



WBUB15

IEEE 802.11 a/b/g/n/ac 2x2 +BT Combo Module

Product Specification 1.0

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Revision History

Date	Number	Approver	Comments
July. 8, 2015	1.0	Ben Ho	Initial Draft

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CHAPTER 1. MODULE OVERVIEW

The Foxconn WBUB15 WLAN/BT module contains the Broadcom® BCM43569 single-chip which is a highly integrated IEEE 802.11 a/b/g/n/ac MAC/baseband/radio and Bluetooth 4.1 +EDR. It provides a small form-factor solution with minimal external components to drive down cost for

1-1 Key Characteristic

- An IEEE 802.11a/b/g/b/ac dual-band 2 x 2 MIMO radio with virtual-simultaneous dual-band operatoin
- Bluetooth 4.1 + EDR with an integrated class 1 PA
- Concurrent Bluetooth and WLAN operation
- 20/40/80MHz bandwidth
- Reverse direction grant data flow and frame aggregation
- Security : WEP ,WPA ,WPA2, TKIP, AES, CKIP
- QoS-WMM, WMM-PS, WMM-SA
- A full-speed USB 2.0-compliant interface for WLAN and Bluetooth
- Bluetooth SmartAudio® technology improves voice and music quality to headsets
- Bluetooth low-power (BLE) support
- Bluetooth packet loss concealment(PLC)

1-2 Certification

TBD

1-3 Block Diagram

The general HW architecture is shown below Figure:

