

AW-NM387

IEEE 802.11 b/g/n Wireless LAN & Bluetooth Module

Datasheet

Version 0.4

Document release	Date	Modification	Initials	Approved
Version0.1	2010/06/30	Initial version	Max Huang	Ivan Chen
Version0.12	2010/7/1	Update page 9 pin out and page 10 reference design	Max Huang	Ivan Chen
Version0.2	2010/7/8	Update final mechanical characteristic	Scott Hsieh	Ivan Chen
Version0.3	2010/7/19	Update Page 10 reference design	Scott Hsieh	Ivan Chen
Version0.4	2010/8/19	Update Sleep_CLK pin define	Scott Hsieh	Ivan Chen

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1. General Description

1-1. Product Overview and Functional Description

AzureWave Technologies, Inc. introduces the first IEEE 802.11b/g/n WLAN & Bluetooth module IC---**AW-NM387**. The module is targeted to mobile devices including **Personal Digital Assistants (PDAs), Netbook, Tablet and Gaming Devices** which need small package module, low power consumption, multiple interfaces and OS support. By using AW-NM387, the customers can easily enable the Wi-Fi , and BT embedded applications with the benefits of **high design flexibility, short development cycle, and quick time-to-market.**

Compliance with the IEEE 802.11b/g/n standard, the AW-NM387 uses Direct Sequence Spread Spectrum (**DSSS**), Orthogonal Frequency Division Multiplexing (**OFDM**), **DBPSK, DQPSK, CCK** and **QAM** baseband modulation technologies. A high level of integration and full implementation of the power management functions specified in the IEEE 802.11 standard minimize the system power requirements by using AW-NM387. In addition to the support of **WPA/WPA2** and **WEP** 64-bit and 128-bit encryption, the AW-NM387 also supports the **IEEE 802.11i** security standard through the implementation of **Advanced Encryption Standard (AES)/Counter Mode CBC-MAC Protocol (CCMP)**, Wired Equivalent Privacy(**WEP**) with Temporal Key Integrity Protocol(**TKIP**), Advanced Encryption Standard(**AES**)/Cipher-Based Message Authentication Code(**CMAC**), and WLAN Authentication and Privacy Infrastructure (**WAPI**) security mechanisms.

For the video, voice and multimedia applications the AW-NM387 support **802.11e Quality of Service (QoS)**.

For Bluetooth operation, AW-NM387 is **Bluetooth 3.0 + High Speed (HS) also complaint with Bluetooth 2.1 + Enhanced Data Rate (EDR)**. **Bluetooth 3.0 + HS** can make it **easier to connect**

The AW-NM387 supports **SDIO** for WLAN to the host processor. **SDIO** interface are available to connect the BT core the host processor.

AW-NM387 is suitable for multiple mobile processors for different applications. With the support **cellular phone co-existence**, the AW-NM387 is also the best solution for mobile phones and PDA phones applications.

AW-NM387 module adopts Marvell's latest highly-integrated WLAN & Bluetooth SoC---**88W8787**. All the other components are implemented by all means to reach the mechanical specification required.

1-2. Key Features

- ✦ **Small footprint: 23mm(L) x 11mm(W) x 2.4 mm(H)**
- ✦ **SDIO interfaces support for WLAN**
- ✦ **SDIO for Bluetooth**
- ✦ **Bluetooth 3.0 + High Speed (HS) also complaint with Bluetooth 2.1 + Enhanced Data Rate (EDR)**
- ✦ **Cellular phone co-existence support**
- ✦ **Multiple power saving modes for low power consumption**
- ✦ **IEEE 802.11i for advanced security**
- ✦ **Quality of Service (QoS) support for multimedia applications**
- ✦ **Drip-in WLAN Linux drivers are Android ready and validated on Android based systems.**
- ✦ **Support for Linux kernel versions up to 2.6.32.**
- ✦ **Support for BlueZ v4.47 Bluetooth profiles stack used in Android Éclair**
- ✦ **Simultaneous AP-STA**
- ✦ **Support China WAPI**
- ✦ **Lead-free design**

