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<h2>Revision Note (Specification Sheet)</h2>
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Part Name	802.11a/g/n + BT4.0 Module
Revision Note Rev.	3.2
Foxconn Part No.	T77H462.02
Lenovo Part No.	

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Total Pages	Product Rev.	Date	Sales
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1. Revision History

Date	Change Note	Rev.
2012-12-26	Initial release	1.0
2013-01-18	Modify the Pin definition to PCIeM.2_Rev0.7a and RF connector information	1.1
2013-04-08	Modify Section 3.2: Hardware Architecture Section 3.4: WLAN RF Characteristics Section 3.6: LGA Pin Definition: add note to some pins Chapter 4: add note to the mechanical drawing	2.0
2013-04-12	Modify Section 3.2: Hardware Architecture Section 3.4: WLAN RF Characteristics Section 3.6: LGA Pin Definition Section 5: Schematics reference design	2.1
2013-04-26	Add Section 3.6: signal level voltage Modify Section 3.6: UART_WAKE from platform signal Output to Signal Input	2.2
2013-06-28	Modify Section 3.4: WLAN RF Characteristics Section 3.5: BT RF Characteristics Add 3.6 interface timing Section 3.7: Pin definition Section 4: Mechanical drawing Section 5: schematics reference design Section 7: Software support Section 8: Regulatory Section 9: environment specification Section 10: package information	3.0
2013-07-02	Modify Section 3.7: Pin definition, The I/O type of UART pin 54-58	3.1
2013-07-25	Add FCC power table	3.2

2. Introduction

Project Name: 802.11abgn (2X2) + BT4.0 combo module

This documentation describes the product specification of the WLAN+BT combo Module. WLAN is Compliant with IEEE 802.11 a/b/g and 2x2 IEEE 802.11n MAC/ baseband/radio, Bluetooth is compliant with Bluetooth 4.0+HS. This module takes advantage of the high throughput and extended range of Broadcom second-generation MIMO solution. It is a confidential document of Foxconn.

* For b/g/n and a/b/g/n module, Foxconn HW/FW are the same, platform use different firmware and driver to enable or disable 5GHz

2.1 Scope

This combo Module combines WLAN, Bluetooth in one module, the WLAN is available in the 2.4GHz and 5GHz band, it is compatible with the IEEE 802.11 a/b/g standard and the 802.11n standard. It allow user to switch to different vendors' Access Points through the wireless networks and to prevent from eavesdropping. The 802.11 a/g data rate provides for 54, 48, 36, 24, 18, 12, 9, 6Mbps, 802.11b data rate provides for 11, 5.5, 2, 1 Mbps, it can also support 11n high data rate up to MCS15(HT40) with PHY data rate to 300Mbps by dual stream. Bluetooth is compliant to Core Specification version 4.0.

2.2 Function

- Single stream 802.11n support for 20MHz channels provide PHY Layer rates up to 72Mbps.
- Dual stream 802.11n support for 20MHz/40MHz channels provide PHY Layer rates up to 300Mbps.
- Bluetooth supports Class 1 and Class 2 output power.
- Provides a small form factor solution and ultra low power consumption to support low cost requirement.
- Host interface supports:
 - WLAN: SDIO
 - BT data: UART
 - BT digital audio: PCM

3. Product Specification

3.1 Hardware Characteristic

Form factor	12mmx16mmx1.5mm
Host Interface	WLAN: SDIO BT: UART for data, PCM for Audio
PCB	6-layer HDI design
RF connector	Two MHF4 RF connectors on module

3.2 Hardware Architecture

The WLAN+BT combo module is designed base on BROADCOM BCM43241 chip, the Broadcom BCM43241 is a highly integrated single chip solution for single and dual stream dual-band WLAN and BT4.0. Single and dual Antenna support, a 37.4MHz crystal is used for reference clock generation, see the block diagram as below:

3.3 Electrical Specification

Absolute Maximum Ratings

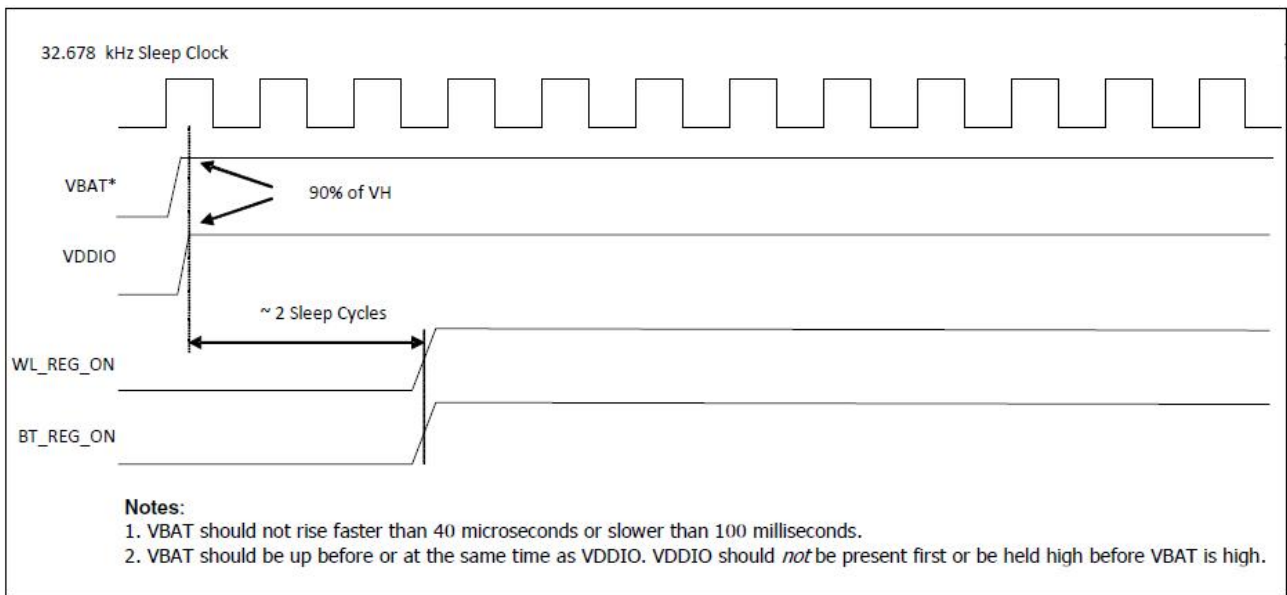
These specifications indicate levels where permanent damage to the device can occur. Functional operation is not guaranteed under these conditions. Operation at absolute maximum conditions for extended can adversely affect long-term reliability of the device.

Rating	Symbol	Value	Unit
DC supply voltage for the device	3.3V	2.3 to 4.8	V

Recommended Operating Condition

Element	Symbol	Value			Unit
		Minimum	Typical	Maximum	
DC supply voltage for the device	3.3V	3.0	3.3	3.6	V

Power-Up Sequence Timing



WLAN = ON, BT = ON

Current Consumption

TBD

3.4 WLAN RF Characteristics

3.4.1 IEEE802.11b

Parameter	Condition	Min.	Type	Max.	Units
Target Power	CH1~CH13, 1~11Mbps	14.5	16.5	17.5	dBm
Spectrum Mask	fc-22MHz<f< fc-11MHz fc+11MHz<f<fc+22MHz			-30	dBr
	f<fc-22MHz f>fc+22MHz			-50	
Transmission Spurious Emission-1	f<2.387GHz			-26	dBm
	2.387 GHz< f<2.400 GHz			-16	
	2.4835 GHz<f<2.4965 GHz			-16	
	f>2.4965 GHz			-26	
Transmission Spurious Emission-2	470~805MHz			-125	dBm/Hz
	869~894MHz			-130	
	925~960MHz			-130	
	1,805~1,880MHz			-130	
	1,930~1,990MHz			-130	
	2,110~2,170MHz			-130	
	1,574.4~1,576.4MHz			-145	
OBW	--			26	MHz
Spread Bandwidth	--	7			
RF Carrier Suppression	Data=0101 and DQPSK modulation	15			dB
Transmit power –on ramp	10% to 90% of max power			2	us
Transmit power –down ramp	90% to 10% of max power			2	us
Center Frequency Tolerance		-20		20	ppm
EVM (peak)	1Mbps			35	%
	2Mbps			35	
	5.5Mbps			35	
	11Mbps			35	
Receiver Minimum Input Level Sensitivity at Antenna	1 Mbps		-95.5	-93	dBm
	2 Mbps		-93	-90	
	5.5 Mbps		-91	-88	
	11 Mbps		-87.5	-85	
Adjacent Channel Rejection	11Mbps	35			dB
Receiver Maximum Input Level	ALL	-6			dBm