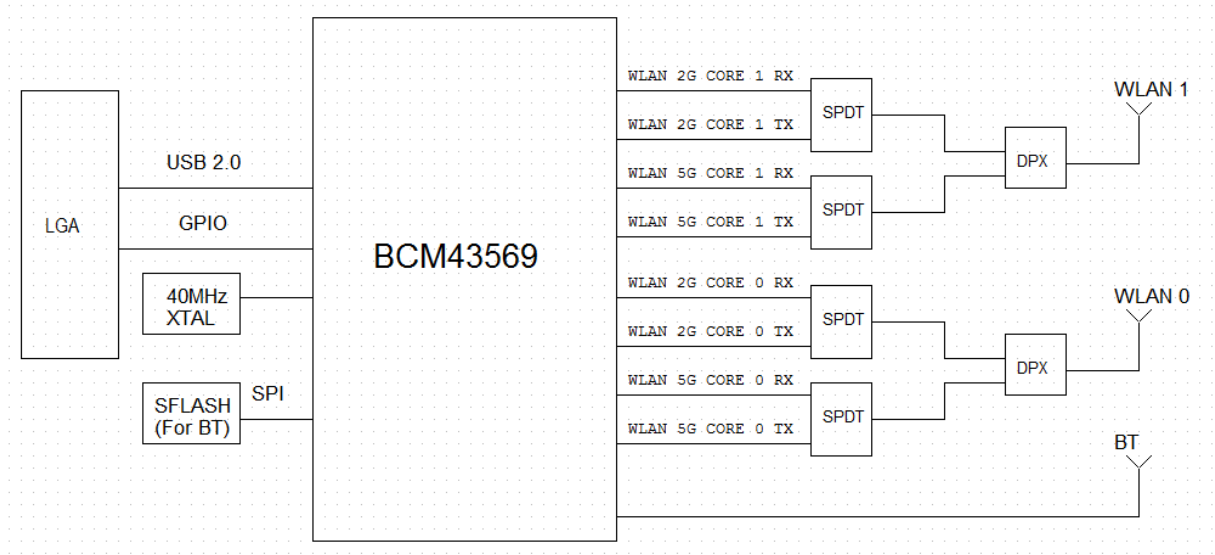


Figure 1 Module Block Diagram

1-4 LGA Pin Definition

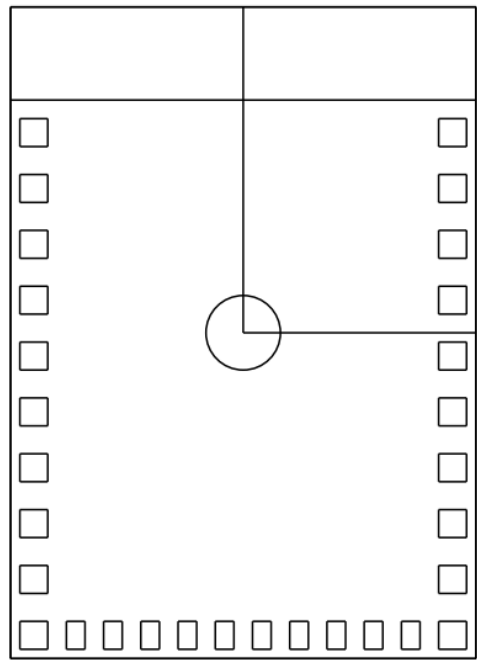


Figure 2 Pin Definitions (Module Bottom View)

Table 1 Pin Definitions

Pin Number	Symbol Name	Type	Pin Description
1	GND	GND	Ground
2	GND	GND	Ground
3	GND	GND	Ground
4	VDD3_3	Power	3.3V
5	GND	GND	Ground
6	GND	GND	Ground
7	BT_Host_Wake	O	Host wake up
8	BT_DEV_WAKE	I	Bluetooth device wake up
9	NC	NC	NC
10	GND	GND	Ground
11	USB_D-	I/O	USB 2.0 D-
12	USB_D+	Power	USB 2.0 D+
13	GND	GND	Ground
14	GND	GND	Ground
15	BT_REG_ON	I	Power-up/Power-Down/Reset Control Signal
16	WL_REG_ON	I	Power-up/Power-Down/Reset Control Signal
17	WL_HOST_WAKE	O	Host wake up
18	WL_DEV_WAKE	I	WLAN device wake up
19	GND	GND	Ground
20	VDD3_3	Power	3.3V
21	GND	GND	Ground
22	GND	GND	Ground
23	GND	GND	Ground
24	GND	GND	Ground
25	GND	GND	Ground
26	GND	GND	Ground
27	GND	GND	Ground
28	GND	GND	Ground
29	GND	GND	Ground
30	GND	GND	Ground

CHAPTER 2. ELECTRICAL AND RF SPECIFICATION

2-1 Recommended Operation Rating

Table 2 Operation Rating

Parameter	Condition	Min	Typ.	Max.	Unit
VDD3_3	3.3V	3.3V	3.3V	3.6V	V
RF Interface	Zo		50		Ohm

2-3 WiFi RF Specification – TX

Table 3 IEEE 802.11 b/g/n/ac TX Output Power (WLAN0&WLAN1)

Data Rate (Mbps)	Modulation	Tx Typical Power (dBm)	Data Rate (Mbps)	Modulation	Tx Typical Power (dBm)
1	DBPSK	17	HT20-MCS0	BPSK	14.5
2	DQPSK	17	HT20-MCS1	BPSK	14.5
5.5	CCK	17	HT20-MCS2	QPSK	14.5
11	CCK	17	HT20-MCS3	QPSK	14.5
6	OFDM	15.5	HT20-MCS4	16-QAM	14.5
9	OFDM	15.5	HT20-MCS5	16-QAM	14.5
12	OFDM	15.5	HT20-MCS6	64-QAM	14.5
18	OFDM	15.5	HT20-MCS7	64-QAM	14.5
24	OFDM	15.5	HT40-MCS0	BPSK	14
36	OFDM	15.5	HT40-MCS1	QPSK	14
48	OFDM	15.5	HT40-MCS2	QPSK	14
54	OFDM	15.5	HT40-MCS3	16-QAM	14
			HT40-MCS4	16-QAM	14
			HT40-MCS5	64-QAM	14
			HT40-MCS6	64-QAM	14
			HT40-MCS7	64-QAM	14

Table 5 IEEE 802.11 a/n/ac TX Output Power(WLAN0&WLAN1)

