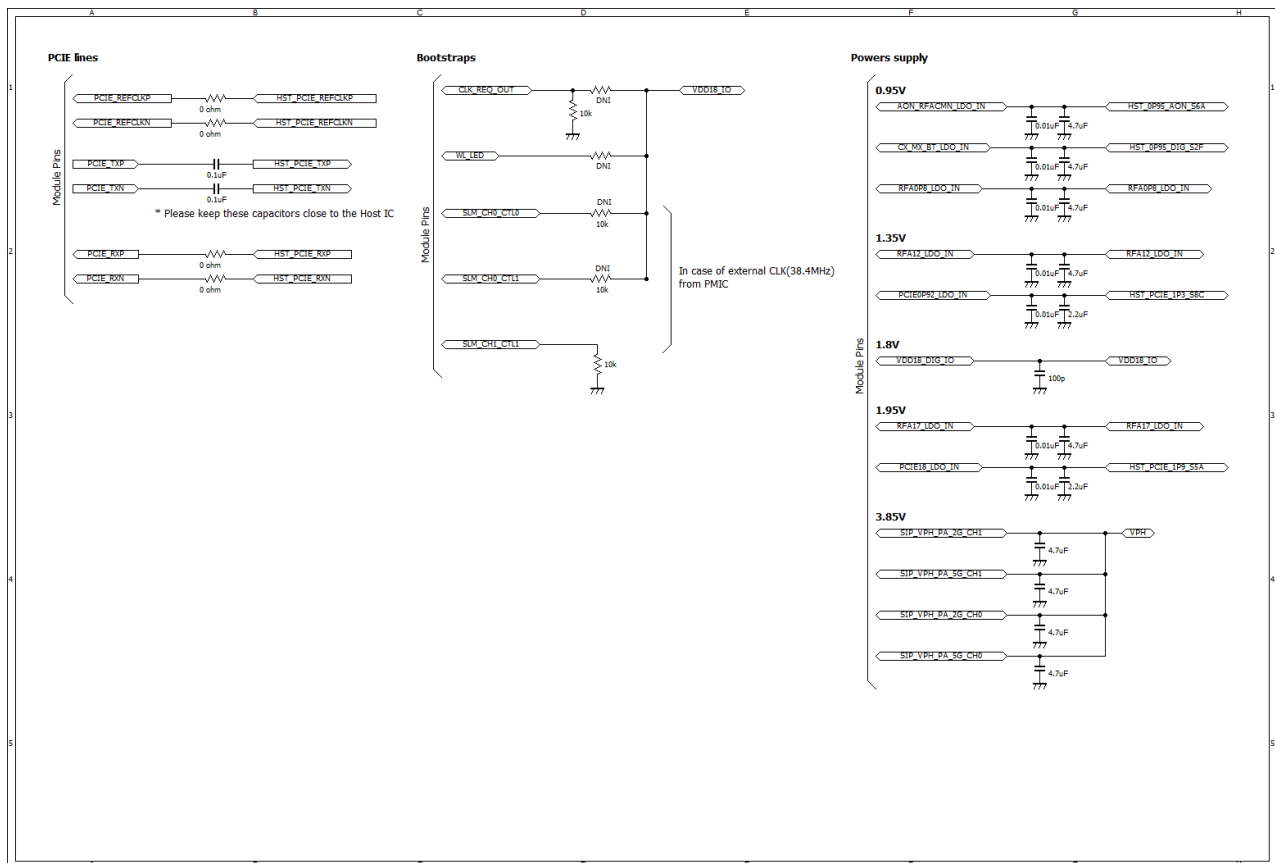
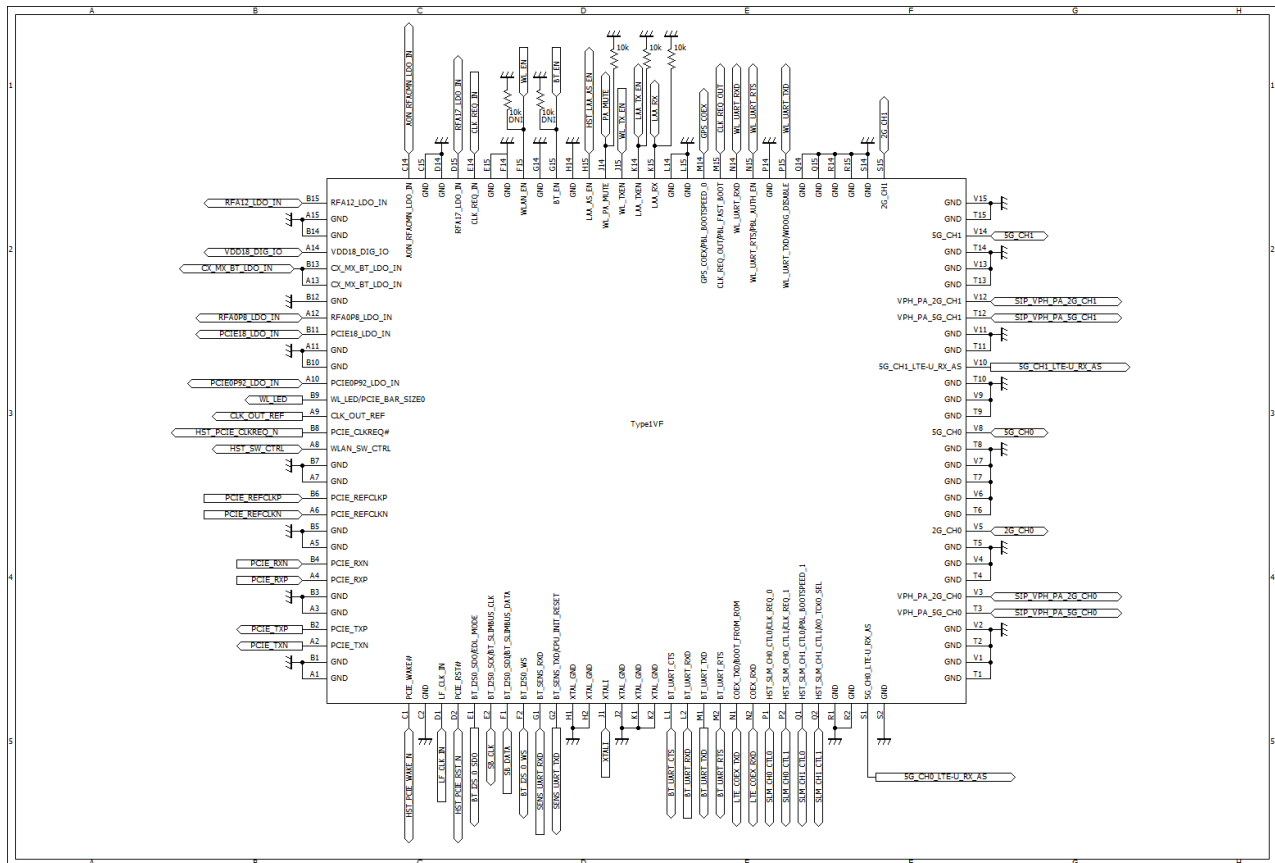
M14	GPS_COEX/PBL_BO OTSPEED_0	I/O	GPIO	GPIO_47	
M15	CLK_REQ_OUT/PBL _FAST_BOOT	I/O	GPIO	GPIO_56	
N1	COEX_TXD/BOOT_F ROM_ROM	I/O	GPIO	GPIO_11	
N2	COEX_RXD	I/O	GPIO	GPIO_10	
N14	WL_UART_RXD	I/O	GPIO	GPIO_49	
N15	WL_UART_RTS/PBL_ AUTH_EN	I/O	GPIO	GPIO_52	
P1	HST_SLM_CH0_CTL 0/CLK_REQ_0	I/O	GPIO	GPIO_36	
P2	HST_SLM_CH0_CTL 1/CLK_REQ_1	I/O	GPIO	GPIO_37	
P14	GND	GND	-		
P15	WL_UART_TXD/WD OG_DISABLE	I/O	GPIO	GPIO_50	
Q1	HST_SLM_CH1_CTL 0/PBL_BOOTSPEED_ 1	I/O	GPIO	GPIO_38	
Q2	HST_SLM_CH1_CTL 1/XO_TCXO_SEL	I/O	GPIO	GPIO_39	
Q14	GND	GND	-		
Q15	GND	GND	-		
R1	GND	GND	-		
R2	GND	GND	-		
R14	GND	GND	-		
R15	GND	GND	-		
S1	5G_CH0_LTE-U_RX_ AS	RF	RF		Antenna sharing 5G_CH0 and LTE-U
S2	GND	GND	-		
S14	GND	GND	-		
S15	2G_CH1	RF	RF	ANT	
T1	GND	GND	-		
T2	GND	GND	-		
T3	VPH_PA_5G_CH0	P			Power from Battery for 5G_CH0_PA
T4	GND	GND	-		
T5	GND	GND	-		
T6	GND	GND	-		
T7	GND	GND	-		
T8	GND	GND	-		
T9	GND	GND	-		
T10	GND	GND	-		
T11	GND	GND	-		
T12	VPH_PA_5G_CH1	P			Power from Battery for 5G_CH1_PA