3.4.2 IEEE802.11g

Parameter		Min.	Type	Max.	Units
Target Power	CH1~CH13,6~24Mbps	13.5	15.5	16.5	dBm
	CH1~CH13, 36~54Mbps	12.5	14.5	15.5	
Spectrum Mask	+/- 11MHz			-20	dBr
	+/- 20MHz			-28	
	+/- 30MHz			-40	
Transmission Spurious Emission-1	f<2.387GHz			-26	dBm
	2.387 GHz< f<2.400 GHz			-16	
	2.4835 GHz<f<2.4965 GHz			-16	
	f>2.4965 GHz			-26	
Transmission Spurious Emission-2	470~805MHz			-125	dBm/Hz
	869~894MHz			-130	
	925~960MHz			-130	
	1,805~1,880MHz			-130	
	1,930~1,990MHz			-130	
	2,110~2,170MHz			-130	
	1,574.4~1,576.4MHz			-145	
Output Center Frequency Tolerance	Overall	-20		+20	ppm
OBW	--			26	MHz
Output Center Frequency Leakage	--			-15	dB
Output Spectrum Flatness	In-band	-2		2	dB
	Out-band	-4		2	
EVM	6 Mbps			-5	dB
	9 Mbps			-8	
	12 Mbps			-10	
	18 Mbps			-13	
	24 Mbps			-16	
	36 Mbps			-19	
	48 Mbps			-22	
	54 Mbps			-25	

Parameter		Min.	Type	Max.	Units
Receiver Minimum Input Level Sensitivity at the Antenna	6 Mbps		-91.5	-89	dBm
	9 Mbps		-89	-86	
	12 Mbps		-87.5	-85	
	18 Mbps		-85.5	-83	
	24 Mbps		-81.5	-79	
	36 Mbps		-79	-76	
	48 Mbps		-75.5	-73	
	54 Mbps		-73	-70	
Adjacent Channel Rejection	6 Mbps	16			dB
	9 Mbps	15			
	12 Mbps	13			
	18 Mbps	11			
	24 Mbps	8			
	36 Mbps	4			
	48 Mbps	0			
	54 Mbps	-1			
Receiver Maximum Input Level	ALL	-16			dBm
Receiver Spurious	<1GHz			-54	dBm
	1~10GHz			-54	
	10GHz~			-54	

3.4.3 IEEE802.11gn HT20 Single chain

Parameter		Min.	Type	Max.	Units
Target Power	CH1~CH13,MCS0~MCS4	12.5	14.5	15.5	dBm
	CH1~CH13,MCS5~MCS7	11.5	13.5	14.5	
Spectrum Mask	+/- 11MHz			-20	dBr
	+/- 20MHz			-28	
	+/- 30MHz			-45	
Transmission Spurious Emission-1	f<2.387GHz			-26	dBm
	2.387 GHz< f<2.400 GHz			-16	
	2.4835 GHz<f<2.4965 GHz			-16	
	f>2.4965 GHz			-26	
Transmission Spurious Emission-2	470~805MHz			-125	dBm/ Hz
	869~894MHz			-130	
	925~960MHz			-130	
	1,805~1,880MHz			-130	
	1,930~1,990MHz			-130	
	2,110~2,170MHz			-130	
	1,574.4~1,576.4MHz			-145	
Output Center Frequency Tolerance	Overall	-20		+20	ppm
OBW	--			26	MHz
Output Center Frequency Leakage	--			-20	dB
Output Spectrum Flatness	Inband	-2		2	dB
	Outband	-4		2	
EVM	MCS0 Mbps			-5	dB
	MCS1 Mbps			-10	
	MCS2 Mbps			-13	
	MCS3 Mbps			-16	
	MCS4 Mbps			-19	
	MCS5 Mbps			-22	
	MCS6 Mbps			-25	
	MCS7 Mbps			-28	

Parameter		Min.	Type	Max.	Units
Receiver Minimum Input Level Sensitivity at the Antenna	MCS0 Mbps		-89.5	-87	dBm
	MCS1 Mbps		-86.5	-84	
	MCS2 Mbps		-84	-81	
	MCS3 Mbps		-80.5	-78	
	MCS4 Mbps		-77.5	-75	
	MCS5 Mbps		-73	70	
	MCS6 Mbps		-72	-69	
	MCS7 Mbps		-71	-68	
Adjacent Channel Rejection	MCS0 Mbps	16			dB
	MCS1 Mbps	13			
	MCS2 Mbps	11			
	MCS3 Mbps	8			
	MCS4 Mbps	4			
	MCS5 Mbps	0			
	MCS6 Mbps	-1			
	MCS7 Mbps	-2			
Receiver Maximum Input Level	ALL	-16			dBm
Receiver Spurious	<1GHz			-54	dBm
	1~10GHz			-54	
	10GHz~			-54	

3.4.4 IEEE802.11a

Parameter		Min.	Type	Max.	Units
Target Power	B1,B2,B3,B4,6~24Mbps	13.5	15.5	16.5	dBm
	B1,B2,B3,B4, 36~54Mbps	12.5	14.5	15.5	
Spectrum Mask	+/- 11MHz			-20	dBr
	+/- 20MHz			-28	
	+/- 30MHz			-40	
Transmission Spurious Emission-1	f<2.387GHz			-26	dBm
	2.387 GHz< f<2.400 GHz			-16	
	2.4835 GHz<f<2.4965 GHz			-16	
	f>2.4965 GHz			-26	
Transmission Spurious Emission-2	470~805MHz			-125	dBm/Hz
	869~894MHz			-130	
	925~960MHz			-130	
	1,805~1,880MHz			-130	
	1,930~1,990MHz			-130	
	2,110~2,170MHz			-130	
	1,574.4~1,576.4MHz			-145	
Output Center Frequency Tolerance	Overall	-20		+20	ppm
OBW	--			26	MHz
Output Center Frequency Leakage	--			-15	dB
Output Spectrum Flatness	In-band	-2		2	dB
	Out-band	-4		2	
EVM	6 Mbps			-5	dB
	9 Mbps			-8	
	12 Mbps			-10	
	18 Mbps			-13	
	24 Mbps			-16	
	36 Mbps			-19	
	48 Mbps			-22	
	54 Mbps			-25	

Parameter		Min.	Type	Max.	Units
Receiver Minimum Input Level Sensitivity at the Antenna	6 Mbps		-92	-89	dBm
	9 Mbps		-88.5	-86	
	12 Mbps		-86.5	-84	
	18 Mbps		-84.5	-82	
	24 Mbps		-81.5	-79	
	36 Mbps		-78.5	-76	
	48 Mbps		-74.5	-72	
	54 Mbps		-73	-70	
Adjacent Channel Rejection	6 Mbps	16			dB
	9 Mbps	15			
	12 Mbps	13			
	18 Mbps	11			
	24 Mbps	8			
	36 Mbps	4			
	48 Mbps	0			
	54 Mbps	-1			
Receiver Maximum Input Level	ALL	-26			dBm
Receiver Spurious	<1GHz			-54	dBm
	1~10GHz			-54	
	10GHz~			-54	

