



# COMPANY CONFIDENTIAL

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## User Manual

### IEEE 802.11b/g/n WLAN and Bluetooth Combo Card

Project Name	Marvell 88W8787 WLAN/BT Combo Card
Customer	--
Foxconn Part No.	M26H002
Customer Part No.	--



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**0. Revision History**

Date	Document revision	Product revision	Change Description
2012/07/30	00		1. Initial release
2012/10/19	01		1. Update the WiFi TX/RX performance 2. Add Label and package information

## 1. Introduction

Project Name: Marvell 88W8787 WLAN/BT Combo Card  
Project Number: M26H002

This documentation describes the engineering requirements specification of 88W8787 (WLAN+BT) combo Card. It is a confidential document of Foxconn.

### 1.1 Scope

This combo design is based on the Marvell 8787 single-chip solution. It's operating in 2.4GHz, compatible with the IEEE 802.11b/g/n standard and Bluetooth BT2.1+EDR standard. The 802.11n data rate provides for MCS0 to MCS7 (HT20,HT40). The 802.11g data rate provides for 54, 48, 36, 24, 18, 12, 9, 6Mbps, and 802.11b data rate provides for 11, 5.5, 2, 1Mbps. In addition, it's also compatible with BT2.1+EDR. This combo card has implemented some efficient mechanisms in its software and hardware to maximize the performance of WLAN and BT.

### 1.2 Feature

- Marvell 88W8787 combo card with B2B connector
- Compatible with IEEE 802.11b/g/n standard
- Compatible with BT2.1+EDR standard, also compatible with BTv3.0+HS
- Two U.FL RF connectors (one for WiFi, the other one for BT)
- Support 11n HT20/HT40 mode
- WLAN/BT data transactions are handled over SDIO interface
- Support Wireless multimedia enhancements quality of service support (QoS)
- Support WEP,TKIP, and AES hardware encryption
- GP compliance

## 2. Product Specification

### 2.1 Hardware Specification

- **WLAN Features**

Marvell's 88W8787 is the IC of choice for the WLAN module with the following basic features enabled:

- Single band: 2.4GHz
- 802.11e (Quality of Service)
- 802.11i (Enhanced Security)
- High Throughput 20MHz channel
- High Throughput 40MHz channel
- Mixed Format
- Greenfield Format
- Short Guard Interval
- STA and AP concurrency

- **Bluetooth Features**

Marvell's 88W8787 as the IC of choice for the Bluetooth module with the following features enabled:

- Bluetooth 2.1 + EDR
- Bluetooth 3.0 with Unicast Connectionless Data (UCD)
- All Bluetooth-Host transactions will be done via the SDIO interface.

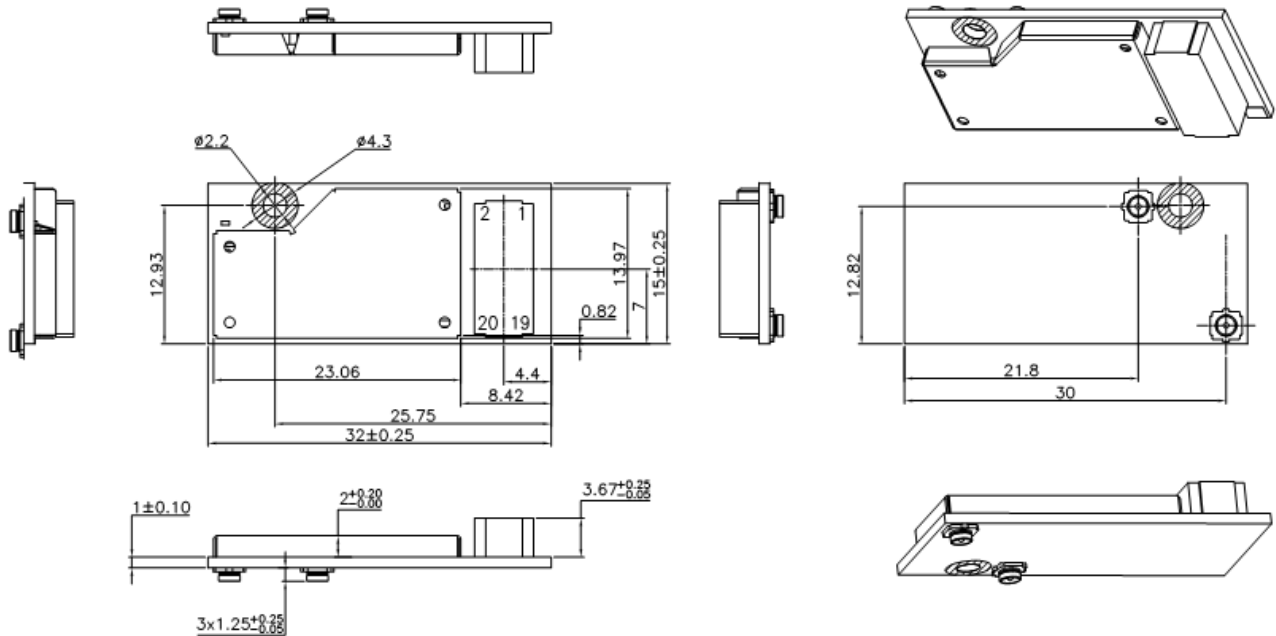
In other words, there will be no supported to use the UART, I2C, I2S, or PCM interfaces.

