



WBU034

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

Product Specification 2.0

Approved:	Approved:	Prepared by:
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Revision History

Date	Number	Approver	Comments
July. 29, 2016	1.0	Ben Ho	Initial Draft
Aug. 17, 2016	2.0	Cathy Kuo	Updated Module Top Side Photo

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TABLE OF CONTENTS

Revision History	1
Table of Contents	2
Chapter 1. Module Overview	4
1-1 Key Characteristic	4
1-2 Certification.....	4
1-3 Pin Definition	5
Chapter 2. Electrical and RF Specifcaiton	6
2-1 Recommended Operation Rating	6
2-2 Power Consumption.....	6
2-3 WiFi RF Specification – TX	7
2-4 WiFi RF Specification – RX.....	9
2-5 Bluetooth RF Specification	11
2-6 Bluetooth Low Energy RF Specification	13
2-7 Antenna Specification Requirements	14
Chapter 3. MECHANICAL SPECIFICATION	15
3-1 Module Assembly Dimension	15
3-2 Label Specification	16
Chapter 4. Additional Information	17
4-1 EEPROM Information	17
4-2 Module Photo	17
4-3 Environment Specifications	17

Figures:

Figure 1 Pin Definitions (Module Top View)	5
Figure 2 Mechanical Drawing	15
Figure 3 Label Drawing(TOP)	16
Figure 4 Label Drawing(BOTTOM)	16
Figure 5 Top Side Photo	17
Figure 6 Bottom Side Photo	17

Tables

Table 1 Pin Definitions	5
Table 2 Operation Rating	6
Table 3 Power Consumption	6
Table 4 IEEE 802.11 b/g/n/ac TX Output Power (WLAN0 & WLAN1)	7
Table 5 IEEE 802.11 a/n/ac TX Output Power (WLAN0 & WLAN1)	8
Table 6 IEEE 802.11 b/g/n/ac Rx sensitivity (WLAN0 & WLAN1)	9
Table 7 IEEE 802.11 a/n/ac Rx sensitivity (WLAN0 & WLAN1)	10
Table 8 USB PID/VID Setting	17

CHAPTER 1. MODULE OVERVIEW

The Foxconn WBU034 is a highly integrated module which has built in a 2x2 dual-band wireless LAN radio and Bluetooth radio. It supports IEEE 802.11a/b/g/n/ac standard and provides the highest PHY rate up to 867Mbps, offering feature-rich wireless connectivity and reliable throughput from an extended distance. It includes Bluetooth EDR and LE radio which complies with Bluetooth v2.1+EDR, v3.0, and v4.0+BLE.

Optimized RF architecture and baseband algorithms provide superb performance and low power consumption. WBU034 integrates PA/LNA such that the number of the external components is reduced to minimum. Intelligent MAC design deploys a high efficient DMA engine and hardware data processing accelerators which offloads the host processor.

The WBU034 supports the 802.11i security standard and implements hardware acceleration for TKIP, CCMP and WAPI. The device also supports 802.11e QoS for video, voice, and multimedia applications.

1-1 Key Characteristic

- IEEE 802.11 a/b/g/n and 802.11ac draft compliant
- Support 20MHz, 40MHz, 80MHz in 5GHz band, and 20MHz, 40MHz bandwidth in 2.4GHz band
- Dual-band 2T2R mode with data rate up to 867Mbps
- Integrated LNA, PA, and T/R switch
- Security support for WFA WPA/WPA2 personal, WPS2.0, WAPI
- Compliance to Bluetooth v4.2
- Integrated BALUN and PA with 9 dBm transmit power
- Advanced FDD/TDD mode WiFi/Bluetooth coexistence scheme
- WiFi and Bluetooth over USB

1-2 Certification

TBD

1-3 Pin Definition

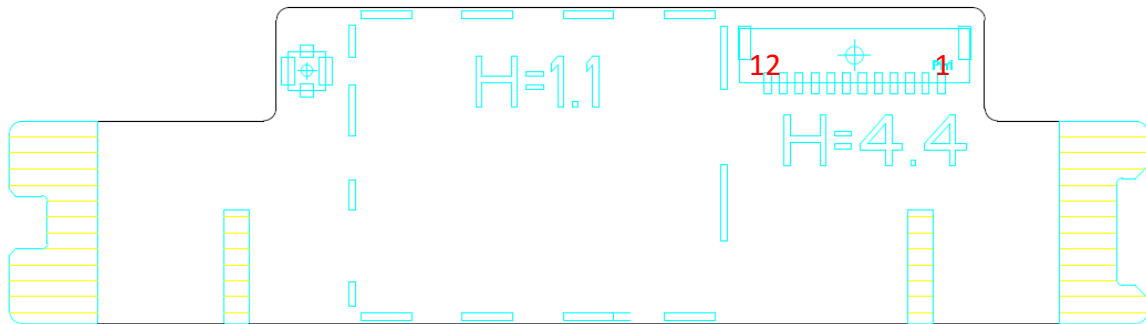


Figure 1 Pin Definitions (Module Top View)