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3. Specifications Table

Product Description	Wireless LAN & Bluetooth Module
WLAN Standard	IEEE 802.11b/g/n, Wi-Fi compliant
Bluetooth Standard	Bluetooth 3.0 +high speed complaint with Bluetooth 2.1+Enhanced Data Rate (EDR)
Host Interface	WLAN and Bluetooth through SDIO
Major Chipset	Marvell 8787
Dimension	11mm x 23mm x 2.4mm
Operating Conditions	
Voltage	3.3V, +/- 10%
Temperature	Operating: -20 ~ 70°C ; Storage: -40 ~ 85°C
Electrical Specifications	
Frequency Range	2.4 GHz ISM radio band
Number of Channels	802.11b: USA, Canada and Taiwan – 11 Most European Countries – 13 France – 4, Japan – 14 802.11g: USA, Canada and Taiwan – 11 Most European Countries – 13 Japan – 13 802.11n(HT20): Channel 1~14(2412~2484) 802.11n(HT40): Channel 1~7(2422~2472)
Modulation	DSSS, OFDM, DBPSK, DQPSK, CCK, 16-QAM, 64-QAM for WLAN GFSK (1Mbps), Π/4 DQPSK (2Mbps) and 8DPSK (3Mbps) for Bluetooth
Output Power	WLAN:

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	802.11b(Ch1~13): typical 17dBm +/- 2dBm 802.11b(Ch14): typical 10dBm +/- 2dBm 802.11g: typical 14dBm +/- 2dBm 802.11n: typical HT20 13dBm +/- 2dBm HT40 12dBm +/- 2dBm Typical power: Bluetooth Bluetooth Class 1.5>1dBm
Antenna	WLAN&BT through U.FL connector
Receive Sensitivity	WLAN: 802.11b: Minimum -86dBm at 11Mbps 802.11g: Minimum -71dBm at 54Mbps 802.11n: Minimum -68dBm at HT20 MCS7 Minimum -65dBm at HT20 MCS7 Bluetooth: GFSK: typical -87dBm Π/4 DQPSK: typical -88dBm 8DPSK: typical -81dBm
Medium Access Protocol	CSMA/CA with ACK
Data Rates	WLAN 802.11b: 1, 2, 5.5, 11Mbps 802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps 802.11n up to 150Mbps Bluetooth Bluetooth 2.1+EDR data rates of 1,2, and 3Mbps
Operating Range	Open Space: ~300m ; Indoor: ~100m for WLAN Minimum 10 m indoor for Bluetooth The transmission speed may vary according to the environment)
Security	<ul style="list-style-type: none"> ◆ WAPI ◆ WEP 64-bit and 128-bit encryption with H/W TKIP processing ◆ WPA/WPA2 (Wi-Fi Protected Access) ◆ AES-CCMP hardware implementation as part of 802.11i security standard
Co-Existence	Bluetooth and cell phone(GSM/DCS/WCDMA/UMTS/3G) co-existence

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2. Electrical Characteristics

2-1. Absolute Maximum Ratings

Symbol	Parameter	Condition	Min	Typ	Max	Units
3.3V	PA and Internal voltage power supply			3.3	4.6	V
VIO	Host I/O power supply			1.8	2.3	V
				2.6	3.1	
				3.3	4.2	

2-2. Recommended Operating Conditions

Symbol	Parameter	Condition	Min	Typ	Max	Units	
3.3V	PA and Internal voltage power supply		3	3.3	3.6	V	
VIO	Host I/O power supply			1.62	1.8	1.98	V
				2.5	2.6	2.7	
				2.97	3.3	3.63	
External 1.8V	Analog I/O power supply (optional)		1.7	1.8	1.9	V	

2-3. Clock Specifications

AW-NM387 has internal reference clock source. The customer doesn't need to use external CLK.

2-3.1 External Sleep Clock Timing

External Sleep Clock is necessary for two reasons:

- Auto frequency Detection.
This is where the internal logic will bin the Ref clock source to figure out what is the reference clock frequency is. This is done so no strapping is needed for telling 8787 what the ref clock input is.
- Allow low current modes for BT to enter sleep modes such as sniff modes.