- The following profiles are anticipated for Bluetooth.
  - ✓ Human Interface Device (HID)
  - ✓ Headset Profile (HSP)
  - ✓ Hands-Free Profile (HFP)
  - ✓ Audio/Video Remote Control Profile (AVRCP)
  - ✓ Advanced Audio Distribution Profile (A2DP)

## 2.2 Mechanical Specification

### 2.2.1 Module Dimension

PCB: FR4, 4layers, double side design  
 Typical PCB size (W×L): 15mm ×32mm.

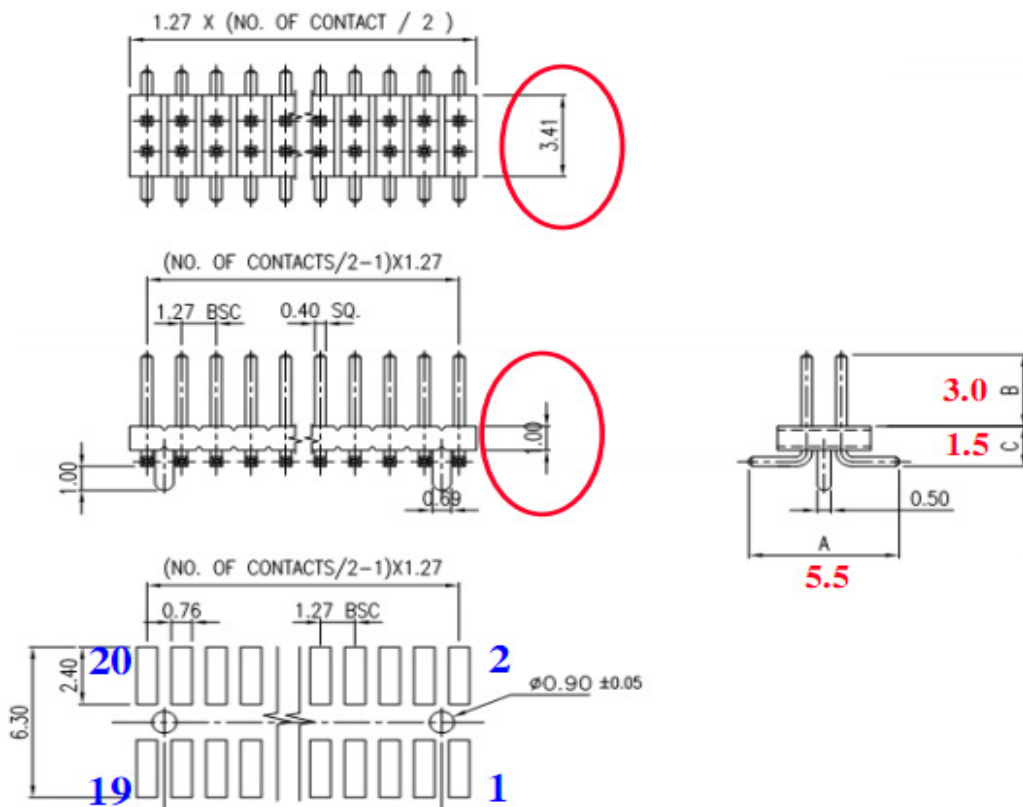


Unit: mm

### 2.2.2 Host Interface Connector

This module use 20 pins BTB connector for the Host-Module interface.