B1:5180~5240MHz; B2: 5260~5320MHz; B3:5500~5700MHz; B4:5745~5825MHz

3.4.5 IEEE802.11an HT20 Single chain

Parameter		Min.	Type	Max.	Units
Target Power	B1,B2,B3,B4;MCS0~MCS4	12.5	14.5	15.5	dBm
	B1,B2,B3,B4;MCS5~MCS7	11.5	13.5	14.5	
Spectrum Mask	+/- 11MHz			-20	dBr
	+/- 20MHz			-28	
	+/- 30MHz			-45	
Transmission Spurious Emission-1	f<2.387GHz			-26	dBm
	2.387 GHz< f<2.400 GHz			-16	
	2.4835 GHz<f<2.4965 GHz			-16	
	f>2.4965 GHz			-26	
Transmission Spurious Emission-2	470~805MHz			-125	dBm/ Hz
	869~894MHz			-130	
	925~960MHz			-130	
	1,805~1,880MHz			-130	
	1,930~1,990MHz			-130	
	2,110~2,170MHz			-130	
	1,574.4~1,576.4MHz			-145	
Output Center Frequency Tolerance	Overall	-20		+20	ppm
OBW	--			26	MHz
Output Center Frequency Leakage	--			-20	dB
Output Spectrum Flatness	In-band	-2		2	dB
	Out-band	-4		2	
EVM	MCS0 Mbps			-5	dB
	MCS1 Mbps			-10	
	MCS2 Mbps			-13	
	MCS3 Mbps			-16	
	MCS4 Mbps			-19	
	MCS5 Mbps			-22	
	MCS6 Mbps			-25	
	MCS7 Mbps			-28	

Parameter		Min.	Type	Max.	Units
Receiver Minimum Input Level Sensitivity at the Antenna	MCS0 Mbps		-90	-87	dBm
	MCS1 Mbps		-87.5	-85	
	MCS2 Mbps		-84.5	-82	
	MCS3 Mbps		-81.5	-79	
	MCS4 Mbps		-78.5	-76	
	MCS5 Mbps		-74	-71	
	MCS6 Mbps		-72.5	-70	
	MCS7 Mbps		-71	-68	
Adjacent Channel Rejection	MCS0 Mbps	16			dB
	MCS1 Mbps	13			
	MCS2 Mbps	11			
	MCS3 Mbps	8			
	MCS4 Mbps	4			
	MCS5 Mbps	0			
	MCS6 Mbps	-1			
	MCS7 Mbps	-2			
Receiver Maximum Input Level	ALL	-26			dBm
Receiver Spurious	<1GHz			-54	dBm
	1~10GHz			-54	
	10GHz~			-54	

B1:5180~5240MHz; B2:5260~5320MHz; B3:5500~5700MHz; B4:5745~5825MHz

3.4.6 IEEE802.11an HT40 Single chain

Parameter		Min.	Type	Max.	Units
Target Power	B1,B2,B3,B4;MCS0~MCS4	12.5	14.5	15.5	dBm
	B1,B2,B3,B4;MCS5~MCS7	11.5	13.5	14.5	
Spectrum Mask	+/- 11MHz			-20	dBr
	+/- 20MHz			-28	
	+/- 30MHz			-45	
Transmission Spurious Emission-1	f<2.387GHz			-26	dBm
	2.387 GHz< f<2.400 GHz			-16	
	2.4835 GHz<f<2.4965 GHz			-16	
	f>2.4965 GHz			-26	
Transmission Spurious Emission-2	470~805MHz			-125	dBm/ Hz
	869~894MHz			-130	
	925~960MHz			-130	
	1,805~1,880MHz			-130	
	1,930~1,990MHz			-130	
	2,110~2,170MHz			-130	
	1,574.4~1,576.4MHz			-145	
Output Center Frequency Tolerance	Overall	-20		+20	ppm
OBW	--			26	MHz
Output Center Frequency Leakage	--			-20	dB
Output Spectrum Flatness	In-band	-2		2	dB
	Out-band	-4		2	
EVM	MCS0 Mbps			-5	dB
	MCS1 Mbps			-10	
	MCS2 Mbps			-13	
	MCS3 Mbps			-16	
	MCS4 Mbps			-19	
	MCS5 Mbps			-22	
	MCS6 Mbps			-25	
	MCS7 Mbps			-28	

Parameter		Min.	Type	Max.	Units
Receiver Minimum Input Level Sensitivity at the Antenna	MCS0 Mbps		-87.5	-85	dBm
	MCS1 Mbps		-84.5	-82	
	MCS2 Mbps		-82.5	-80	
	MCS3 Mbps		-78.5	-76	
	MCS4 Mbps		-75.5	-73	
	MCS5 Mbps		-71	-68	
	MCS6 Mbps		-69.5	-67	
	MCS7 Mbps		-68	-65	
Adjacent Channel Rejection	MCS0 Mbps				dB
	MCS1 Mbps				
	MCS2 Mbps				
	MCS3 Mbps				
	MCS4 Mbps				
	MCS5 Mbps				
	MCS6 Mbps				
	MCS7 Mbps				
Receiver Maximum Input Level	ALL	-26			dBm
Receiver Spurious	<1GHz			-54	dBm
	1~10GHz			-54	
	10GHz~			-54	

B1:5190~5230MHz; B2:5270~5310MHz; B3:5510~5670MHz; B4:5755~5795MHz

3.5 Bluetooth RF Specifications

- Bluetooth Core Specification version 4.0:
- Host interface: UART, baud rates up to 4Mbps
- Support all Bluetooth 4.0+HS packet types.
- Operating frequency range: 2400MHz ~2483.5MHz
- Modulation type:
 - Basic rate 1Mbps: GFSK,
 - Enhanced data rate 2Mbps: QPSK
 - Enhanced data rate 3Mbps: 8PSK

Parameter	Condition	Specification			Units
		Min	Typ	Max	
Basic Data Rate – Transmit Performance					
RF Transmit Power at the Antenna		+5	8	+11	dBm
Tx Output Spectrum	-20 dB Bandwidth			1	MHz
	Frequency range			83.5	
Initial Carrier Frequency Tolerance		≤ ±75			KHz
Carrier Frequency Drift	DH1/3/5 Drift rate	≤ ±20			kHz/50 μs
	DH1	<±20			KHz
	DH3	≤ ±40			
	DH5	<±40			
Modulation Characteristics	F1avg	140<Δf1avg<175			kHz
	F2max	≥ 115			
	F2avg/F1avg	80			%
Adjacent Channel Transmit Power	+/-500KHz		-27		dBc
	M-N =2			-20	dBm
	M-N ≥3			-40	
Transmission Spurious Emission-1	f<2.387GHz			-26	dBm
	2.387 GHz< f<2.400 GHz			-16	
	2.4835 GHz<f<2.4965 GHz			-16	
	f>2.4965 GHz			-26	
Transmission Spurious Emission-2	470~805MHz			-130	dBm/ Hz
	869~894MHz			-135	
	925~960MHz			-135	
	1,805~1,880MHz			-135	
	1,930~1,990MHz			-135	
	2,110~2,170MHz			-135	
	1,574.4~1,576.4MHz			-150	

Parameter	Condition	Specification			Units
		Min	Typ	Max	
Enhanced Data Rate – Transmit Performance					
RF Transmit Power	$\pi/4$ DQPSK	+3	6	+9	dBm
	8DPSK	+3	6	+9	
Relative Transmit Power	P _{dpsk}	$(P_{GFSK}-4\text{ dB}) < P_{DPSK} < (P_{GFSK}+1\text{ dB})$			
Carrier Frequency Stability	i	-75		75	kHz
	0	-10		10	
	$i + \omega 0$	-75		75	
Modulation Accuracy – RMS DEVM	$\pi/4$ DQPSK	≤ 20			%
	8DPSK	≤ 13			
Modulation Accuracy – Peak DEVM	$\pi/4$ DQPSK	≤ 35			
	8DPSK	≤ 25			
Modulation Accuracy – 99% DEVM	$\pi/4$ DQPSK	≤ 30			
	8DPSK	≤ 20			
In-band Spurious Emissions	$f > f_0 + 3\text{ MHz}$	≤ -40			dBm
	$f < f_0 - 3\text{ MHz}$	≤ -40			
	$f = f_0 - 3\text{ MHz}$	≤ -40			
	$f = f_0 - 2\text{ MHz}$	≤ -20			dBr
	$f = f_0 - 1\text{ MHz}$	≤ -26			
	$f = f_0 + 1\text{ MHz}$	≤ -26			
	$f = f_0 + 2\text{ MHz}$	≤ -20			dBm
	$f = f_0 + 3\text{ MHz}$	≤ -40			