Data Rate (Mbps)	Modulation	Tx Typical Power (dBm)	Data Rate (Mbps)	Modulation	Tx Typical Power (dBm)
6	OFDM	15	HT20-MCS0	BPSK	13
9	OFDM	15	HT20-MCS1	BPSK	13
12	OFDM	15	HT20-MCS2	QPSK	13
18	OFDM	15	HT20-MCS3	QPSK	13
24	OFDM	15	HT20-MCS4	16-QAM	13
36	OFDM	15	HT20-MCS5	16-QAM	13
48	OFDM	15	HT20-MCS6	64-QAM	13
54	OFDM	15	HT20-MCS7	64-QAM	13
			HT40-MCS0	BPSK	12
			HT40-MCS1	QPSK	12
			HT40-MCS2	QPSK	12
			HT40-MCS3	16-QAM	12
			HT40-MCS4	16-QAM	12
			HT40-MCS5	64-QAM	12
			HT40-MCS6	64-QAM	12
			HT40-MCS7	64-QAM	12
			HT80_MCS0	BPSK	10
			HT80_MCS1	QPSK	10
			HT80_MCS2	QPSK	10
			HT80_MCS3	16-QAM	10
			HT80_MCS4	16-QAM	10
			HT80_MCS5	64-QAM	10
			HT80_MCS6	64-QAM	10
			HT80_MCS7	64-QAM	10
			HT80_MCS8	256-QAM	10
			HT80_MCS9	256-QAM	10

2-4 WiFi RF Specification – RX

Table 6 IEEE 802.11 b/g/n RX Sensitivity (WLAN0&WLAN1)

Data Rate (Mbps)	Modulation	Rx Sensitivity (dBm)		Data Rate (Mbps)	Modulation	Rx Sensitivity (dBm)	
		Max.	Typ.			Max.	Typ.
1	DBPSK	-83	-94	HT20-7.22	BPSK	-82	-89.5
2	DQPSK	-80	-93.5	HT20-14.44	QPSK	-79	-87.5
5.5	CCK	-83	-91	HT20-21.67	QPSK	-77	-85.5
11	CCK	-80	-88.5	HT20-28.89	16-QAM	-74	-82.5
6	OFDM	-85	-90	HT20-43.33	16-QAM	-70	-80.5
9	OFDM	-84	-89.5	HT20-57.78	64-QAM	-66	-76
12	OFDM	-82	-89	HT20-65	64-QAM	-65	-75
18	OFDM	-80	-86	HT20-72.22	64-QAM	-64	-73.5
24	OFDM	-77	-83.5	HT40-15	BPSK	-79	-89.5
36	OFDM	-73	-80	HT40-30	QPSK	-76	-86.5
48	OFDM	-69	-76	HT40-45	QPSK	-74	-84
54	OFDM	-68	-74.5	HT40-60	16-QAM	-71	-81
				HT40-90	16-QAM	-67	-78.5
				HT40-120	64-QAM	-63	-74
				HT40-135	64-QAM	-62	-71.5
				HT40-150	64-QAM	-61	-68

Table 4 IEEE 802.11 a/n/ac RX Sensitivity (WLAN0&WLAN1)

Data Rate (Mbps)	Modulation	Rx Sensitivity (dBm)		Data Rate (Mbps)	Modulation	Rx Sensitivity (dBm)	
		Max.	Typ.			Max.	Typ.
6	OFDM	-85	-88	HT20-7.22	BPSK	-82	-88
9	OFDM	-84	-88	HT20-14.44	QPSK	-79	-87
12	OFDM	-82	-86.5	HT20-21.67	QPSK	-77	-85
18	OFDM	-80	-84.5	HT20-28.89	16-QAM	-74	-82
24	OFDM	-77	-82	HT20-43.33	16-QAM	-70	-79
36	OFDM	-73	-78.5	HT20-57.78	64-QAM	-66	-75
48	OFDM	-69	-74.5	HT20-65	64-QAM	-65	-73
54	OFDM	-68	-73	HT20-72.22	64-QAM	-64	-72
				HT40-15	BPSK	-79	-85
				HT40-30	QPSK	-76	-84
				HT40-45	QPSK	-74	-82
				HT40-60	16-QAM	-71	-79
				HT40-90	16-QAM	-67	-75.5
				HT40-120	64-QAM	-63	-71.5
				HT40-135	64-QAM	-62	-70
				HT40-150	64-QAM	-61	-68.5
				HT80_MCS0	BPSK	-76	-87
				HT80_MCS1	QPSK	-73	-83
				HT80_MCS2	QPSK	-71	-81
				HT80_MCS3	16-QAM	-68	-78
				HT80_MCS4	16-QAM	-64	-75
				HT80_MCS5	64-QAM	-60	-70
				HT80_MCS6	64-QAM	-59	-69
				HT80_MCS7	64-QAM	-58	-67
				HT80_MCS8	256-QAM	-53	-62
				HT80_MCS9	256-QAM	-51	-60