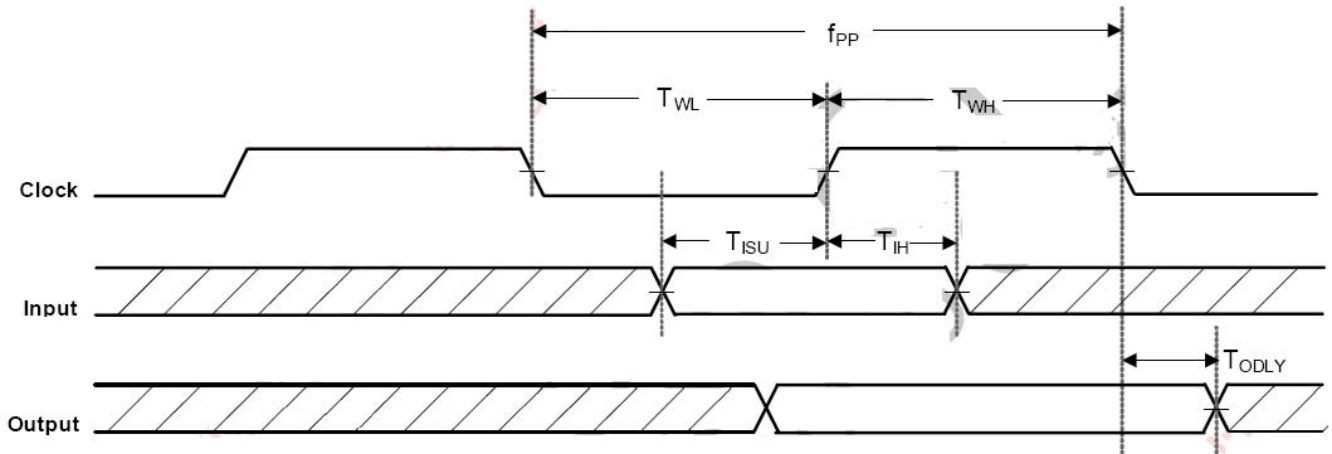
The AW-NM387 external sleep clock pin is powered from the 1.8V voltage supply.

Symbol	Parameter	Min	Typical	Max	Units
CLK	Clock Frequency Range	32 or 32.768 -50ppm	32 or 32.768	32 or 32.768 +50ppm	kHz
T _{HIGH}	Clock high time	40	--	--	ns
T _{LOW}	Clock low time	40	--	--	ns
T _{RISE}	Clock rise time	--	--	5	ns
T _{FALL}	Clock fall time	--	--	5	ns