Parameter	Condition	Specification			Units
		Min	Typ	Max	
EDR Differential Phase Coding					
Transmission Spurious Emission-1	f<2.387GHz			-26	dBm
	2.387 GHz< f<2.400 GHz			-16	
	2.4835 GHz<f<2.4965 GHz			-16	
	f>2.4965 GHz			-26	
Transmission Spurious Emission-2	470~805MHz			-130	dBm/ Hz
	869~894MHz			-135	
	925~960MHz			-135	
	1,805~1,880MHz			-135	
	1,930~1,990MHz			-135	
	2,110~2,170MHz			-135	
	1,574.4~1,576.4MHz			-150	
Basic Data Rate – Receiver Performance at the Antenna					
Sensitivity (DH1) at 0.1% BER	Nominal		-90	-88	dBm
C/I Performance at BER≤0.1%	Co-ch interface C/I _{co}	<11			dB
	Adjacent Chanel Sensitivity C/I f=f ₀ ±1 MHz	< 0			
	Adjacent Chanel Sensitivity C/I f=f ₀ ±2 MHz	<-30			
	Adjacent Chanel Sensitivity C/I f≥f ₀ ±3 MHz	< -40			
	Image Ch interference C/I _{image}	< -9			
	Image Ch interference C/I _{image} 1MHz	< -20			
Blocking Performance at BER≤0.1%	30MHz~2GHz	-10			dBm
	2GHz~2.4GHz	-27			
	2.5GHz~3GHz	-27			
	3GHz~12.75GHz	-10			
Intermodulation Performance at BER≤0.1%	Carrier Level:-64dBm	-39			dBm
Max input Level		-20			dBm
Receiver Spurious	<1GHz			-54	dBm
	1~10GHz			-54	
	10GHz~			-54	

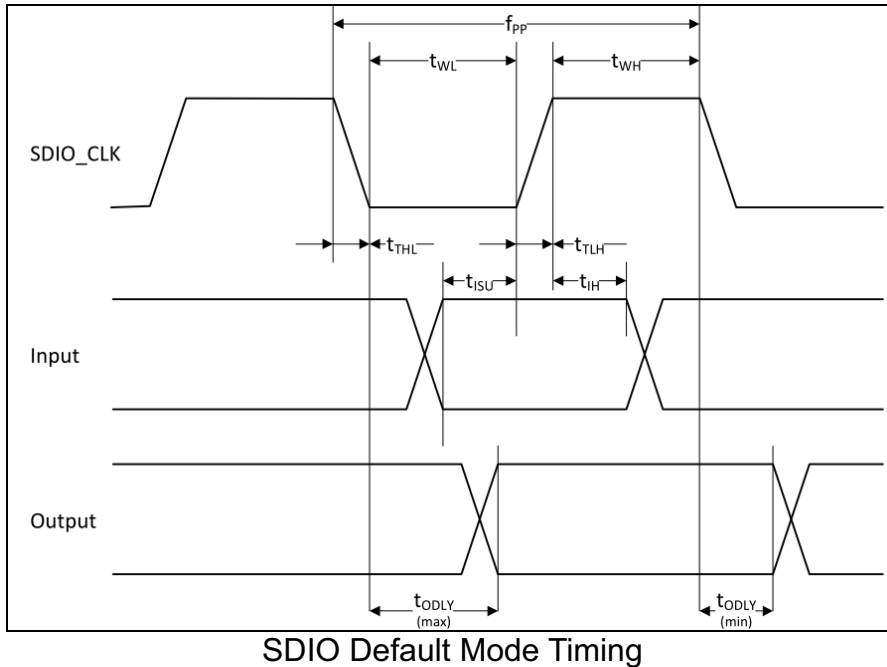
Parameter	Condition	Specification			Units	
		Min	Typ	Max		
Enhanced Data Rate – Receiver Performance at the Antenna						
Sensitivity at BER≤0.01%	Nominal	π/4 DQPSK(ch0~78)		-92	-90	dBm
		8DPSK(ch0~78)		-86	-84	
Max input Level		π/4 DQPSK	-20			dBm
		8DPSK	-20			
C/I Performance at BER≤0.1%(π/4 DQPSK)	Co-ch interface C/I _{co}		<13			dB
	Adjacent Chanel Sensitivity C/I f=f ₀ ±1 MHz		< 0			
	Adjacent Chanel Sensitivity C/I f=f ₀ ±2 MHz		<-30			
	Adjacent Chanel Sensitivity C/I f≥f ₀ ±3 MHz		< -40			
	Image Ch interference C/I _{image}		< -7			
	Image Ch interference C/I _{image} 1MHz		< -20			
C/I Performance at BER≤0.1%(8DPSK)	Co-ch interface C/I _{co}		<21			dB
	Adjacent Chanel Sensitivity C/I f=f ₀ ±1 MHz		< 5			
	Adjacent Chanel Sensitivity C/I f=f ₀ ±2 MHz		<-25			
	Adjacent Chanel Sensitivity C/I f≥f ₀ ±3 MHz		< -33			
	Image Ch interference C/I _{image}		< -0			
	Image Ch interference C/I _{image} 1MHz		< -13			
Receiver Spurious	<1GHz				-54	dBm
	1~10GHz				-54	
	10GHz~				-54	

BLE RF specification:

Parameter		Condition	Specification			Units
			Min	Typ	Max	
BLE RF specification:						
Sensitivity at BER≤0.01%	Nominal	GFSK 0.1%, 1M		-91.5	-89.5	dBm
RF Transmit Power		GFSK	2	5	8	dBm
Mod char:delta f1 average			225		275	kHz
Mod char:delta f2 max			99.9			%
Receiver Spurious		<1GHz			-54	dBm
		1~10GHz			-54	
		10GHz~			-54	
Transmission Spurious Emission-1		f<2.387GHz			-26	dBm
		2.387 GHz< f<2.400 GHz			-16	
		2.4835 GHz<f<2.4965 GHz			-16	
		f>2.4965 GHz			-26	
Transmission Spurious Emission-2		470~805MHz			-130	dBm/ Hz
		869~894MHz			-135	
		925~960MHz			-135	
		1,805~1,880MHz			-135	
		1,930~1,990MHz			-135	
		2,110~2,170MHz			-135	
		1,574.4~1,576.4MHz			-150	

3.6 Interface timing

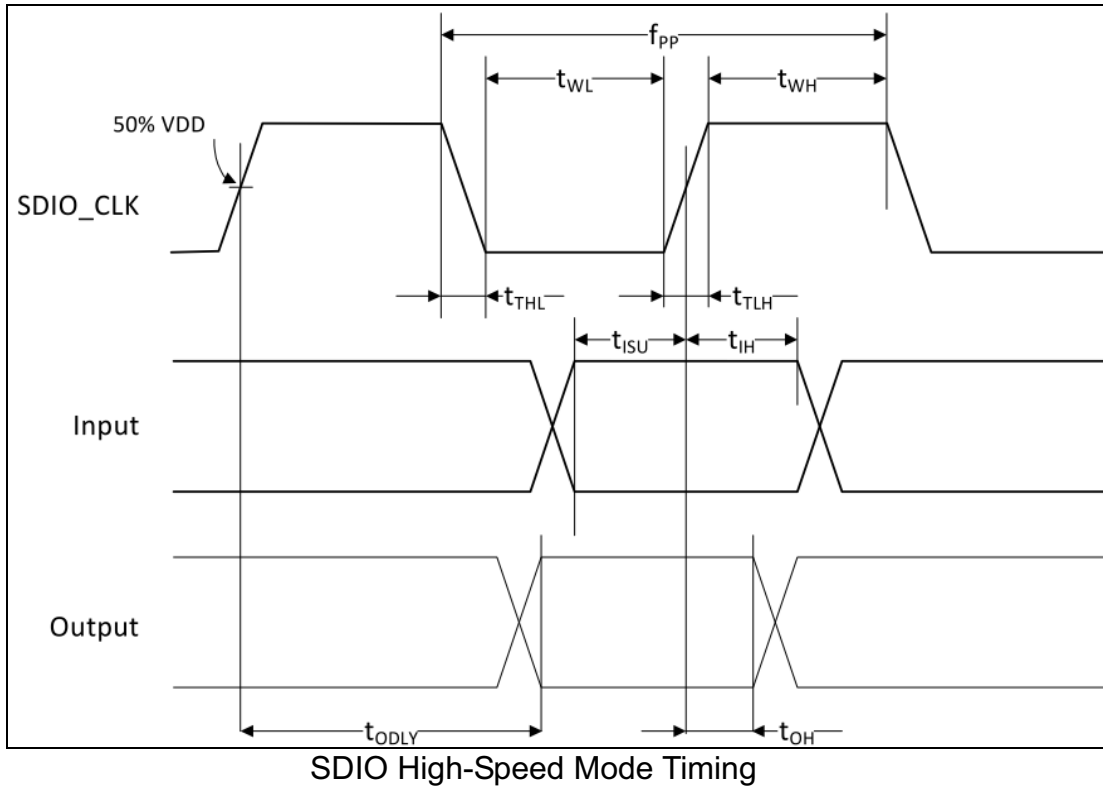
3.6.1 SDIO Interface timing



SDIO Bus Timing Parameters (Default Mode)

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

- a. Timing is based on $CL \leq 40pF$ load on CMD and Data.
- b. $\min(V_{IH}) = 0.7 \times V_{DDIO}$ and $\max(V_{IL}) = 0.2 \times V_{DDIO}$.