T13	GND	GND	-		
T14	GND	GND	-		
T15	GND	GND	-		
V1	GND	GND	-		
V2	GND	GND	-		
V3	VPH_PA_2G_CH0	P			Power from Battery for 2G_CH0_PA
V4	GND	GND	-		
V5	2G_CH0	RF	RF	ANT	
V6	GND	GND	-		
V7	GND	GND	-		
V8	5G_CH0	RF	RF	ANT	
V9	GND	GND	-		
V10	5G_CH1_LTE-U_RX_AS	RF	RF		Antenna sharing 5G_CH1 and LTE-U
V11	GND	GND	-		
V12	VPH_PA_2G_CH1	P			Power from Battery for 2G_CH1_PA
V13	GND	GND	-		
V14	5G_CH1	RF	RF	ANT	
V15	GND	GND	-		

6. POWER OF SEQUENCE



7. REFERENCE CIRCUIT



8. ELECTORICAL CHARACTERISTICS (Chain 0/1)

8.1. DC/RF Characteristics for IEEE802.11b - 2.4GHz

Normal Condition : 25deg.C, Supply voltage is typ value in "4. operating condition"
11Mbps mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11b-2.4GHz			
Mode	CCK			
Channel frequency (spacing)	2412 to 2472 MHz (5MHz)			
Current Consumption	Min.	Typ.	Max.	unit
(a) Tx mode	-	-	350	mA
(b) Rx mode	-	-	90	mA
Transmitter	Min.	Typ.	Max.	Unit
Power Levels(Power setting : 21dBm)	18.5	21	23.5	dBm
Spectrum Mask				
(a) 1st side lobes	-	-	-30	dBr
(b) 2nd side lobes	-	-	-50	dBr
Power-on/off ramp	-	-	2.0	Usec
Modulation Accuracy	-	-	35	%
Spurious Emissions (BW=100kHz)				
(a) 30-1000MHz	-	-	-36	dBm
(b) 1000-12500MHz	-	-	-30	dBm
(c) 1800-1900MHz	-	-	-47	dBm
(d) 5150-5300MHz	-	-	-47	dBm
Receiver *FER _≤ 8%	Min.	Typ.	Max.	Unit
Minimum Input Level	-	-	-76	dBm