Table 1 Pin Definitions

Pin Number	Symbol Name	Type	Pin Description
1	GND	GND	Ground
2	RSL_L	I/O	Reset Signal
3	WOW_L	I/O	Wake on WLAN Signal output
4	WOBT_L	I/O	Wake on Bluetooth Signal output
5	GND	GND	Ground
6	VCC	POWER	DC 3.3V
7	VCC	POWER	DC 3.3V
8	GND	GND	Ground
9	VSYNC	I/O	3D Video sync Signal
10	GND	GND	Ground
11	DM	I/O	USB 2.0 Data -
12	DP	I/O	USB 2.0 Data +

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	3.0V	3.3V	3.6V	V
RF Interface	Zo		50		Ohm

2-2 Power Consumption

Power consumption is measured using current probe loop on the Power rails of the USB interface (Pins).

**Table 3 Power Consumption
(IPG setting default=200, 50% duty cycle)**

Description	Typical	Unit
IDLE	26	mA
2G/2T- N mode HT 40MHz MCS 7 (14.5dBm)	213	mA
2G/2T- N mode HT 20MHz MCS 7 (14.5dBm)	282	mA
2G/2T- G mode OFDM54M (16dBm)	320	mA
2G/2T- B mode CCK11M (16dBm)	473	mA
5G/2T- AC mode VHT 80MHz MCS 9 (12.5dBm)	244	mA
5G/2T- N mode HT 40MHz MCS 7 (12.5dBm)	290	mA
5G/2T- N mode HT 20MHz MCS 7 (12.5dBm)	340	mA
5G/2T- A mode OFDM54M (14dBm)	366	mA
2G/2R- N mode HT 40MHz MCS 7 (-60dBm)	212	mA
2G/2R- N mode HT 20MHz MCS 7 (-60dBm)	187	mA
2G/2R- G mode OFDM54M (-60dBm)	187	mA
2G/2R- B mode CCK11M (-60dBm)	188	mA
5G/2R- AC mode VHT 80MHz MCS 9 (-60dBm)	263	mA
5G/2R- N mode HT 40MHz MCS 7 (-60dBm)	210	mA
5G/2R- N mode HT 20MHz MCS 7 (-60dBm)	202	mA
5G/2R- A mode OFDM54M (-60dBm)	193	mA

2-3 WiFi RF Specification – TX

Table 4 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	15	HT20-MCS0	BPSK	15
2	DQPSK	15	HT20-MCS1	BPSK	15
5.5	CCK	15	HT20-MCS2	QPSK	15
11	CCK	15	HT20-MCS3	QPSK	15
6	OFDM	15	HT20-MCS4	16-QAM	14
9	OFDM	15	HT20-MCS5	16-QAM	14
12	OFDM	15	HT20-MCS6	64-QAM	14
18	OFDM	15	HT20-MCS7	64-QAM	14
24	OFDM	14			
36	OFDM	14			
48	OFDM	14			
54	OFDM	14			

Tolerance : + 1.5dBm / - 2dBm

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	13	HT20-MCS0	BPSK	13
9	OFDM	13	HT20-MCS1	BPSK	13
12	OFDM	13	HT20-MCS2	QPSK	13
18	OFDM	13	HT20-MCS3	QPSK	13
24	OFDM	12	HT20-MCS4	16-QAM	12
36	OFDM	12	HT20-MCS5	16-QAM	12
48	OFDM	12	HT20-MCS6	64-QAM	12
54	OFDM	12	HT20-MCS7	64-QAM	12
			HT40-MCS0	BPSK	13
			HT40-MCS1	QPSK	13
			HT40-MCS2	QPSK	13
			HT40-MCS3	16-QAM	13
			HT40-MCS4	16-QAM	12
			HT40-MCS5	64-QAM	12
			HT40-MCS6	64-QAM	12
			HT40-MCS7	64-QAM	12
			VHT80_MCS0	BPSK	13
			VHT80_MCS1	QPSK	13
			VHT80_MCS2	QPSK	13
			VHT80_MCS3	16-QAM	13
			VHT80_MCS4	16-QAM	12
			VHT80_MCS5	64-QAM	12
			VHT80_MCS6	64-QAM	12
			VHT80_MCS7	64-QAM	12
			VHT80_MCS8	256-QAM	11
			VHT80_MCS9	256-QAM	11