2-5 Bluetooth RF Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Basic Data Rate – Transmit Performance					
RF Transmit Power (TRM01)		-6	7	20	dBm
Power Density (TRM02)	Per 100kHz	≤20			dBm
Power Control (TRM03)		2≤ step size ≤ 8			dB
TX Output Spectrum – Freq. Range (TRM04)	F(low)- CH0	> 2400			MHz
	F(high)-CH78	< 2483.5			
TX Output Spectrum – 20dB BW (TRM05)		f _H -f _L ≤ 1000			MHz
TX Output Spectrum – Adjacent Channel Power (TRM06)	f-f ₀ ≤ 2MHz	≤ -20			dBm
	f-f ₀ ≥ 3MHz	≤ -40			
TX Output Spectrum – Out of Band Spurious Emission	30MHz – 1GHz	≤ -36			dBm
	1GHz -12.75GHz	≤ -30			
	5.15GHz -5.35GHz	≤ -47			
	5.725GHz-5.825GHz	≤ -47			
Modulation Characteristic (TRM07)	Delta f1 avg	140 ≤ Δf _{1avg} ≤ 175			kHz
	Delta f2 max	≥ 115 at 99.9%			
	Delta f2 avg/Delta f1 avg	≥ 0.8			
Initial Carrier Frequency Tolerance (TRM08)		≤± 75			kHz
Carrier Frequency Drift (TRM09)	DH1	≤± 25			kHz
	DH3	≤± 40			
	DH5	≤± 40			
Maximum Drift Rate (TRM09)		20 kHz/50 us			
Enhanced Data Rate – Transmit Performance					
RF Transmit Power	π/4 DQPSK	-1.5	1	3.5	dBm
	8DPSK	-1.5	1	3.5	
Relative Transmit Power (TRM10)	All pairs	(P _{GFSK} -4 dB)<P _{DPSK} <(P _{GFSK} +1 dB)			
Carrier Frequency Stability (TRM11)	All packets	-75 ≤ w _i ≤ 75			kHz
	All blocks	-75 ≤ (w ₀ +w _i) ≤ 75			
	All blocks	-10 ≤ w ₀ ≤ 10			
Modulation Accuracy – RMS DEVM (TRM11)	π/4 DQPSK	≤ 20			%
	8DPSK	≤ 13			
Modulation Accuracy – Peak DEVM (TRM11)	π/4 DQPSK	≤ 35			
	8DPSK	≤ 25			
Modulation Accuracy – 99% DEVM (TRM11)	π/4 DQPSK	≤ 30			
	8DPSK	≤ 20			
EDR Differential Phase Emissions (TRM12)		≥ 99			%
In-band Spurious Emission (TRM13)	f-f ₀ ≤ 1MHz	≤ -26			dB
	f-f ₀ ≤ 2MHz	≤ -20			dBm
	f-f ₀ ≥ 3MHz	≤ -40			
TX Output Spectrum – Out of Band Spurious Emission	30MHz – 1GHz	≤ -36			dBm
	1GHz -12.75GHz	≤ -30			