8.2. DC/RF Characteristics for IEEE802.11g - 2.4GHz

Normal Condition : 25deg.C, Supply voltage is typ value in "4. operating condition"
54Mbps mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11g-2.4GHz			
Mode	OFDM			
Channel frequency (spacing)	2412 to 2472 MHz (5MHz)			
Current Consumption	Min.	Typ.	Max.	Unit
(a) Tx mode	-	-	340	mA
(b) Rx mode	-	-	90	mA
Transmitter	Min.	Typ.	Max.	Unit
Power Levels (Power setting : 18dBm)	15.5	18	20.5	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≥ +/-30MHz	-	-	-40	dBr
Constellation Error	-	-	-25	dB
Spurious Emissions (BW=100kHz)				
(a) 30-1000MHz	-	-	-36	dBm
(b) 1000-12500MHz	-	-	-30	dBm
(c) 1800-1900MHz	-	-	-47	dBm
(d) 5150-5300MHz	-	-	-47	dBm
Receiver *PER _≤ 10%	Min.	Typ.	Max.	Unit
Minimum Input Level	-	-	-65	dBm

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

Normal Condition : 25deg.C, Supply voltage is typ value in "4. operating condition"
65Mbps (MCS7) mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11n-2.4GHz			
Mode	OFDM			
Channel frequency (spacing)	2412 to 2472 MHz (5MHz)			
Current Consumption	Min.	Typ.	Max.	Unit
(a) Tx mode		-	300	mA
(b) Rx mode		-	90	mA
Transmitter	Min.	Typ.	Max.	Unit
Power Levels (Power setting :16dBm)	13.5	16	18.5	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≥ +/-30MHz	-	-	-45	dBr
Constellation Error *measured at full packet channel estimation	-	-	-27	dB
Spurious Emissions (BW=100kHz)				
(a) 30-1000MHz	-	-	-36	dBm
(b) 1000-12500MHz	-	-	-30	dBm
(c) 1800-1900MHz	-	-	-47	dBm
(d) 5150-5300MHz	-	-	-47	dBm
Receiver *PER≤ 10%, LDPC enabled	Min.	Typ.	Max.	Unit
Minimum Input Level	-	-	-64	dBm

8.4. DC/RF Characteristics for IEEE802.11ax - 2.4GHz

Normal Condition : 25deg.C, Supply voltage is typ value in "4. operating condition"
MCS9 mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11ax-2.4GHz			
Mode	OFDM			
Channel frequency (spacing)	2412 to 2472 MHz (5MHz)			
Current Consumption	Min.	Typ.	Max.	Unit
(b) Tx mode		-	350	mA
(b) Rx mode		-	90	mA
Transmitter	Min.	Typ.	Max.	Unit
Power Levels (Power setting : 16dBm)	13.5	16	18.5	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≥ +/-30MHz	-	-	-45	dBr
Constellation Error *measured at full packet channel estimation	-	-	-32	dB
Spurious Emissions (BW=100kHz)				
(a) 30-1000MHz	-	-	-36	dBm
(b) 1000-12500MHz	-	-	-30	dBm
(c) 1800-1900MHz	-	-	-47	dBm
(d) 5150-5300MHz	-	-	-47	dBm
Receiver *PER≤ 10%, LDPC enabled	Min.	Typ.	Max.	Unit
Minimum Input Level	-	-	-57	dBm

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

Normal Condition : 25deg.C, Supply voltage is typ value in "4. operating condition"
54Mbps mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11a-5GHz			
Mode	OFDM			
Channel frequency (spacing)	5180MHz to 5825MHz			
Current Consumption	min.	Typ.	Max.	Unit
(a) Tx mode		-	360	mA
(b) Rx mode		-	100	mA
Transmitter	min.	Typ.	Max.	Unit
Power Levels (Power setting : 18dBm)	15.5	18	20.5	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≥ +/-30MHz	-	-	-40	dBr
Constellation Error	-	-	-25	dB
Spurious Emissions (BW=100kHz)				
(a) 30MHz -1GHz	-	-	-36	dBm
(b) 1GHz – 26GHz	-	-	-30	dBm
Receiver *PER≤ 10%	min.	Typ.	Max.	Unit
Minimum Input Level	-	-	-65	dBm

8.6. DC/RF Characteristics for IEEE802.11n(HT20) - 5GHz

Normal Condition : 25deg.C, Supply voltage is typ value in "4. operating condition"
MCS7 mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11n-5GHz			
Mode	OFDM			
Channel frequency	5180MHz to 5825MHz			
Current Consumption	min.	Typ.	Max.	Unit
(a) Tx mode		-	310	mA
(b) Rx mode		-	100	mA
Transmitter	min.	Typ.	Max.	Unit
Power Levels(Power setting : 17dBm)	14.5	17	19.5	dBm
Spectrum Mask				
(a) at fc +/- 11MHz	-	-	-20	dBr
(b) at fc +/- 20MHz	-	-	-28	dBr
(c) at fc ≥ +/-30MHz	-	-	-40	dBr
Constellation Error	-	-	-27	dB
*measured at full packet channel estimation				
Spurious Emissions (BW=100kHz)				
(a) 30MHz -1GHz	-	-	-36	dBm
(b) 1GHz – 26GHz	-	-	-30	dBm
Receiver *PER≤ 10%, LDPC enabled	min.	Typ.	Max.	Unit
Minimum Input Level	-	-	-64	dBm