Tolerance : + 1.5dBm / - 2dBm

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
2	DQPSK	-80	-91	HT20-14.44	QPSK	-79	-86
5.5	CCK	-79	-90	HT20-21.67	QPSK	-77	-85
11	CCK	-76	-87	HT20-28.89	16-QAM	-74	-82
6	OFDM	-85	-91	HT20-43.33	16-QAM	-70	-78
9	OFDM	-84	-90	HT20-57.78	64-QAM	-66	-74
12	OFDM	-82	-88	HT20-65	64-QAM	-65	-73
18	OFDM	-80	-86	HT20-72.22	64-QAM	-64	-72
24	OFDM	-77	-83				
36	OFDM	-73	-79				
48	OFDM	-69	-75				
54	OFDM	-68	-74				

Table 7 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	-89	HT20-7.22	BPSK	-82	-89
9	OFDM	-84	-88	HT20-14.44	QPSK	-79	-86
12	OFDM	-82	-86	HT20-21.67	QPSK	-77	-85
18	OFDM	-80	-84	HT20-28.89	16-QAM	-74	-81
24	OFDM	-77	-81	HT20-43.33	16-QAM	-70	-77
36	OFDM	-73	-77	HT20-57.78	64-QAM	-66	-73
48	OFDM	-69	-73	HT20-65	64-QAM	-65	-72
54	OFDM	-68	-72	HT20-72.22	64-QAM	-64	-71
				HT40-15	BPSK	-79	-86
				HT40-30	QPSK	-76	-83
				HT40-45	QPSK	-74	-81
				HT40-60	16-QAM	-71	-78
				HT40-90	16-QAM	-67	-74
				HT40-120	64-QAM	-63	-70
				HT40-135	64-QAM	-62	-69
				HT40-150	64-QAM	-61	-68
				VHT80_MCS0	BPSK	-76	-83
				VHT80_MCS1	QPSK	-73	-80
				VHT80_MCS2	QPSK	-71	-78
				VHT80_MCS3	16-QAM	-68	-75
				VHT80_MCS4	16-QAM	-64	-71
				VHT80_MCS5	64-QAM	-60	-67
				VHT80_MCS6	64-QAM	-59	-66
				VHT80_MCS7	64-QAM	-58	-65
				VHT80_MCS8	256-QAM	-53	-60
				VHT80_MCS9	256-QAM	-51	-57

2-5 Bluetooth RF Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Basic Data Rate – Transmit Performance					
RF Transmit Power (TRM01)		-6	-2	2	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 _{1,avg} ≤ 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	-6	-2	2	dBm
	8DPSK	-6	-2	2	
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			
	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 = 1\text{MHz}$	≤ 0	
	$ f-f_0 = 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 = 1\text{MHz}$ (RCV09)	$\pi/4$ DQPSK	≤ 0	
	8DPSK	$\leq +5$	
C/I Adjacent Channel C/I $ f-f_0 = 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	-2	2	dBm
In-Band Emission (TRM-LE03,04)	$ f-f_0 = 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	$225 \leq \Delta f_{1,avg} \leq 275$			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 = 1\text{MHz}$	≤ 15			
	$ f-f_0 = 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 PER \leq 65.4% (RCV-LE07)		-30			dBm
Spurious Emission	30MHz – 12.75GHz	≤ -57			dBm

2-7 Antenna Specification Requirements

Nominal antenna port impedance specification is 50 ohms for the Foxconn WBU034 hardware.

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

For WLAN0 & WLAN1 (WiFi):

WLAN0 Antenna gain for the 2.4GHz band : 1.68 dBi

WLAN0 Antenna gain for the 5GHz band : 2.78 dBi

WLAN1 Antenna gain for the 2.4GHz band : 3.36 dBi

WLAN1 Antenna gain for the 5GHz band : 4.11 dBi

For BT (Bluetooth):