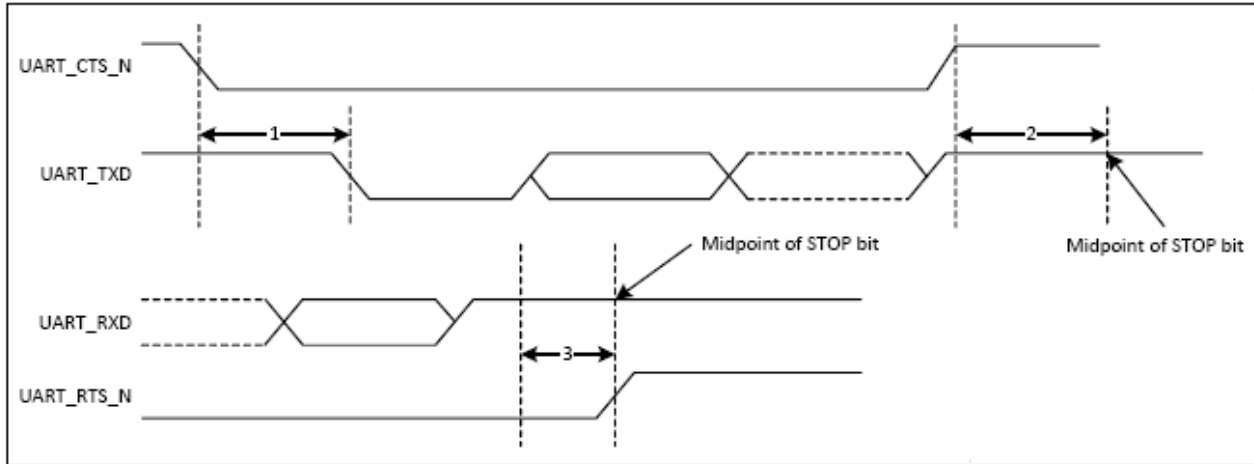
SDIO Bus Timing Parameters (High-Speed Mode)

Parameter	Symbol	Minimum	Typical	Maximum	Unit
SDIO CLK (All values are referred to minimum VIH and maximum VIL^b)					
Frequency – Data Transfer mode	fPP	0	-	50	MHz
Frequency – Identification mode	fOD	0	-	400	kHz
Clock low time	tWL	7	-	-	ns
Clock high time	tWH	7	-	-	ns
Clock rise time	tTLH	-	-	3	ns
Clock low time	tTHL	-	-	3	ns
Inputs: CMD DAT (referenced to CLK)					
Input setup time	tISU	6	-	-	ns
Input hold time	tIH	2	-	-	ns
Outputs: CMD, DAT (referenced to CLK)					
Output delay time – Data Transfer mode	tODLY	-	-	14	ns
Output hold time	tOH	2.5	-	-	ns
Total system capacitance (each line)	CL	-	-	40	pF

a. Timing is based on $CL \leq 40pF$ load on CMD and Data.
 b. $\min(V_{ih}) = 0.7 \times VDDIO$ and $\max(V_{il}) = 0.2 \times VDDIO$.

3.6.2 UART Interface timing

UART Timing



UART Timing Specifications

Ref No.	Characteristics	Minimum	Typical	Maximum	Unit
1	Delay time, UART_CTS_N low to UART_TXD valid	–	–	1.5	Bit periods
2	Setup time, UART_CTS_N high before midpoint of stop bit	–	–	0.5	Bit periods
3	Delay time, midpoint of stop bit to UART_RTS_N high	–	–	0.5	Bit periods

3.7 LGA Pin Definition

- Module pin-out definition:

GND (G1)		GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND (G4)		
1	UIM_Power_In/GPIO1																					GND	76	
2	UIM_Power_Out																						GND	75
3	UIM_SWP																						GND	74
4	3.3V																						3.3V	73
5	3.3V																						3.3V	72
6	GND																						GND	71
7	Reserved																						USB_D+	70
8	ALERT																						USB_D-	69
9	I2C CLK																						GND	68
10	I2C DATA																						Reserved	67
11	COEX1																						Reserved	66
12	COEX2																						LED#1	65
13	COEX3																						LED#2	64
14	SUSCLK/GNSS0																						W_DISABLE#2	63
15	TX Blanking/GNSS1																						GND	62
16	Reserved																						PCMCLK	61
17	GND																						PCMOUT	60
18	Reserved																						BT PCMIN	59
19	Reserved																						PCMF1	58
20	GND																						UART RTS	57
21	Reserved																						UART Rx	56
22	Reserved																						UART Tx	55
23	GND																						UART CTS	54
24	Reserved																						UART WAKE	53
25	Reserved																						SDIO CLK	52
26	GND																						SDIO CMD	51
27	SUSCLK(32kHz)																						SDIO DAT0	50
28	W_DISABLE#1																						SDIO DAT1	49
	GND (G2)	PEWake#	CLKREQ#	PERST#	GND	REFCLKNO	REFCLKPO	GND	PETn0	PETp0	GND	PERn0	PERp0	GND	Reserved	Reserved	Reserved	SDIO Reset	SDIO Wake	SDIO DAT3	SDIO DAT2	GND (G3)		
		29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48			

Top View

- Platform pin-out definition:

GND (G1)		GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND (G4)	
1	UIM_Power_In/GPIO1																						GND	76
2	UIM_Power_Out																						GND	75
3	UIM_SWP																						GND	74
4	3.3V																						3.3V	73
5	3.3V																						3.3V	72
6	GND																						GND	71
7	Reserved																						USB_D+	70
8	ALERT#																						USB_D-	69
9	I2C CLK																						GND	68
10	I2C DATA																						Reserved	67
11	COEX1																						Reserved	66
12	COEX2																						LED#1	65
13	COEX3																						LED#2	64
14	SUSCLK/GNSS0																						W_DISABLE#2	63
15	TX Blanking/GNSS1																						GND	62
16	Reserved																						PCMCLK	61
17	GND																						BT PCMIN	60
18	Reserved																						PCMOUT	59
19	Reserved																						PCMF1	58
20	GND																						UART CTS	57
21	Reserved																						UART Tx	56
22	Reserved																						UART Rx	55
23	GND																						UART RTS	54
24	Reserved																						UART WAKE	53
25	Reserved																						SDIO CLK	52
26	GND																						SDIO CMD	51
27	SUSCLK(32kHz)																						SDIO DAT0	50
28	W_DISABLE#1																						SDIO DAT1	49
	GND (G2)	PEWake#	CLKREQ#	PERST#	GND	REFCLKNO	REFCLKPO	GND	PERn0	PERp0	GND	PETn0	PETp0	GND	Vendor Defined	Vendor Defined	Vendor Defined	SDIO Reset	SDIO Wake	SDIO DAT3	SDIO DAT2	GND (G3)		
		29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48			

Top View

- Pin definition (module point of view):