- 1.2mm Dual Row Pin header, SMT, 2x10Pin



➤ Here is the pin-out signals of module's connector. The pin number is refer to "Item2.2.1 module dimension".

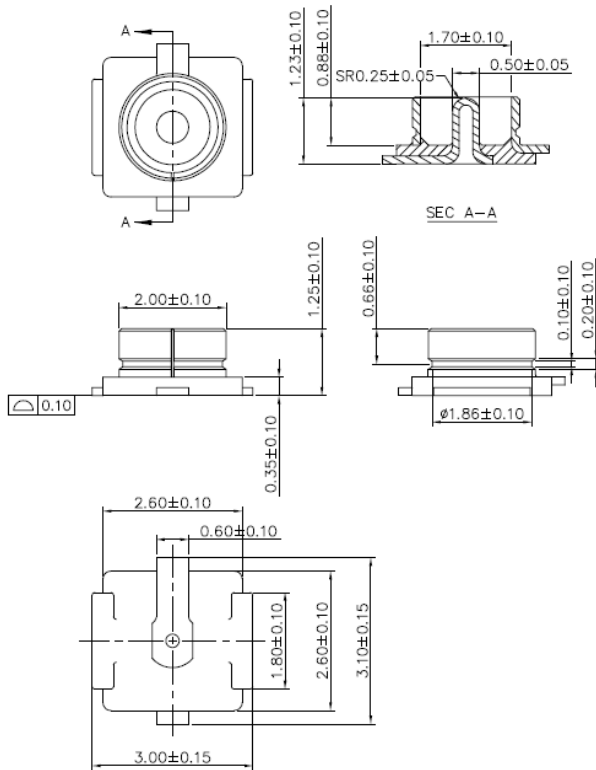
Table 1: Host-Module Connector Pin-out Signals

Pin-Out	No.	No.	Pin-Out
3V3	1	2	SD_CLK
3V3	3	4	GND
GND	5	6	SD_D0
RESET#	7	8	SD_D1
SLEEP_CLK (32.768kHz)	9	10	GND
GND	11	12	SD_D2
SD_CMD	13	14	SD_D3
PDn	15	16	GND
GND	17	18	HOST_WAKEUP_DEV
VIO	19	20	VIO

\*Note, Pin18[HOST\_WAKEUP\_DEV] of connector is connected with the pinM11[GPIO4] of 88W8787 TFBGA IC. It can be configured to IO input or IO output for wake-up application.

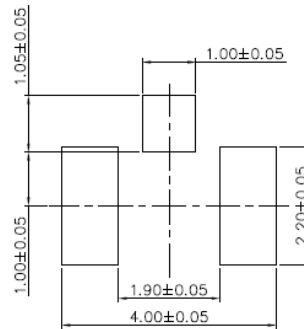
### 2.2.3 RF Connector

This module use U.F.L type RF connector for external WiFi/BT antenna connecting.



- NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL DIMENSION ARE IN MILLIMETER
  2. DIMENSION SHALL BE INTERPRETED PER ASME Y14.5M-1994
  3. MATERIAL: 307-0500-1009  
HOUSING: THERMOPLASTIC, UL 94V-0 RATING  
CONTACT: COPPER ALLOY, GOLD PLATING  
METAL SHELL: COPPER ALLOY, SILVER OR GOLD PLATING
  4. PRODUCT NO. MATRIX: SEE 307-0500-1393
  5. SPEC. OF PRODUCT PLEASE REFER TO FOXCONN DWG : 307-0300-1393
  6. THE CONCENTRATIONS OF Br&Cl CAN SATISFY THE REQUIREMENT OF HALOGEN-FREE IN DOCUMENT "EPI12".