8.7. DC/RF Characteristics for IEEE802.11n(HT40MHz) - 5GHz

Normal Condition : 25deg.C, Supply voltage is typ value in "4. operating condition"
MCS7 mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11n-5GHz			
Mode	OFDM			
Channel frequency	5190MHz to 5795MHz			
Current Consumption	min.	Typ.	Max.	Unit
(b) Tx mode		-	300	mA
(b) Rx mode		-	100	mA
Transmitter	min.	Typ.	Max.	Unit
Power Levels(Power setting : 16dBm)	13.5	16	18.5	dBm
Spectrum Mask				
(a) at fc +/- 21MHz	-	-	-20	dBr
(b) at fc +/- 40MHz	-	-	-28	dBr
(c) at fc ≥ +/-60MHz	-	-	-40	dBr
Constellation Error *measured at full packet channel estimation	-	-	-27	dB
Spurious Emissions (BW=100kHz)				
(a) 30MHz -1GHz	-	-	-36	dBm
(b) 1GHz – 26GHz	-	-	-30	dBm
Receiver *PER≤ 10%, LDPC enabled	min.	Typ.	Max.	Unit
Minimum Input Level	-	-	-61	dBm

8.8. DC/RF Characteristics for IEEE802.11ac (VHT80) - 5GHz

Normal Condition : 25deg.C, Supply voltage is typ value in "4. operating condition"
MCS9 mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11ac-5GHz			
Mode	OFDM			
Channel frequency (spacing)	5210MHz to 5775MHz			
Current Consumption	min.	Typ.	Max.	Unit
(a) Tx mode		-	320	mA
(b) Rx mode		-	100	mA
Transmitter	min.	Typ.	Max.	Unit
Power Levels (Power setting : 15dBm)	12.5	15	17.5	dBm
Spectrum Mask				
(a) at fc +/- 41MHz	-	-	-20	dBr
(b) at fc +/- 80MHz	-	-	-28	dBr
(c) at fc ≥ +/- 120MHz	-	-	-40	dBr
Constellation Error *measured at full packet channel estimation	-	-	-32	dB
Spurious Emissions (BW=100kHz)				
(a) 30MHz -1GHz	-	-	-36	dBm
(b) 1GHz – 26GHz	-	-	-30	dBm
Receiver *PER≤ 10%, LDPC enabled	min.	Typ.	Max.	Unit
Minimum Input Level	-	-	-51	dBm

8.9. DC/RF Characteristics for IEEE802. 11ax (HE80MHz) - 5GHz

Normal Condition : 25deg.C, Supply voltage is typ value in "4. operating condition"
MCS11 mode unless otherwise specified.

Items	Contents			
Specification	IEEE802.11ax-5GHz			
Mode	OFDM			
Channel frequency (spacing)	5210MHz to 5775MHz			
Current Consumption	min.	Typ.	Max.	Unit
(a) Tx mode		-	370	mA
(b) Rx mode		-	120	mA
Transmitter	min.	Typ.	Max.	Unit
Power Levels (Power setting : 14dBm)	11.5	14	16.5	dBm
Spectrum Mask				
(a) at fc +/- 41MHz	-	-	-20	dBr
(b) at fc +/- 80MHz	-	-	-28	dBr
(c) at fc $\geq$ +/- 120MHz	-	-	-40	dBr
Constellation Error *measured at full packet channel estimation	-	-	-32	dB
Spurious Emissions (BW=100kHz)				
(a) 30MHz -1GHz	-	-	-36	dBm
(b) 1GHz – 26GHz	-	-	-30	dBm
Receiver *PER $\leq$ 10%, LDPC enabled	min.	Typ.	Max.	Unit
Minimum Input Level	-	-	-46	dBm

8.10. DC/RF Characteristics for Bluetooth

Normal Condition : 25deg.C, Supply voltage is typ value in "4. operating condition"

Items		Contents			
Bluetooth specification (power class)		Class1			
Channel frequency (spacing)		2402 to 2480 MHz			
Transmitter		Min.	Typ.	Max.	Unit
Output Power	BDR (PL 10)	12	-	19	dBm
	EDR (PL 10)	8.5	-	15.5	dBm
Frequency range		2400	-	2483.5	MHz
20dB bandwidth		-		1	MHz
Modulation characteristics					
(a) Modulation Δf_{1avg}		140	-	175	kHz
(b) Modulation Δf_{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/50us
EDR Relative Power		-4	-	+1	dB
EDR Carrier Frequency Stability and Modulation Accuracy					
(a) ω_i (2DHx/3DHx)		-75	-	+75	kHz
(b) $\omega_i + \omega_o$ (2DHx/3DHx)		-75	-	+75	kHz
(c) ω_o (2DHx/3DHx)		-10	-	+10	kHz
(d) RMS DEVM (2DHx)		-	-	20	%
(e) Peak DEVM (2DHx)		-	-	35	%
(f) 99% DEVM (2DHx)		-	-	30	%
(g) RMS DEVM (3DHx)		-	-	13	%
(h) Peak DEVM (3DHx)		-	-	25	%
(i) 99% DEVM (3DHx)		-	-	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
Receiver		Min.	Typ.	Max.	Unit
Sensitivity (BER $\leq$ 0.1%)		-	-	-70	dBm
Maximum Input Level (BER $\leq$ 0.1%)		-20	-	-	dBm
EDR Sensitivity (BER $\leq$ 0.007%)					
(a) 3DHx		-	-	-70	dBm