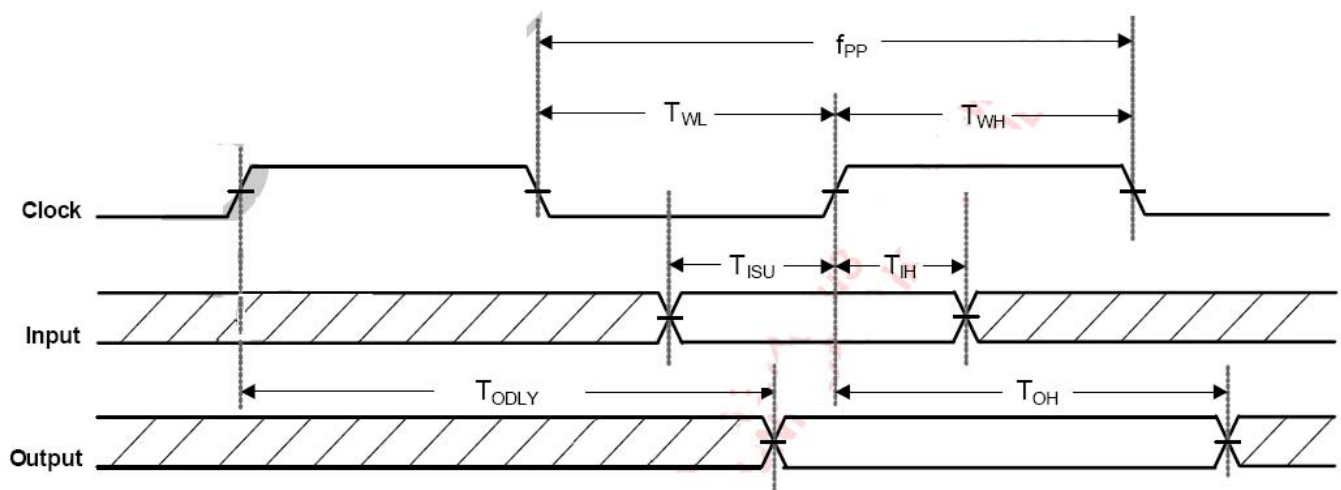
2-4. SDIO Host Interface Specifications

Referred from Marvell hardware specifications

SDIO Protocol Timing Diagram



SDIO Protocol Timing Diagram—High Speed Mode



SDIO Timing Data

Symbol	Parameter	Condition	Min	Typ	Max	Units
f _{pp}	CLK Frequency	Normal	0		25	MHz
		High Speed	0		75	
T _{WH}	CLK High Time	Normal	10			ns
		High Speed	7			
T _{WL}	CLK Low Time	Normal	10			
		High Speed	7			
T _{ISU}	Input Setup Time	Normal	5			
		High Speed	6			
T _{IH}	Input Hold Time	Normal	5			
		High Speed	2			
T _{ODLY}	Output Delay Time		0		7.33	
T _{OH}	Output Hold Time	High Speed	2.5			

2-5. Pin Out Power Supply Use

VIO
PDh
SD_CLK
SD_CMD
SD_DAT[1]
SD_DAT[2]
SD_DAT[3]
WiFi_LED
BT_LED

3. Pin Definition

Pin Assignment

Pin No	Definition	Basic Description	Type
1	GND		
2	External 1.8V(optional)	1.8V voltage optional. Default model is used internal 1.8V, so please keep this pin float. If the customer wants to use external 1.8V model. Please contact to AzureWave.	P
3	PDn	Full Power Down(active low as long as system need) 0=power down mode 1=normal mode (1)Connect to power down pin of host Note: Needs the external host to driver this pin high for normal operation. No internal pull-up on this pin.	I
4	VIO	1.8V/2.6/3.3V Host interface voltage	P
5	SLEEP_CLK	Sleep Clock Input Used for WALN, Bluetooth, and FM low-power modes. External sleep clock of 32.768KHZ must be used for auto reference clock calibration and for WALN/Bluetooth/FM low power operation.	I
6	GND		
7	SD_CMD	SDIO 4-bit Mode: Command/Response SDIO 1-bit Mode: Command Line SDIO SPI Mode: Data Input	I/O
8	SD_DAT[0]	SDIO 4-bit Mode: Data line bit[0] SDIO 1-bit Mode: Data line SDIO SPI Mode: Data output	I
9	SD_DAT[1]	SDIO 4-bit Mode: Data line bit[1] SDIO 1-bit Mode: Interrupt SDIO SPI Mode: Reserved	I/O
10	SD_DAT[2]	SDIO4-bit Mode: Data line bit[2]or Read Wait(optional) SDIO 1-bit Mode: Read Wait(optional) SDIO SPI Mode: Reserved	I/O
11	SD_CLK	SDIO 4-bit Mode: Clock Input SDIO 1-bit Mode: Clock Input SDIO SPI Mode: Clock Input	I/O
12	SD_DAT[3]	SDIO 4-bit Mode: Data line bit[3] SDIO 1-bit Mode: Reserved SDIO SPI Mode: Card Select(active low)	I/O
13	WIFI_LED/GPIO1	WIFI LED function	I/O
14	BT_LED/GPIO 17	BT LED function	I/O
15	3.3V		P
16	3.3V		P
17	GND		