REV	ECN	NO.	APP
A		BC-07-7064499	Yusor



X.±	X'±	UNITS	NAME(INTENDED USE)	FOXCONN
.X± 0.2	.X'±	MATL	RF HEADER	HON HAI PRECISION IND. CO.,LTD TAIPEI, TAIWAN, R.O.C.
.XX± 0.1	.XX'±		PART NO.(INTENDED USE)	TITLE: CUSTOMER DWG., SMT
.XXX±	.XXX'±	FINISH	KK23 SERIES	RF HEADER
		APPD:	Yihsin Chen	DWG NO.: 307-0000-1393
		QTY	CHKD: Wolfe Iiu	SCALE SHEET RE

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### 3. Electrical Specification

#### 3.1 Operating Condition

Parameter	Condition	Min.	Typ.	Max.	Unit
DC Input	3.3V	3.135	3.3	3.465	V
VIO Input(Note1)	3.3	2.97	3.3	3.63	
	2.6	2.5	2.6	2.7	
	1.8	1.62	1.8	1.98	
Module Current (DC input nominal)	WiFi TX only and BT sleep		214		mA
	WiFi RX only and BT sleep		168		
	BT TX only		29		
	BT RX only		24		
	WiFi/BT co-existence (wifi will run at 20MHz BW)		187		
	Standby with connection AP		30		
Operating Temperature	--	0		+65	°C
Storage Temperature	--	-10		+85	°C

Note1: Digital I/O power supply, VIO pin should be connected to the same supply which drives the SDIO interface of the host processor

#### 3.2 WiFi RF Specification

##### 3.2.1 802.11b Mode

Items	Contents				
Standard	IEEE802.11b				
Modulation Type	DSSS / CCK				
Frequency range	2400MHz~2483.5MHz				
Channel	CH1 to CH13				
Data rate	1, 2, 5.5, 11Mbps				
<b>TX Characteristics</b>	Min.	Typ.	Max.	Unit	
1. Transmitter Output Power					
1) 11b Target Power(average)	15.5	17	18.5	dBm	
2. Spectrum Mask @ target power					
1) fc +/-11MHz to +/-22MHz	-	-	-30	dBr	
2) fc > +/-22MHz	-	-	-50	dBr	
3. Frequency Error	-25	-1	+25	ppm	
4 Constellation Error( peak EVM)@ target power					
1) 1~11Mbps	-	-35dB			
<b>RX Characteristics</b>	Min.	Typ.	Max.	Unit	
5 Minimum Input Level Sensitivity					
1) 1Mbps (FER ≤8%)	-	-97	-83	dBm	
2) 2Mbps (FER ≤8%)	-	-94	-80	dBm	
3) 5.5Mbps (FER ≤8%)	-	-91	-79	dBm	
4) 11Mbps (FER ≤8%)	-	-88	-76	dBm	
6 Maximum Input Level (FER ≤8%)	-10	-	-	dBm	