8.11. DC/RF Characteristics for Bluetooth (LE)

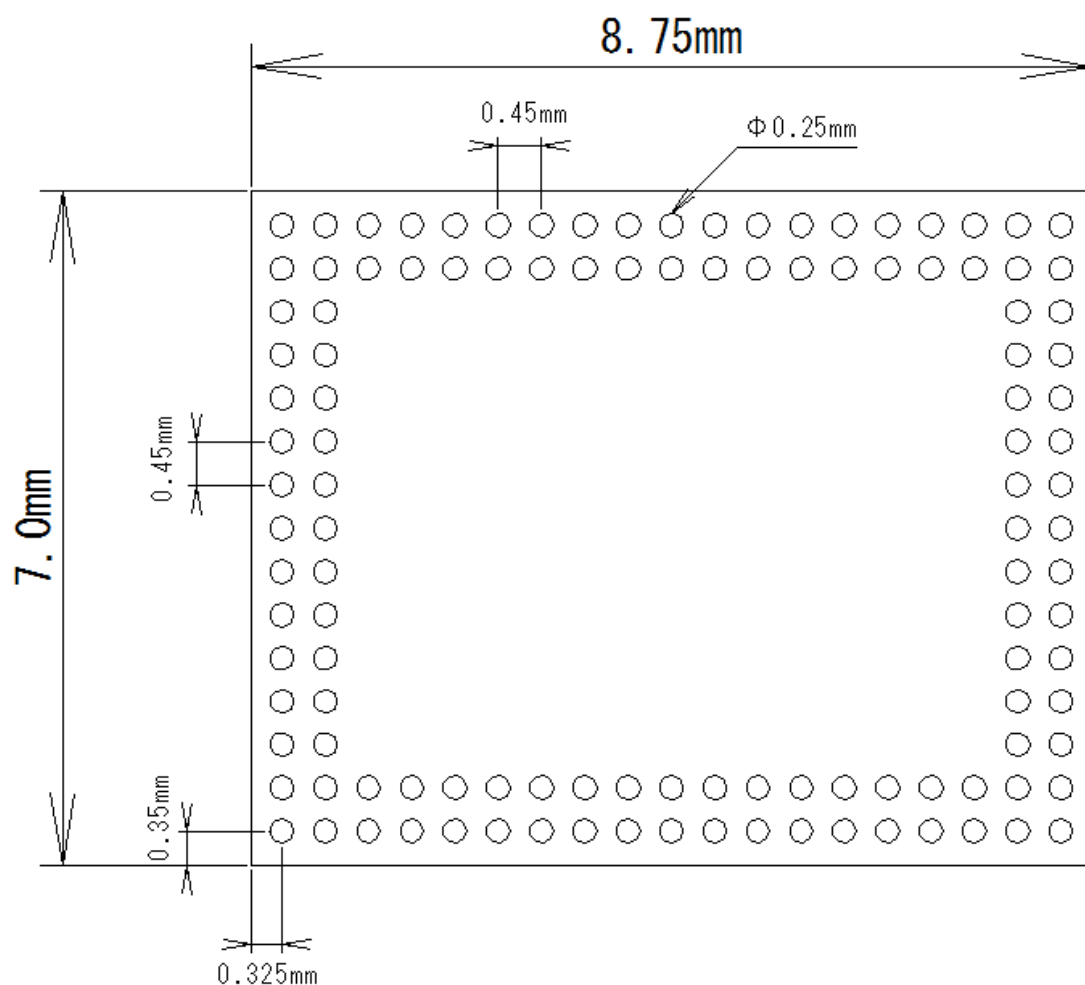
Normal Condition : 25deg.C, Supply voltage is typ value in "4. operating condition"

Items	Contents			
Bluetooth specification (power class)	LE			
Channel frequency (spacing)	2402 to 2480 MHz			
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 (PL 9)	4.5	-	11.5	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%)	-	-	-70	dBm
Maximum input signal level (PER < 30.8%)	-10	-	-	dBm
PER Report Integrity (-30dBm input)	50	-	65.4	%

Note

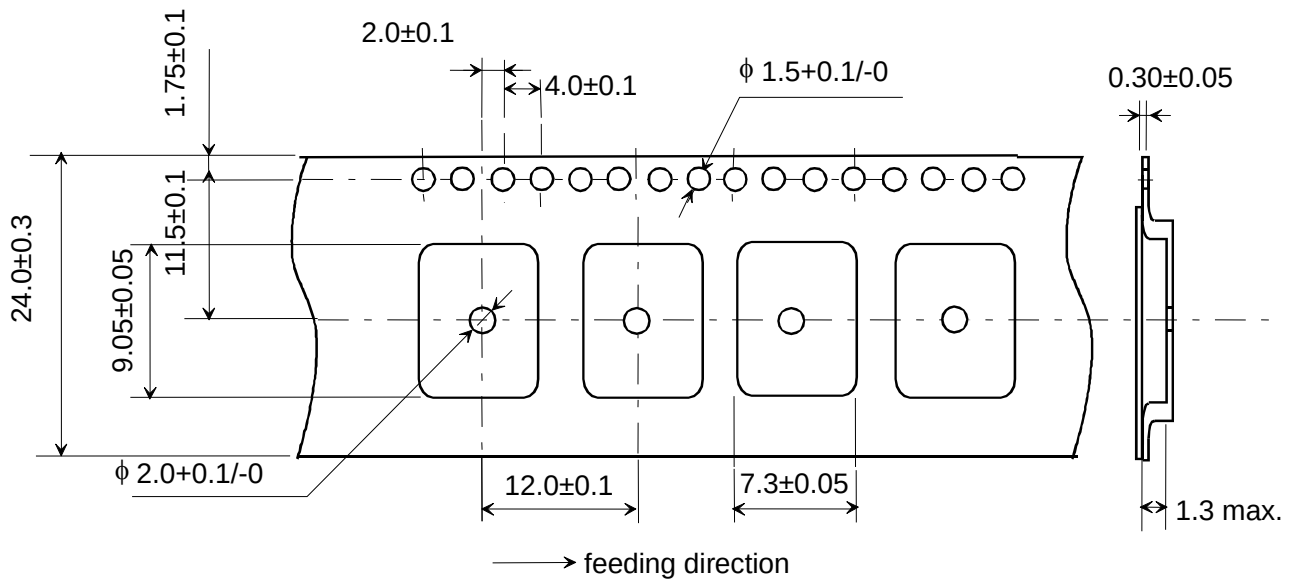
The above mentioned values have been obtained according to our own measuring methods and may very depend on the circuit, in which the component is actually incorporated. Therefore, you are kindly requested to test the performance of the component actually in your set.