Antenna gain for the 2.4GHz band :3.11 dBi



CHAPTER 3. MECHANICAL SPECIFICATION

3-1 Module Assembly Dimension

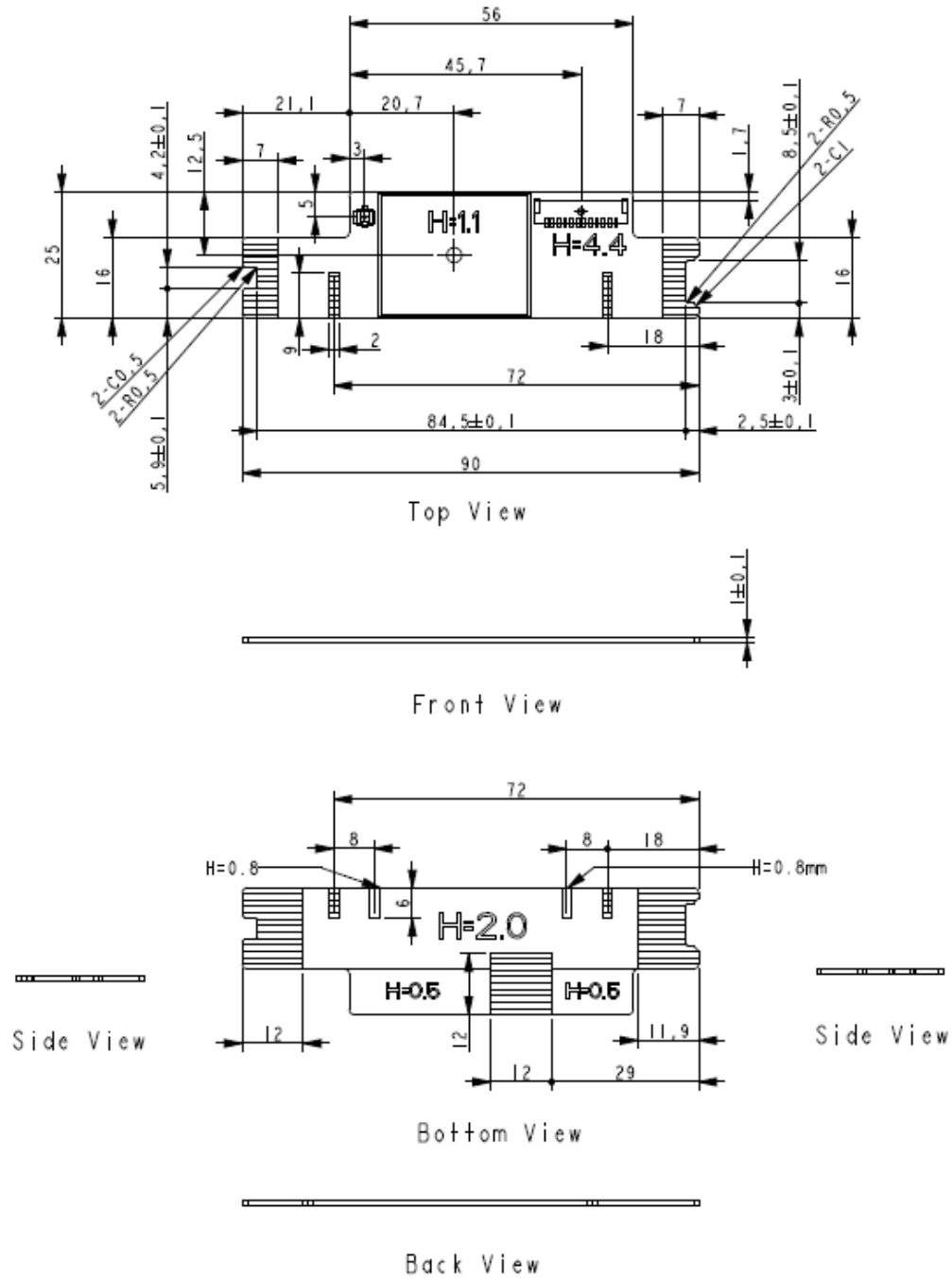


Figure 2 Mechanical Drawing

3-2 Label Specification

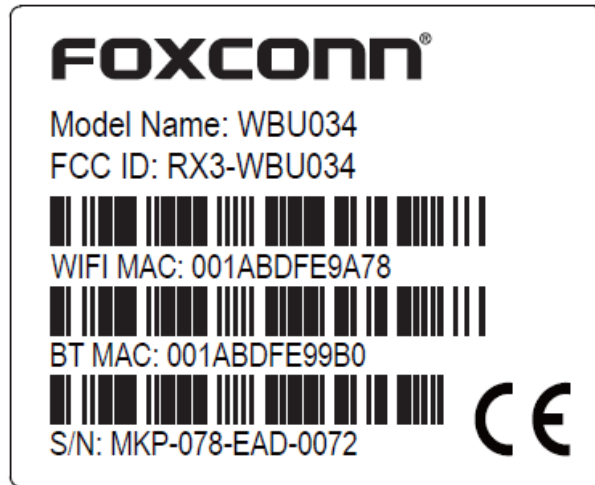


Figure 3 Label Drawing (TOP)



Figure 4 Label Drawing (BOTTON)

CHAPTER 4. ADDITIONAL INFORMATION

4-1 EEPROM Information

Table 8 USB PID/VID Setting (TBD)

Type	Mode	PID	VID
WiFi_If	AC	9A50	04DD

4-2 Module Photo



Figure 5 Top Side Photo



Figure 6 Bottom Side Photo

4-3 Environment Specifications

Operating Conditions (preliminary)

Operation Temperature : 0 ~ 60°C

Storage Conditions (preliminary)

Non-Operation Temperature : -44 ~ 60°C (Typ. 25°C)

Relevant Humidity: 5 ~ 90% (non-condensing)

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.

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 reevaluating 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: RX3-WBU034". 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.