### 3.2.2 802.11g Mode

Items	Contents				
Standard	IEEE802.11g				
Modulation Type	OFDM				
Frequency range	2400MHz~2483.5MHz				
Channel	CH1 to CH13				
Data rate	6, 9, 12, 18, 24, 36, 48, 54Mbps				
<b>TX Characteristics</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>	
1. Transmitter Output Power					
1) 11g Target Power(average)	13.5	15	16.5	dBm	
2. Spectrum Mask @ target power					
1) at fc +/- 11MHz	-	-	-20	dBr	
2) at fc +/- 20MHz	-	-	-28	dBr	
3) at fc > +/-30MHz	-	-	-40	dBr	
3 Constellation Error(EVM)@ target power					
1) 6Mbps	-	-31	-5	dB	
2) 9Mbps	-	-31	-8	dB	
3) 12Mbps	-	-30	-10	dB	
4) 18Mbps	-	-31	-13	dB	
5) 24Mbps	-	-29	-16	dB	
6) 36Mbps	-	-30	-19	dB	
7) 48Mbps	-	-31	-22	dB	
8) 54Mbps	-	-30	-25	dB	
4 Frequency Error	-25	-1.1	+25	ppm	
<b>RX Characteristics</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>	
5 Minimum Input Level Sensitivity					
1) 6Mbps (PER ≤ 10%)	-	-90	-85	dBm	
2) 9Mbps (PER ≤ 10%)	-	-89	-84	dBm	
3) 12Mbps (PER ≤ 10%)	-	-88	-82	dBm	
4) 18Mbps (PER ≤ 10%)	-	-86	-80	dBm	
5) 24Mbps (PER ≤ 10%)	-	-83	-77	dBm	
6) 36Mbps (PER ≤ 10%)	-	-80	-73	dBm	
7) 48Mbps (PER ≤ 10%)	-	-75	-69	dBm	
8) 54Mbps (PER ≤ 10%)	-	-74	-68	dBm	
6 Maximum Input Level (PER ≤ 10%)	-20		-	dBm	

**3.2.3 802.11n HT20 Mode**

Items	Contents				
Standard	IEEE802.11n HT20 @ 2.4GHz				
Modulation type	MIMO-OFDM				
Channel	CH1 to CH13				
Data rate (MCS index)	MCS0/1/2/3/4/5/6/7				
<b>TX Characteristics</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>	
1. Transmitter Output Power					
1) 11n HT20 Target Power(average)	12.5	14	15.5	dBm	
2. Spectrum Mask @ target power					
1) at fc +/- 11MHz	-	-	-20	dBr	
2) at fc +/- 20MHz	-	-	-28	dBr	
3) at fc > +/-30MHz	-	-	-45	dBr	
3. Constellation Error(EVM)@ target power					
1) MCS0	-	-31	-5	dB	
2) MCS1	-	-31	-10	dB	
3) MCS2	-	-31	-13	dB	
4) MCS3	-	-31	-16	dB	
5) MCS4	-	-31	-19	dB	
6) MCS5	-	-30	-22	dB	
7) MCS6	-	-31	-25	dB	
8) MCS7	-	-30	-28	dB	
4. Frequency Error	-25	-1.2	+25	ppm	
<b>RX Characteristics</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>	
5. Minimum Input Level Sensitivity					
1) MCS0 (PER $\leq$ 10%)	-	-89	-82	dBm	
2) MCS1 (PER $\leq$ 10%)	-	-87	-79	dBm	
3) MCS2 (PER $\leq$ 10%)	-	-85	-77	dBm	
4) MCS3 (PER $\leq$ 10%)	-	-82	-74	dBm	
5) MCS4 (PER $\leq$ 10%)	-	-78	-70	dBm	
6) MCS5 (PER $\leq$ 10%)	-	-74	-66	dBm	
7) MCS6 (PER $\leq$ 10%)	-	-72	-65	dBm	
8) MCS7 (PER $\leq$ 10%)	-	-71	-64	dBm	
6. Maximum Input Level (PER $\leq$ 10%)	-20		-	dBm	