Pin No.	Pin Name	Type	Description	Voltage
1-3	UIM_power_in/GPIO1 UIM_power_out UIM_SWP	I/O	No connection	-
4-5	3.3V	Power	Power voltage input pin	3.3V
6	GND	GND	Ground	-
7	Reserved	I/O	Reserved LGA pin	-
8*(a)	ALERT	-	No connection	-
9*(a)	I2C_CLK	-	No connection	-
10*(a)	I2C_DATA	-	No connection	-
11*(a)	COEX1	-	No connection	-
12*(a)	COEX2	-	No connection	-
13*(a)	COEX3	-	No connection	-
14-15	SYSClk/GNSS0 TX_Blanking/GNSS1	-	Reserved LGA pin, No connection	-
16	Reserved	I/O	Reserved LGA pin, No connection	-
17	GND	GND	Ground	-
18-19	Reserved	-	Reserved LGA pin, No connection	-
20	GND	GND	Ground	-
21-22	Reserved	-	Reserved LGA pin, No connection	-
23	GND	GND	Ground	-
24-25	Reserved	-	Reserved LGA pin, No connection	-
26	GND	GND	Ground	-
27	SUSCLK (32KHz)	I	32.768 kHz clock supply input that is provided by PCH to reduce power and cost for the module. SUSCLK will have a duty cycle that can be as low as 30% or as high as 70%. 200ppm.	3.3V
28	W_DISABLE#1	I	No connection	-
29*(a)	PEWAKE#	-	No connection	-
30*(a)	CLKREQ#	-	No connection	-
31*(a)	PERST#	-	No connection	-
32	GND	GND	Ground	-
33*(a)	REFCLKN0	-	No connection	-
34*(a)	REFCLKP0	-	No connection	-
35	GND	GND	Ground	-
36*(a)	PETn0	-	No connection	-

37*(a)	PETp0			
38	GND	GND	Ground	
39*(a)	PERn0		No connection	
40*(a)	PERp0			
41	GND	GND	Ground	
42-44	Reserved	-	Reserved LGA pin, No connection	
45	SDIO Reset	I	SDIO sideband GPIO pin to enable/disable (reset) the WiFi function. Platform firmware is required to assert/de-assert this pin on every boot (warm and cold). The WiFi device may use 0.5 to 1 mW in reset, Active Low	1.8V
46	SDIO Wake	O	SDIO Host Wake. Note in band SDIO wake is not used for non-active modes, Active Low. Require pull up on the host side (recommended 15K to 100K)	1.8V
47	SDIO DATA3	I/O	4 lines for SDIO data exchange	1.8V
48	SDIO DATA2	I/O	4 lines for SDIO data exchange	1.8V
49	SDIO DATA1	I/O	4 lines for SDIO data exchange	1.8V
50	SDIO DATA0	I/O	4 lines for SDIO data exchange	1.8V
51	SDIO CMD	I/O	SDIO Command Interface	1.8V
52	SDIO CLK	I	SDIO 3.0 Clock	1.8V
53	UART WAKE	O	Bluetooth host Wake. Active Low	3.3V
54	UART CTS	I	UART Clear To Send, Active low, connected to UART RTS on the platform.	1.8V
55	UART TX	O	UART Transmit Data, connected to UART RX on the platform.	1.8V
56	UART RX	I	UART Receive Data, connected to UART TX on the platform.	1.8V
58	UART RTS	O	UART Request To Send, Active low, connected to UART CTS on the platform.	1.8V
58	PCM FR1	I/O	PCM Synchronous data sync/ I2S Word Select	1.8V
59	PCMIN	I	PCM Synchronous data input/ I2S Serial Data IN	1.8V
60	PCMOUT	O	PCM Synchronous data output/ I2S Serial Data OUT	1.8V
61	PCMCLK	I/O	PCM Clock/ I2S Continuous Serial Clock (SCK)	1.8V
62	GND	GND	Ground	
63	W_DISABLE#2	I	Active low, debounced signal when applied by the platform it will disable BT radio operation	3.3V
64	LED#2	-	No connection	
65	LED#1	-	No connection	
66-67	Reserved	-	Reserved LGA pin	
68	GND	GND	Ground	
69*(a)	USB_D-		No connection	
70*(a)	USB_D+			

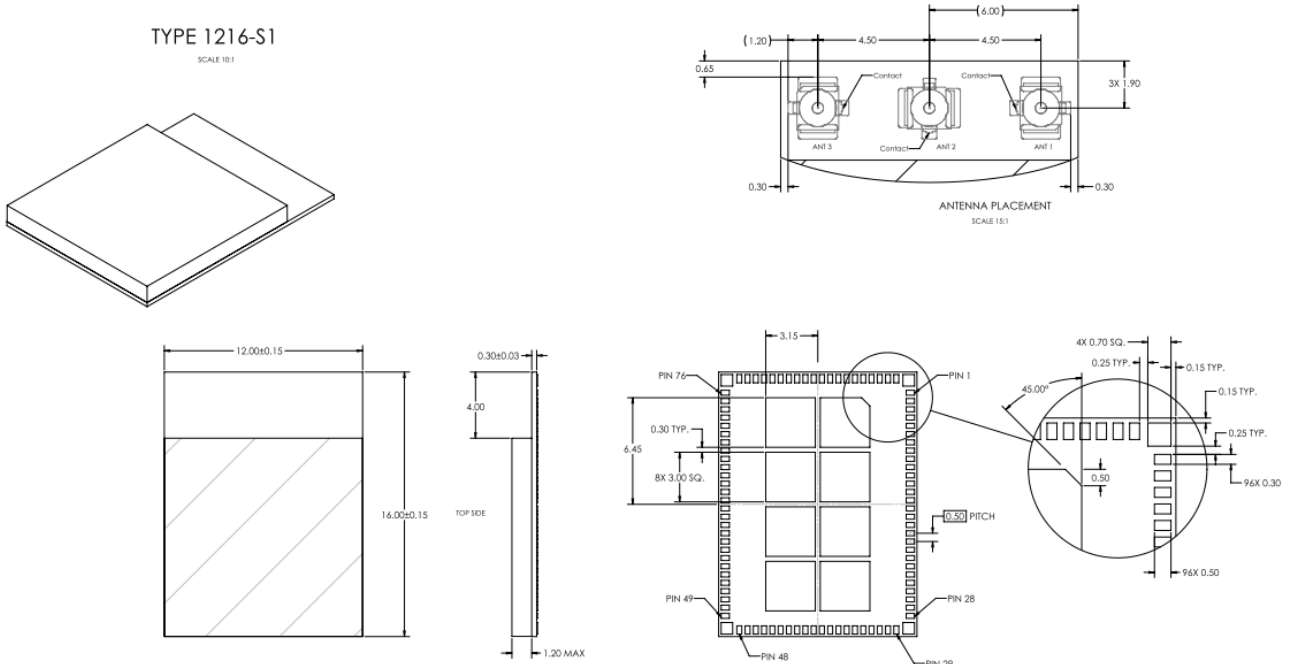
71	GND	GND	Ground	
72-73	3.3V	Power	Power voltage input pin	3.3V
74-76, others	GND	GND	Ground	

The pin-out definition is following NGFF1216, but removed some functions such as PCIE, BT_USB.

*(a) FOXCONN remove the function according to BCM43241function.