9. LAND PATTERN (TOP VIEW)



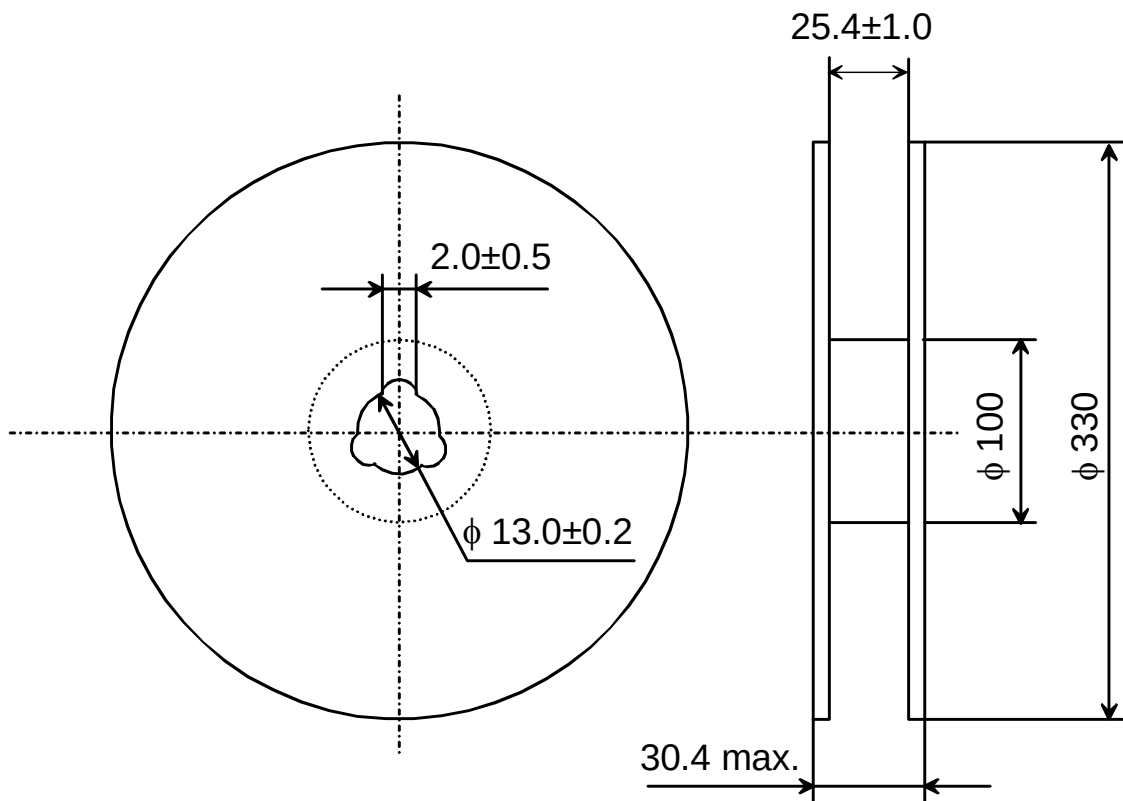
10. TAPE AND REEL PACKING

(1) Dimensions of Tape (Plastic tape)



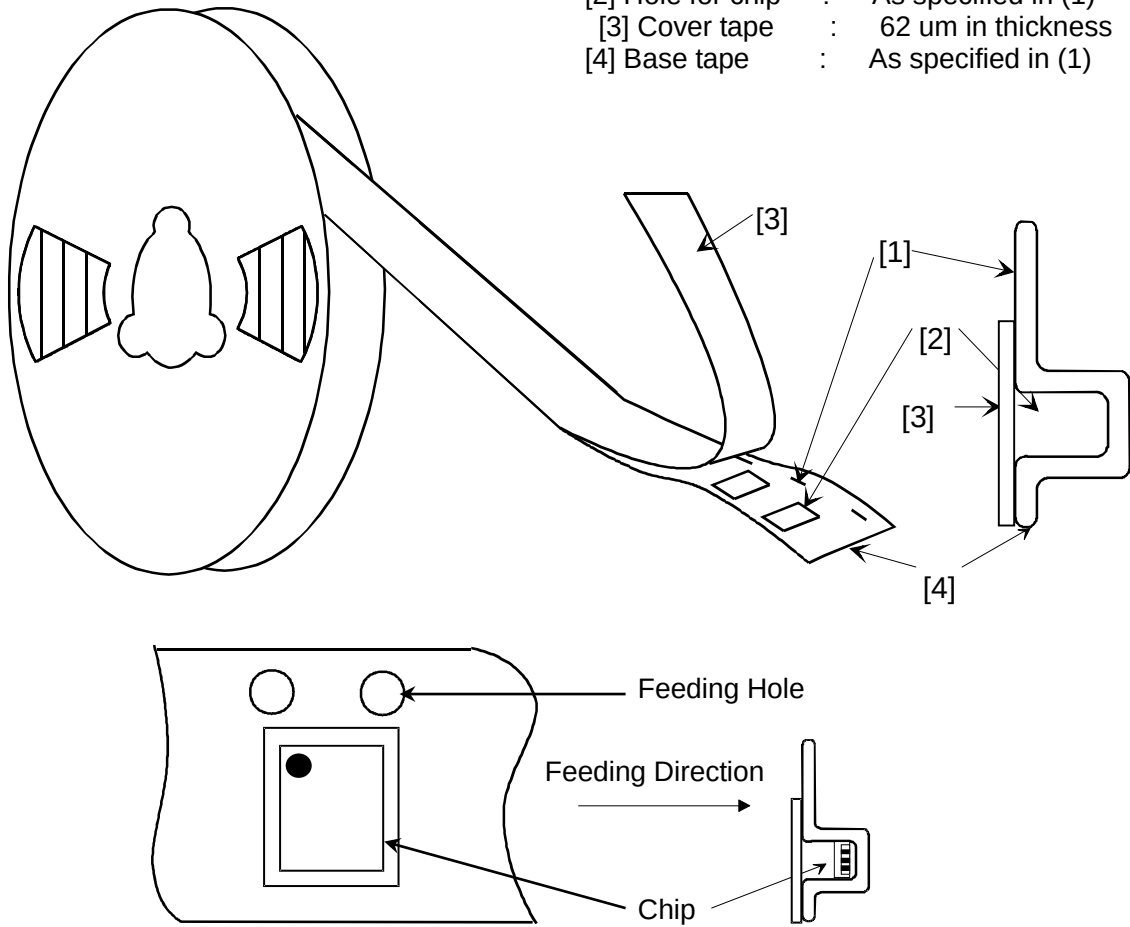
*1 Cumulative tolerance 10 pitches of the sprocket hole is ± 0.2 mm.