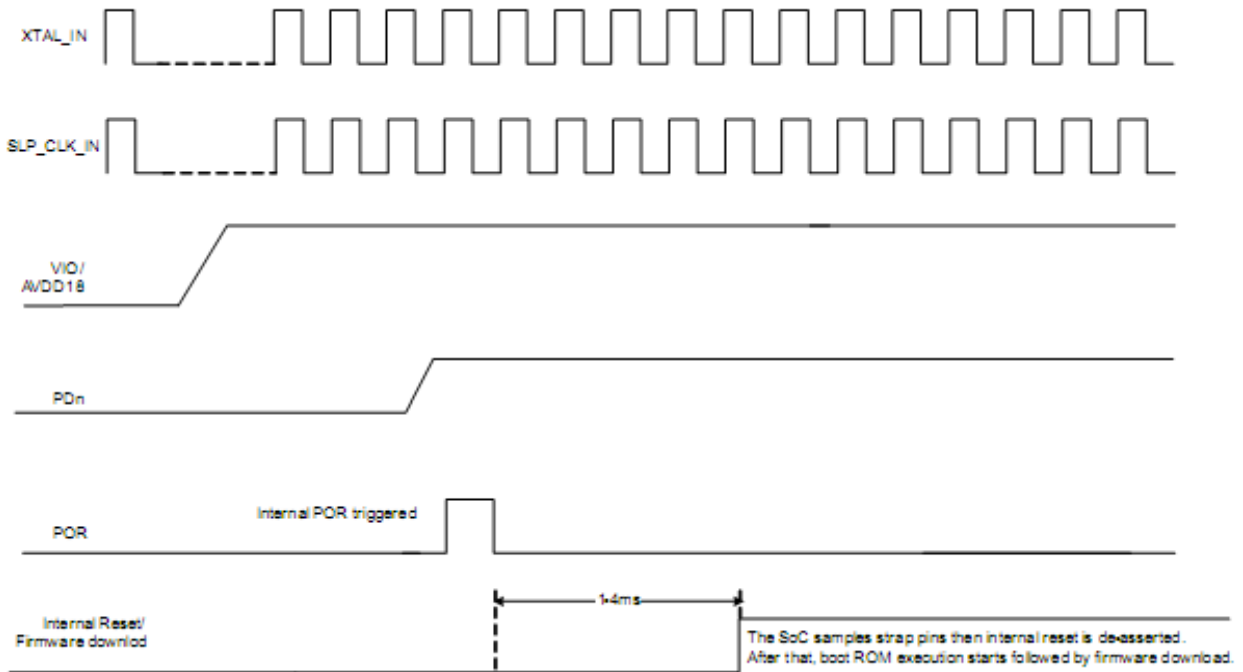
**3.2.4 802.11n HT40 Mode**

Items	Contents				
Standard	IEEE802.11n HT40 @ 2.4GHz				
Modulation type	MIMO-OFDM				
Channel	CH3 to CH11				
Data rate (MCS index)	MCS0/1/2/3/4/5/6/7				
<b>TX Characteristics</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>	
1. Transmitter Output Power					
1) 11n HT40 Target power(average)	12.5	14	15.5	dBm	
2. Spectrum Mask @ target power					
1) at fc +/- 22MHz	-	-	-20	dBr	
2) at fc +/- 40MHz	-	-	-28	dBr	
3) at fc > +/-60MHz	-	-	-45	dBr	
3. Constellation Error(EVM)@target power					
1) MCS0	-	-33	-5	dB	
2) MCS1	-	-32	-10	dB	
3) MCS2	-	-32	-13	dB	
4) MCS3	-	-32	-16	dB	
5) MCS4	-	-32	-19	dB	
6) MCS5	-	-32	-22	dB	
7) MCS6	-	-33	-25	dB	
8) MCS7	-	-33	-28	dB	
4. Frequency Error	-25	-1.3	+25	ppm	
<b>RX Characteristics</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>	
5. Minimum Input Level Sensitivity					
1) MCS0 (PER ≤ 10%)	-	-87	-79	dBm	
2) MCS1 (PER ≤ 10%)	-	-84	-76	dBm	
3) MCS2 (PER ≤ 10%)	-	-82	-74	dBm	
4) MCS3 (PER ≤ 10%)	-	-79	-71	dBm	
5) MCS4 (PER ≤ 10%)	-	-75	-67	dBm	
6) MCS5 (PER ≤ 10%)	-	-71	-63	dBm	
7) MCS6 (PER ≤ 10%)	-	-70	-62	dBm	
8) MCS7 (PER ≤ 10%)	-	-68	-61	dBm	
6. Maximum Input Level (PER ≤ 10%)	-20		-	dBm	