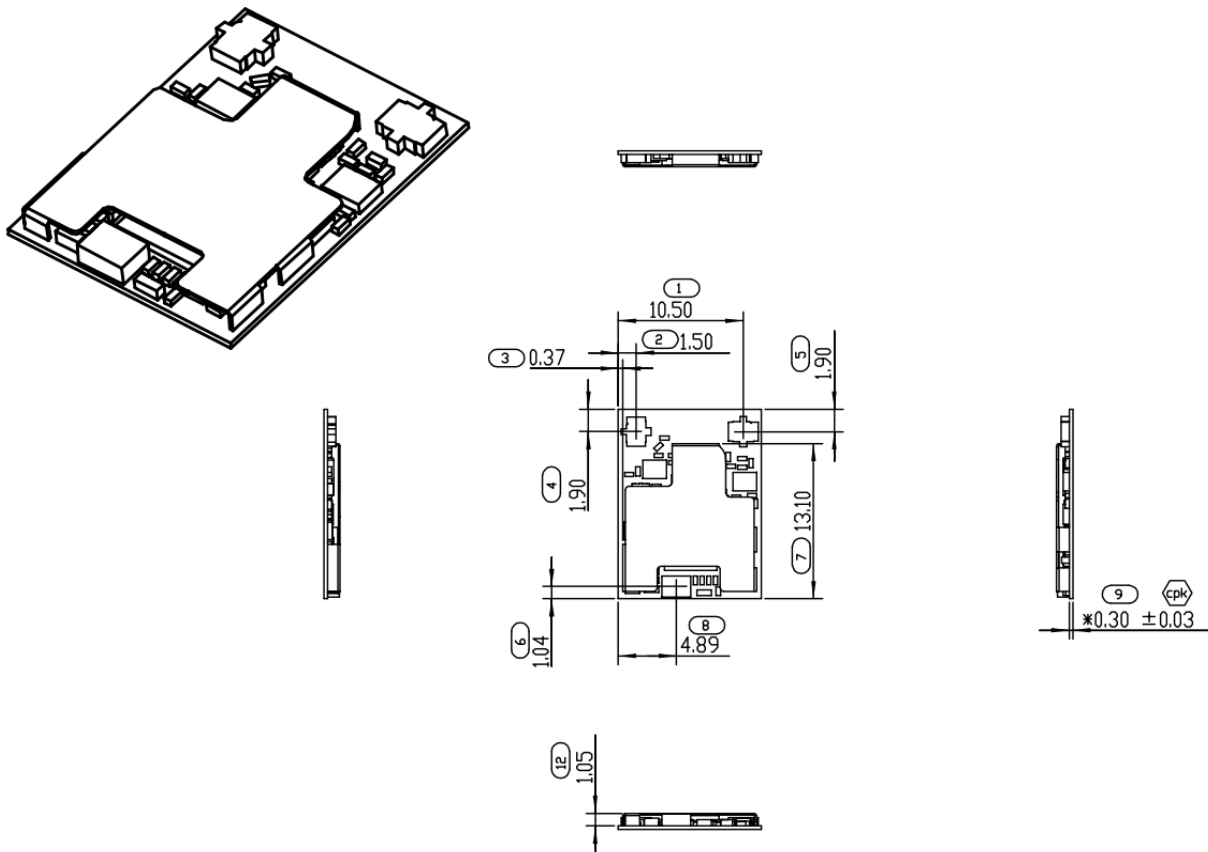
4. Mechanical Drawing

4.1 NGFF Type 1216 specification from PCI-e M.2_Rev0.7a



- The on board RF connector and plug mating height would be 1.2 mm max.
- Only Ant1 and Ant3 on this module.

4.2 T77H462.02 module drawing



4.3 RF connector:

- New RF connector is needed, for lower z-height and smaller footprint
- Same RF Receptacle on module supports either 0.81mm or 1.13mm diameter cable
- Cable diameter determines mated height: 1.2mm mated height with 0.81mm cable

4.4 Example of IPEX RF connector

IPEX P/N: 20449-001E (MHF4)

IPEX P/N: 20448-001R-081

【Material and Finish】

Parts	Material	Plating / Color
HOUSING	LCP UL94V-0	BLACK
CONTACT	COPPER ALLOY	Au
GROUND CONTACT	COPPER ALLOY	Au

MHF[®] 4 Receptacle

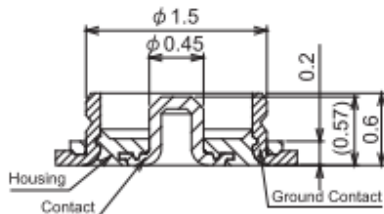
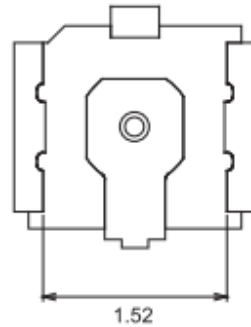
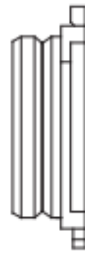
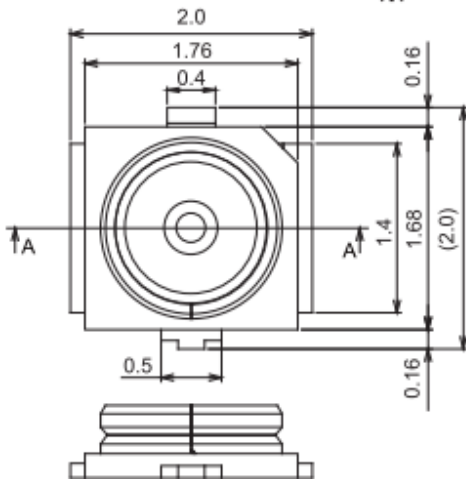
【Part Number】

Ground Contact : Au Plating

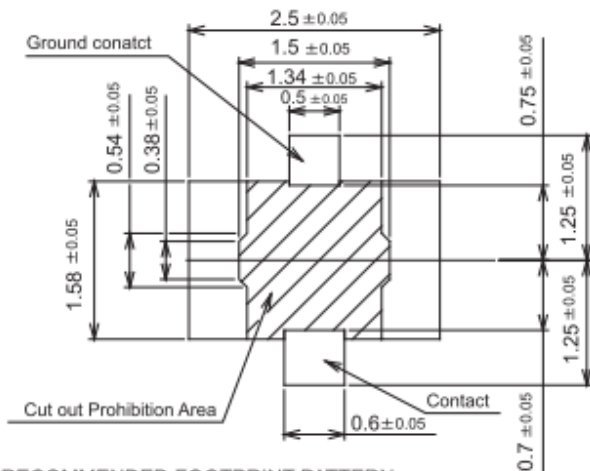
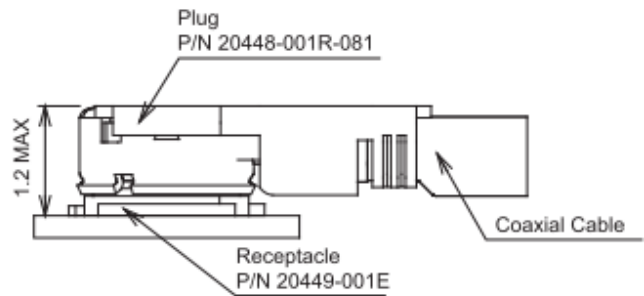
20449-001 E

※

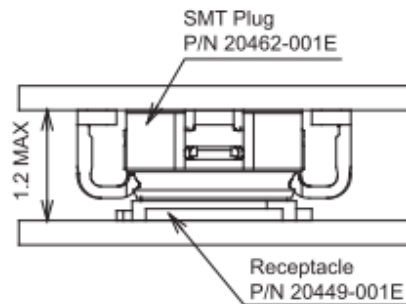
※ Packing : Emboss Tape
1reel : 10,000pcs



Sect. A-A



RECOMMENDED FOOTPRINT PATTERN



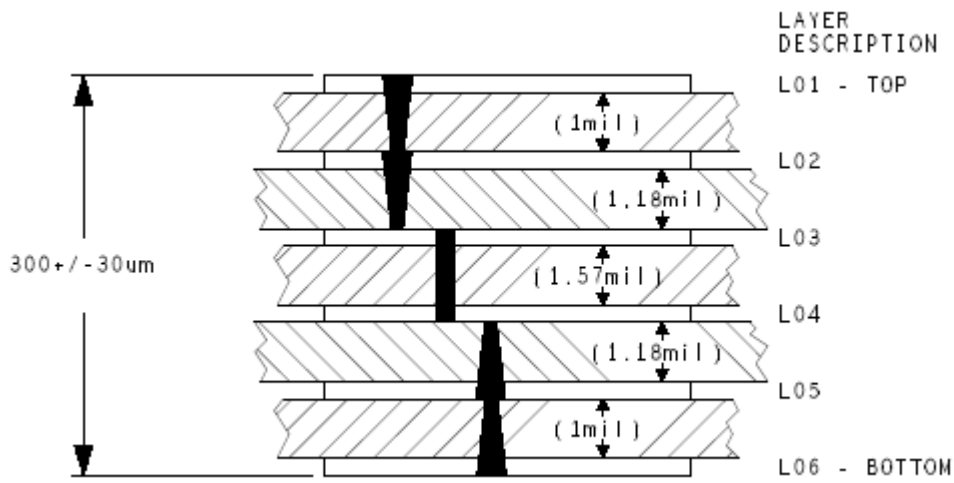
MATED VIEW



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6. PCB Stack

6-layer, 2 order HDI FR-4 (Halogen Free) design, total thickness 0.3+/-0.03mm



7. Software Support

- Operating System Support
 - Windows 8
 - Windows Blue or later Android 4.3 and above
- WLAN Feature Support
 - WiFi Direct
 - WiFi Display
 - Wi-Fi Miracast (Intel will support WiDi with Miracast interoperability)
- WLAN Security Support
 - WPA/WPA2 Enterprise
 - CCX Lite or higher
 - WMM/AES/TKIP/CKIP
- WLAN Transmit Power Reduction
 - Software control to meet FCC SAR requirement
 - Capability to disable 5GHz operation
- Bluetooth Profile Support
 - A2DP-Sink
 - A2DP-Source
 - AVRCP-Target
 - DUN-DT
 - FTP-Client
 - FTP-Server
 - HCRP-Client
 - HID-Host
 - MCAP
 - OPP-Client
 - OPP-Server
 - PAN-User
 - SDP
 - Serial-DevA
 - Serial-DevB
- BLE (Bluetooth Low Energy) Support
 - Windows 8
 - Windows Blue or later