	5.15GHz -5.35GHz	≤ -47	
	5.725GHz-5.825GHz	≤ -47	
Enhanced power control (TRM14)	Step Size	$2 \leq \text{Step Size} \leq 8$	dB
	Difference. Btw. GFSK, $\pi/4$ DQPSK,&8DPSK	≤ 10	
Basic Data Rate – Receiver Performance			
Sensitivity at 0.1% BER (RCV01-02)		≤ -81	dBm
C/I Co-Channel interference (RCV03)		≤ 11	dB
C/I Adjacent CH interference (RCV03)	$ f-f_0 \leq 1\text{MHz}$	≤ 0	
	$ f-f_0 \leq 2\text{MHz}$	≤ -30	
	$ f-f_0 \geq 3\text{MHz}$	≤ -40	
C/I Image CH interference (RCV03)	C/I_{image}	≤ -9	
	$C/I_{\text{image} \pm 1\text{MHz}}$	≤ -20	
Out of band Blocking (RCV04)	30MHz – 2000 MHz	-10	dBm
	2003MHz – 2399MHz	-27	
	2484MHz – 2997MHz	-27	
	3000MHz – 12750MHz	-10	
Intermodulation Performance at $\leq 0.1\%$ BER (RCV05)		-64	dBm
Maximum input power level		≥ -20	dBm
Spurious Emission		30MHz – 12.75GHz	≤ -57 dBm
Enhanced Data Rate – Receiver Performance			
Sensitivity at 0.1% BER (RCV07)	$\pi/4$ DQPSK	≤ -85	dBm
	8DPSK	≤ -77	
EDR BER Floor Performance at $\leq 0.0007\%$ BER (RCV08)		-60	dBm
C/I Co-Channel interference (RCV09)	$\pi/4$ DQPSK	$\leq +13$	dB
	8DPSK	$\leq +21$	
C/I Adjacent Channel C/I $ f-f_0 \leq 1\text{MHz}$ (RCV09)	$\pi/4$ DQPSK	≤ 0	
	8DPSK	$\leq +5$	
C/I Adjacent Channel C/I $ f-f_0 \leq 2\text{MHz}$ (RCV09)	$\pi/4$ DQPSK	≤ -30	
	8DPSK	≤ -25	
C/I Adjacent Channel C/I $ f-f_0 \geq 3\text{MHz}$ (RCV09)	$\pi/4$ DQPSK	≤ -40	
	8DPSK	≤ -33	
C/I Image Channel C/I_{image} (RCV09)	$\pi/4$ DQPSK	≤ -7	
	8DPSK	≤ 0	
C/I Image Channel $C/I_{\text{image} \pm 1\text{MHz}}$ (RCV09)	$\pi/4$ DQPSK	≤ -20	
	8DPSK	≤ -13	
Maximum input power level (RCV10)		≥ -20	dBm
Spurious Emission		30MHz – 12.75GHz	≤ -57 Pass

2-6 Bluetooth Low Energy RF Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Transmit Performance					
RF Transmit Power (TRM-LE01,02)		-6	7	20	dBm
In-Band Emission (TRM-LE03,04)	$ f-f_0 \leq 2\text{MHz}$	≤ -20			dBm
	$ f-f_0 \geq 3\text{MHz}$	≤ -30			
TX Output Spectrum – Out of Band Spurious Emission	30MHz – 1GHz	≤ -36			dBm
	1GHz -12.75GHz	≤ -30			
	5.15GHz -5.35GHz	≤ -47			
	5.725GHz-5.825GHz	≤ -47			
Modulation Characteristic (TRM-LE05)	Delta f1 avg	$225 \leq \Delta f_{1\text{avg}} \leq 275$			kHz
	Delta f2 max	≥ 185 at 99.9%			
	Delta f2 avg/Delta f1 avg	≥ 0.8			
Carrier Frequency Drift (TRM-LE06,07)	Center frequency	$\leq \pm 150$			kHz
	During any packet	$\leq \pm 50$			
Maximum Drift Rate (TRM-LE06,07)		20 Hz/50 us			
Receiver Performance					
Sensitivity at 30.8% PER(0.1%BER) (RCV-LE01,02)		≤ -81			dBm
C/I Co-Channel interference (RCV-LE03)	Co-channel	≤ 21			dB
C/I Adjacent CH interference (RCV-LE03)	$ f-f_0 \leq 1\text{MHz}$	≤ 15			
	$ f-f_0 \leq 2\text{MHz}$	≤ -17			
	$ f-f_0 \geq 3\text{MHz}$	≤ -27			
C/I Image CH interference (RCV-LE03)	C/I_{image}	≤ -9			
	$C/I_{\text{image} \pm 1\text{MHz}}$	≤ -15			
Out of band Blocking (RCV-LE04)	30MHz – 2000 MHz	-30			dBm
	2003MHz – 2399MHz	-35			
	2484MHz – 2997MHz	-35			
	3000MHz – 12750MHz	-30			
Intermodulation Performance at $\leq 30.8\%$ ($\leq 0.1\%$ BER) (RCV-LE05)		-64			dBm
Maximum input power level (RCV-LE06)		≥ -10			dBm
PER Report Integrity $50\% \leq \text{PER} \leq 65.4\%$ (RCV-LE07)		-30			dBm
Spurious Emission	30MHz – 12.75GHz	≤ -57			dBm

2-7 Antenna Specification Requirement

Nominal antenna port impedance specification is 50 ohms for the Foxconn WBUB15.