### 3.3 BT RF Specification

Items	Contents				
Standard	BTv2.1+EDR				
Modulation technology	HFSS				
Modulation type	GFSK, $\pi/4$ -DQPSK, 8DPSK				
Frequency range	2402MHz ~ 2480MHz				
Numbers of Channel	79 channels with 1MHz Bandwidth				
Data rate	1Mbps/2Mbps/3Mbps				
<b>TX Characteristics</b>					
	Min.	Typ.	Max.	Unit	
1. BDR Transmitter Output Power					
1) Target power (class2)(average)	-6	2.0	+4	dBm	
2. BDR Initial Carrier Freq. Tolerance					
	-75	-1.3	+75	KHz	
3. BDR Carrier Drift					
1) Drift Rate/50us					
	-20	4.7	+20	KHz	
2) Average Drift					
DH1	-25	-1	+25	dB	
DH3	-40	+2	+40	KHz	
DH5	-40	0	+40	KHz	
4. BDR Modulation Characteristic					
1) F1avg(kHz)					
	140	162.1	175	KHz	
2) F2avg(kHz)					
	115	146.5	-	KHz	
3) F1/F2 Ratio					
	0.8	0.9	-	-	
5 EDR Carrier Frequency Stability and Modulation Accuracy					
1) Initial Frequency Error					
	-75	-1.3	+75	KHz	
2) Frequency Error					
	-10	0.6	+10	KHz	
3) Block Frequency Error					
	-75	-1.2	+75	KHz	
4) RMS DEVM @2Mbps					
	0.2	0.045		-	
5) Peak DEVM @2Mbps					
	0.35	0.1		-	
6) 99% DEVM @% Symbols <= 0.3 (2Mbps)					
	99%	100%		-	
7) RMS DEVM @3Mbps					
	0.13	0.037		-	
8) Peak DEVM @3Mbps					
	0.25	0.08		-	
9) 99% DEVM @% Symbols <= 0.2(3Mbps)					
	99%	100%		-	
<b>RX Characteristics</b>					
	Min.	Typ.	Max.	Unit	
6. Minimum Input Level Sensitivity					
1) BDR Single slot sensitivity (BER $\leq$ 0.1%)					
	-	-87	-70	dBm	
2) BDR Multi slot sensitivity (BER $\leq$ 0.1%)					
	-	-87	-70	dBm	
3) EDR sensitivity@2Mbps (BER $\leq$ 0.01%)					
	-	-86	-70	dBm	
4) EDR sensitivity@3Mbps (BER $\leq$ 0.01%)					
	-	-77	-70	dBm	
7. Maximum Input Level (BER $\leq$ 0.1%)					
	-20		-	dBm	

### 3.4 Power On Sequence



- PDn must remain asserted for a minimum of 1ms after VIO, SLP\_CLK and XTAL\_IN are stable.
- For auto reference clock detection, the sleep clock (32.768KHz) must be used and must be stable before PDn is de-asserted.

### 3.5 SDIO Host Interface Specification

Symbol	Parameter	Condition	Min	Typ	Max	Units
f <sub>PP</sub>	Clock Frequency	Normal	0	--	25	MHz
		High Speed	0	--	50	MHz
T <sub>WL</sub>	Clock Low Time	Normal	10	--	--	ns
		High Speed	7	--	--	ns
T <sub>WH</sub>	Clock High Time	Normal	10	--	--	ns
		High Speed	7	--	--	ns
T <sub>ISU</sub>	Input Setup Time	Normal	5	--	--	ns
		High Speed	6	--	--	ns
T <sub>IH</sub>	Input Hold Time	Normal	5	--	--	ns
		High Speed	2	--	--	ns
T <sub>ODLY</sub>	Output Delay Time	--	--	--	7.33	ns
T <sub>OH</sub>	Output Hold Time	High Speed	2.5	--	--	ns