(2) Dimensions of Reel

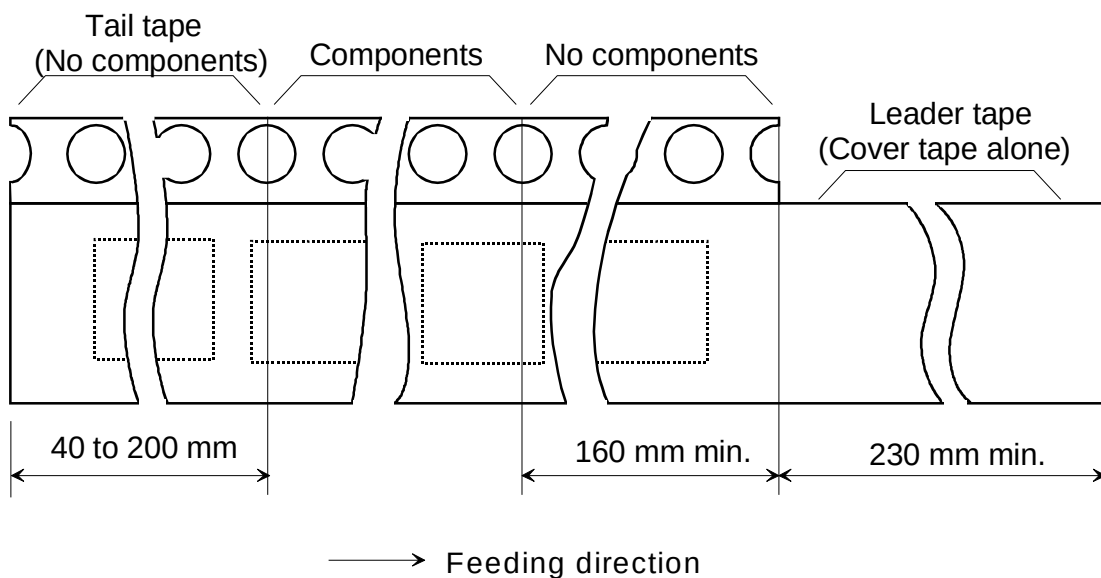


(3) Taping Diagrams

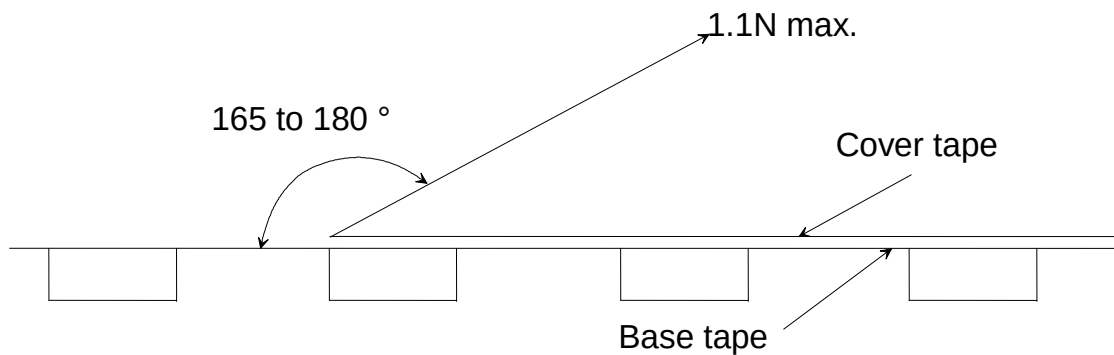
- [1] Feeding Hole : As specified in (1)
- [2] Hole for chip : As specified in (1)
- [3] Cover tape : 62 μ m in thickness
- [4] Base tape : As specified in (1)