For regulatory requirements, it is assumed that the antenna gain is:

For WLAN1 & WLAN2(WiFi):

Antenna gain for the 2.4GHz band: 4.02dBi

Antenna gain for the 5GHz band: 4.61dBi

For BT (Bluetooth):

Antenna gain for the 2.4GHz band: 3.97dBi



CHAPTER 3. MECHANICAL SPECIFICATION

3-1 Module Assembly Dimension

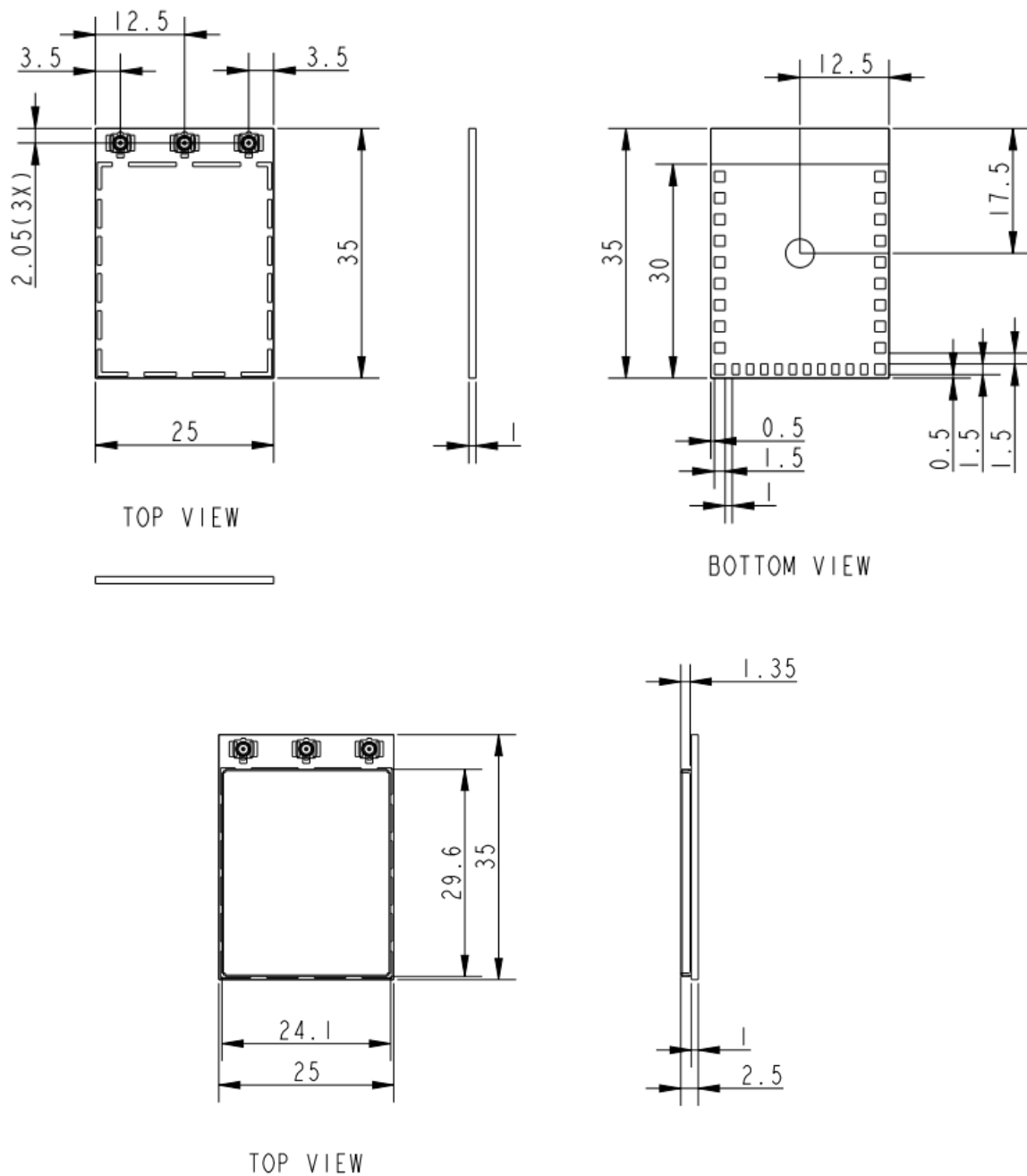


Figure 3 Mechanical Drawing

3-2 Label Specification



Figure 4 Label Drawing

CHAPTER 4. ADDITIONAL INFORMATION

4-1 EEPROM Information

Table 8 USB PID/VID Setting

WLAN Type	Mode	PID	VID
Broadcomm 802.11ac USB3.0 Network Adapter	AC	BD27	0A5C

BT Type	Mode	PID	VID
BCM43569	4.0	BD27	0A5C

4-2 Module Photo



Figure 4 Top Side Photo

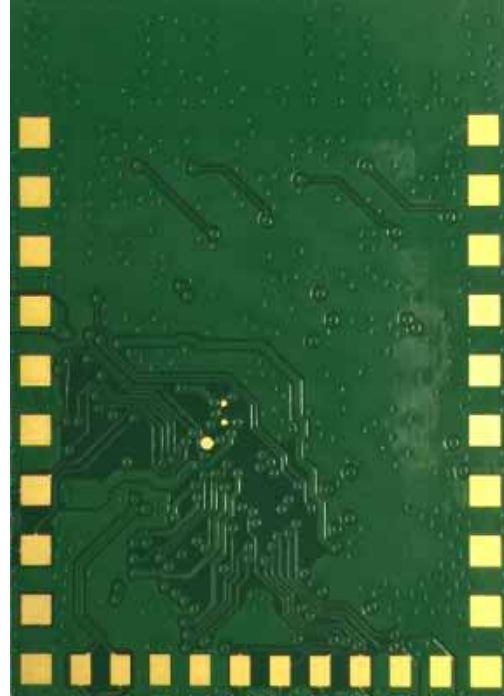


Figure 5 Bottom Side Photo

4-3 FCC/IC Statements

STATEMENTS

Federal Communications Commission (FCC) Statements

Federal Communications Commission (FCC) Statements:

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 any interference that may cause undesired operation of the device.

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 or more 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 Warning: The FCC requires that you be notified that any changes or modifications to this device not expressly approved by the manufacturer could void the user's authority to operate the equipment.

Operation in the band 5150-5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems. Please note that high-power radars are allocated as primary users (i.e. priority users) of the bands 5250-5350 MHz and 5650-5850 MHz and that these radars could cause interference and/or damage to LE-LAN devices.

RF Radiation Exposure Statement:

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

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