Figure2 SDIO Timing Date

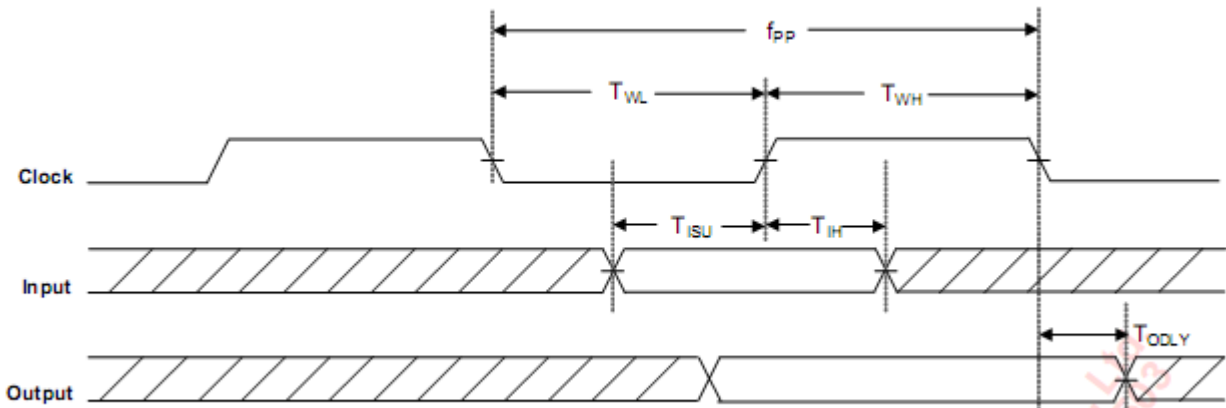


Figure3 SDIO Timing Diagram-Normal Mode

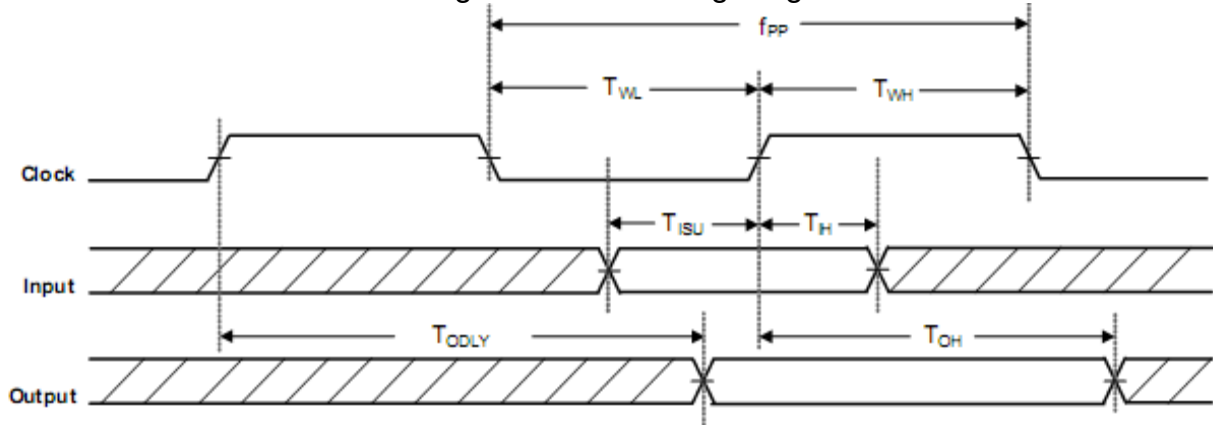


Figure4 SDIO Timing Diagram-High Speed Mode



## 4. Compliance and Certification

### 4.1 FCC Compliance

One of the main reasons for considering a PWB module is that the module is being considered for multiple products, the ODM supplier perform FCC Part 15C (15.247) for 2.4GHz. The customer would be responsible for FCC Part 15B product compliance testing.

## FCC Notice

### ***Federal Communication Commission Interference Statement***

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.

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.

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.

### **IMPORTANT NOTE:**

#### **FCC Radiation Exposure Statement:**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

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

FOXCONN declared that M26H002 is limited in CH1~11 from 2412 to 2462MHz by specified firmware controlled in USA.

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

The antenna must be installed such that 20 cm is maintained between the antenna and users, and

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 (for example, digital device emissions, PC peripheral requirements, etc.).





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**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 TX FCC ID: MCLM26H002".

### **Manual Information That Must be Included**

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 users manual of the end product which integrate this module.

**The users manual for OEM integrators must include the following information in a prominent location “ IMPORTANT NOTE: To comply with FCC RF exposure compliance requirements, the antenna used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.**