8. Regulatory

- USA : FCC P15B / FCC P15C / FCC P15E
- Canada : IC RSS-210
- Japan : TELEC
- EU : EN300328 V1.8.1 , EN301893 V1.6.1 , EN301489-1/-17 , EN 60950-1 2nd

BCM43241 module 5GHz power table :

Typical power (limit is +/-2dB) (unit:dBm)

HT20	CH36	CH48	CH52	CH64	CH100	CH120	CH140	CH149	CH165
6~24Mbps	15.5	15.5	15.5	14	15.5	15.5	13.5	15.5	15.5
36~54Mbps	14.5	14.5	14.5	14	14.5	14.5	13.5	14.5	14.5
MCS0~MCS4	13	13	14.5	13.5	14.5	14.5	12.5	14.5	14.5
MCS5~MCS7	13	13	13.5	13.5	13.5	13.5	12.5	13.5	13.5
MCS8~MCS12	16	16	17.5	16.5	17.5	17.5	15.5	17.5	17.5
MCS13~MCS15	16	16	16.5	16.5	16.5	16.5	15.5	16.5	16.5

Note:for FCC,the power limit is 17dBm for BANDI (5180~5240MHz)

HT40	CH38	CH46	CH54	CH62	CH102	CH134	CH151	CH159
MCS0~MCS4	11.5	13	14.5	11.5	13.5	13	14.5	14.5
MCS5~MCS7	11.5	13	13.5	11.5	13.5	13	13.5	13.5
MCS8~MCS12	14.5	16	17.5	14.5	16.5	16	17.5	17.5
MCS13~MCS15	14.5	16	16.5	14.5	16.5	16	16.5	16.5

BCM43241 module 2.4GHz power table

Typical power (limit is +/-2dB) (unit:dBm)

HT20	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9	CH10	CH11
1~11Mbps	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16
6~24Mbps	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	13
36~54Mbps	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	13
MCS0~MCS4	14	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	13.5
MCS5~MCS7	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
MCS8~MCS12	17	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	16.5
MCS13~MCS15	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5

9. Environmental Requirements and Specifications

9.1 Temperature

9.1.1 Operating Temperature Conditions

The product shall be capable of continuous reliable operation when operating in ambient temperature of 0 °C to +70°C.

9.1.2 Non-Operating Temperature Conditions

Neither subassemblies shall be damaged nor shall the operational performance be degraded when restored to the operating temperature when exposed to storage temperature in the range of -10°C to +85°C.

9.2 PCB bending

The PCB bending spec limits plainness under 0.1mm for both Foxconn and end assembly customer.

9.3 Handling environment

ESD:

There are semiconductors on the module, please handle the module under ESD protected and well-controlled environment (<100V).

Terminals Handling Notice

The product is mounted with motherboard through Land Grid Array. In order to prevent poor soldering, please do not touch LGA portion by hand.

Notes: As a rule, baking the components in accordance with condition mentioned above, because tape and real for packaging materials have no heat resistance, please bake the components moved into another container such as heat resistance trays.

Others:

1. Please make sure to avoid mechanical shock and vibration for this module.
2. Please do not drop the module.
3. Please do not clean the module.

9.4 Storage Condition

1. Moisture barrier bag must be stored under 40 °C, humidity under 90% RH, when the moisture barrier bag is sealed by Foxconn.
2. The calculated shelf life for the dry packed product shall be a 12 months from the bag seal date.
3. If Moisture barrier bag is open, the component must be stored in an environment of <25 °C /10%RH
4. Please keep the module at 30°C/70% RH.

9.5 Baking Condition

The module would be required for baking if:

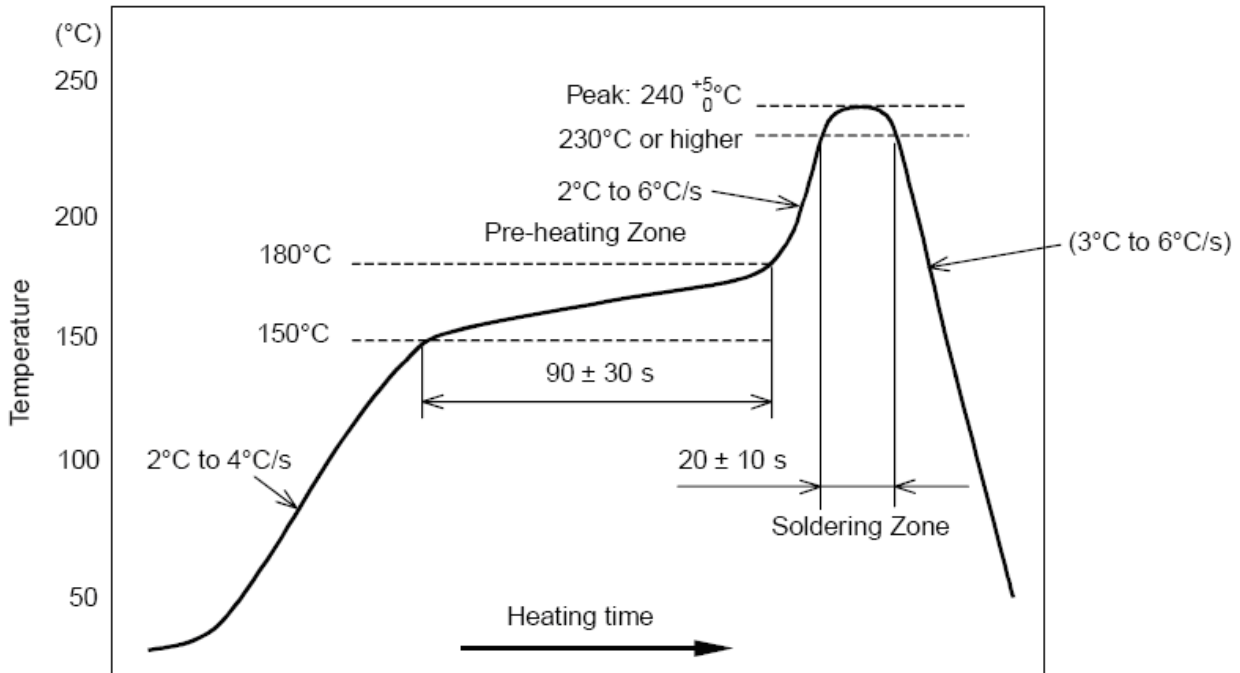
1. Humidity indicator cards read >30%
2. Temp < 30 °C, Humidity <70%RH, moisture barrier bag open over 96 hours

The baking criteria would be:

1. Baking condition: 90 °C, 12-22 hours
2. Baking times: Max. 2 times

9.6 Soldering and reflow condition

1. Heating method:
Conventional Convection or IR/convection
2. Temperature measurement:
Thermocouple $d=0.1\text{mm} \sim 0.2\text{mm}$ CA (K) or CC (T) at soldering portion or equivalent method.
3. Solder paste composition:
Sn/3.0Ag/0.5Cu
4. Allowable reflow soldering times: 2 times, based on the below reflow soldering profile
5. Temperature profile:
Reflow soldering shall be done according to the below temperature profile.
6. Peak temp: 245 degree C



Temperature profile for evaluation of solder heat resistance of a component (at solder joint)



COMPANY CONFIDENTIAL

Federal Communication Commission Interference Statement

This device complies with Part 15 of the FCC Rules. 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.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

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

Operations in the 5.15-5.25GHz band are restricted to indoor usage only.

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This device is intended only for OEM integrators under the following conditions:

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains FCC ID: MCLT77H462". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.