Only those antennas with same type and lesser gain filed under this FCC ID number can be used with this device.

The final system integrator must ensure there is no instruction provided in the user manual or customer documentation indicating how to install or remove the transmitter module.

Release Notes

Required end product labeling:

Any device incorporating this module must include an external, visible, permanent marking or label which states: "Contains FCC ID: YE5-WBUB15."

Industry Canada (IC) Statements

Industry Canada (IC) Statements:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux 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'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This Class B digital apparatus complies with Canadian ICES-003

Cet appareil numérique de classe B est conforme à la norme NMB-003.

Operation in the band 5150-5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems. Please note that high-power radars are allocated as primary users (i.e. priority users) of the bands 5250-5350 MHz and 5650-5850 MHz and that these radars could cause interference and/or damage to LE-LAN devices.

Operation in the band 5150-5250 MHz is only for indoor use .

La bande 5 150-5 250 MHz est réservés uniquement pour une utilisation à l'intérieur

RF Radiation Exposure Statement:

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body.

Déclaration d'exposition aux radiations:

Cet appareil est conforme aux limites d'exposition aux rayonnements définies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé à une distance minimale de 20 centimètres entre le radiateur et votre corps.

Required end product labeling:

Any device incorporating this module must include an external, visible, permanent marking or label which states: "Contains IC:4613B-WBUB15"