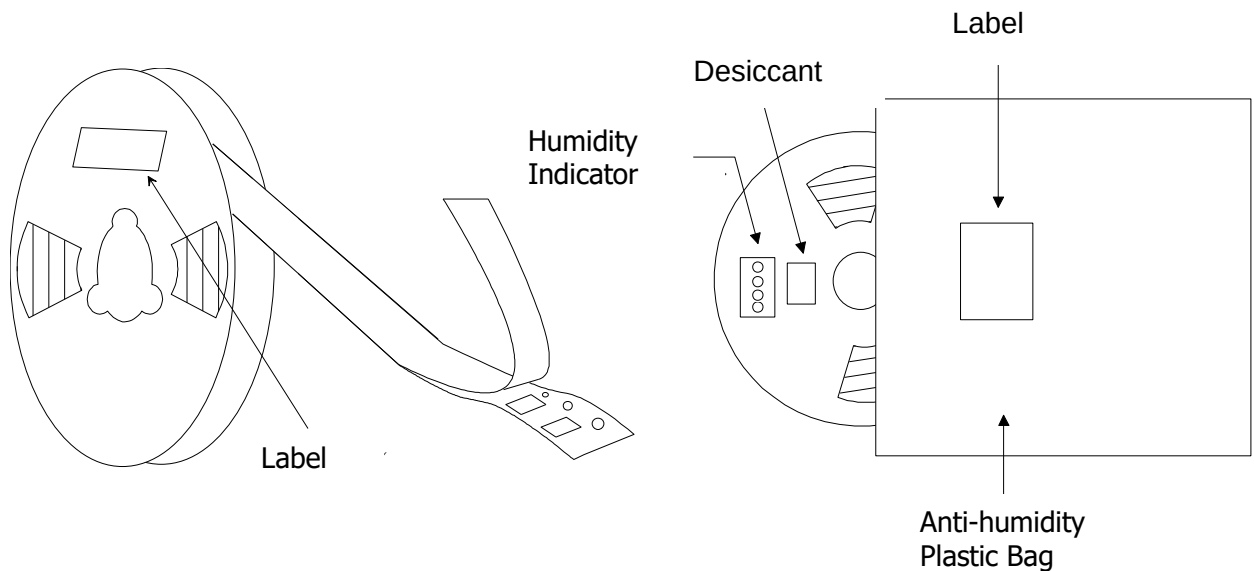
(4) Leader and Tail tape



- The tape for chips are 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 min.
- Tear off strength against pulling of cover tape: 5 N min.
- Packaging unit: 2000 pcs/ reel
- Material: Base tape: Plastic
Reel : Plastic
Cover tape, cavity tape and reel are made the anti-static processing.
- Peeling of force: 1.1N max. in the direction of peeling as shown below.



- PACKAGE (Humidity proof packing)



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

11. NOTICE**11.1. 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 (Cl₂, NH₃, SO₂, No_x, etc.).

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

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

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

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

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

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

11.2. Handling Conditions:

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

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

11.3. 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.

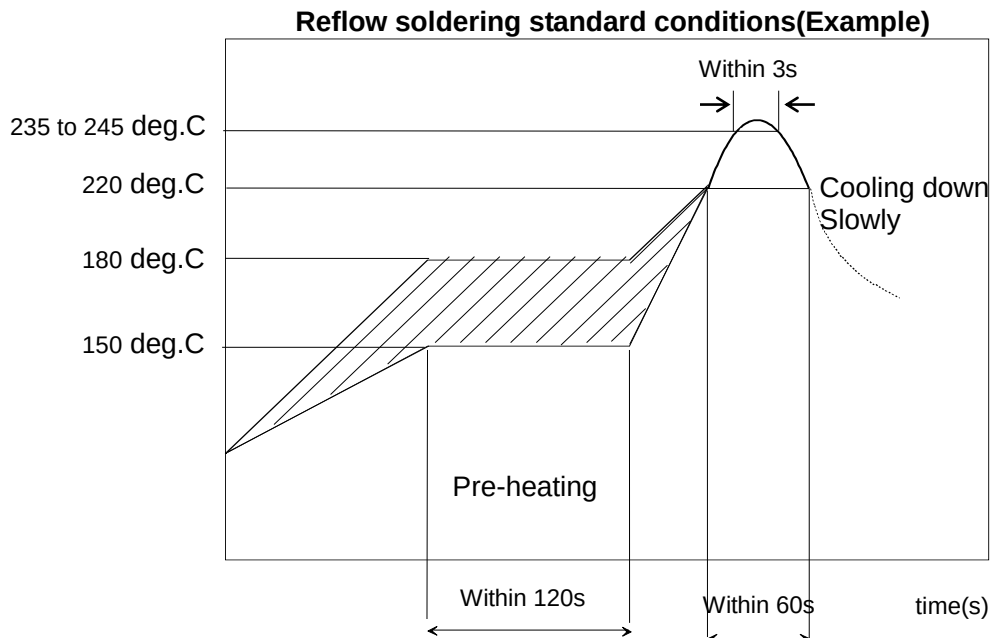
11.4. Notice for Chip Placer:

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.

11.5. Soldering Conditions:

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

When products are immersed in solvent after mounting, pay special attention to maintain the temperature difference within 100 °C. 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.

11.6. Cleaning:

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

11.7. Operational Environment Conditions:

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

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

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

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

11.8. Input Power Capacity:

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

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

12. PRECONDITION TO USE OUR PRODUCTS

PLEASE READ THIS NOTICE BEFORE USING OUR PRODUCTS.

Please make sure that your product has been evaluated and confirmed from the aspect of the fitness for the specifications of our product when our product is mounted to your product.

All the items and parameters in this product specification/datasheet/catalog have been prescribed on the premise that our product is used for the purpose, under the condition and in the environment specified in this specification. You are requested not to use our product deviating from the condition and the environment specified in this specification.

Please note that the only warranty that we provide regarding the products is its conformance to the specifications provided herein. Accordingly, we shall not be responsible for any defects in products or equipment incorporating such products, which are caused under the conditions other than those specified in this specification.

WE HEREBY DISCLAIMS ALL OTHER WARRANTIES REGARDING THE PRODUCTS, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, THAT THEY ARE DEFECT-FREE, OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS.

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 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

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- deviation or lapse in function of engineering sample,
- improper use of engineering samples.

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