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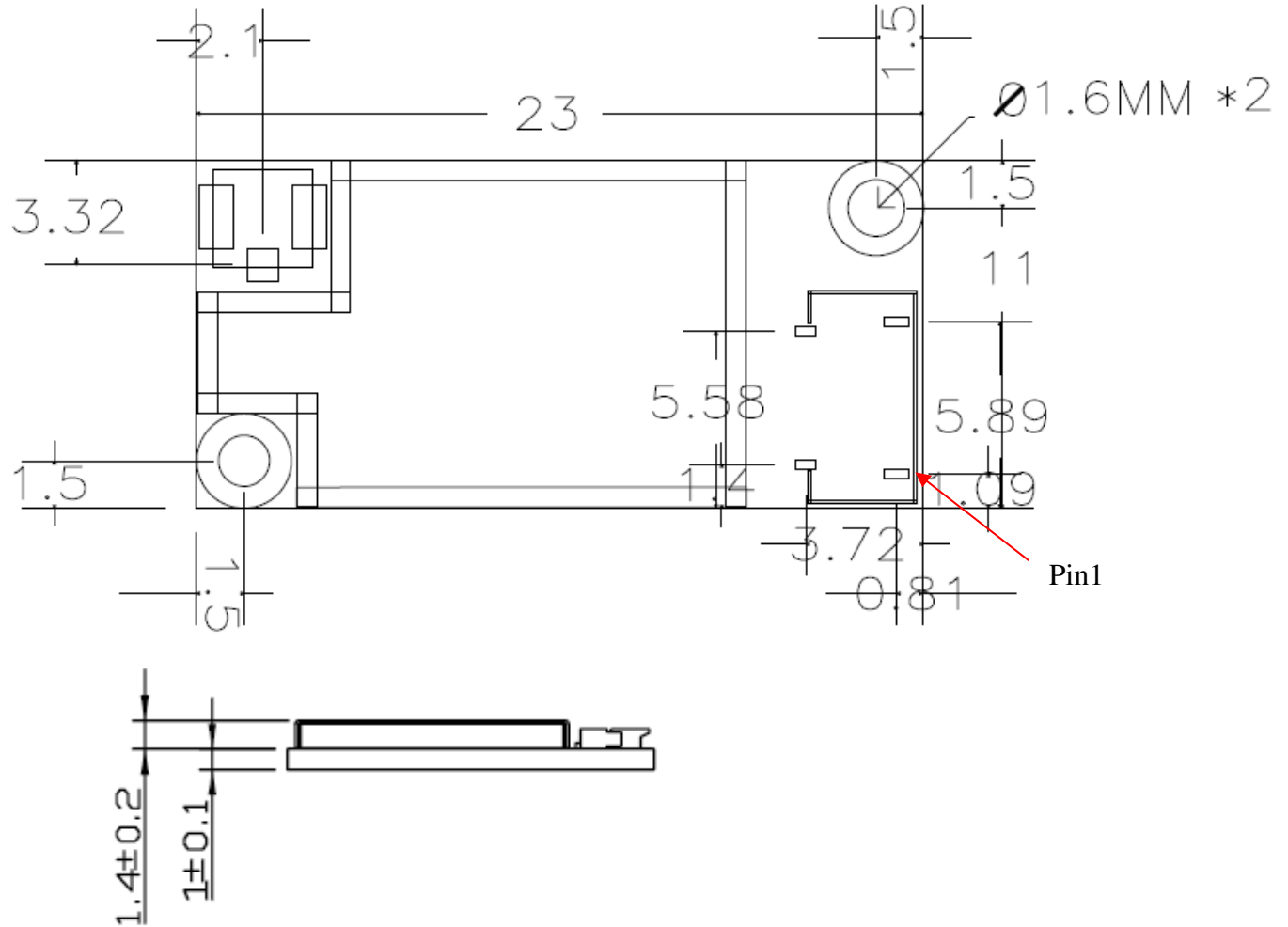
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5. Mechanical Characteristic

5.1 Outline

11X23mm



Tolerances unless otherwise specified : $\pm 0.15\text{mm}$

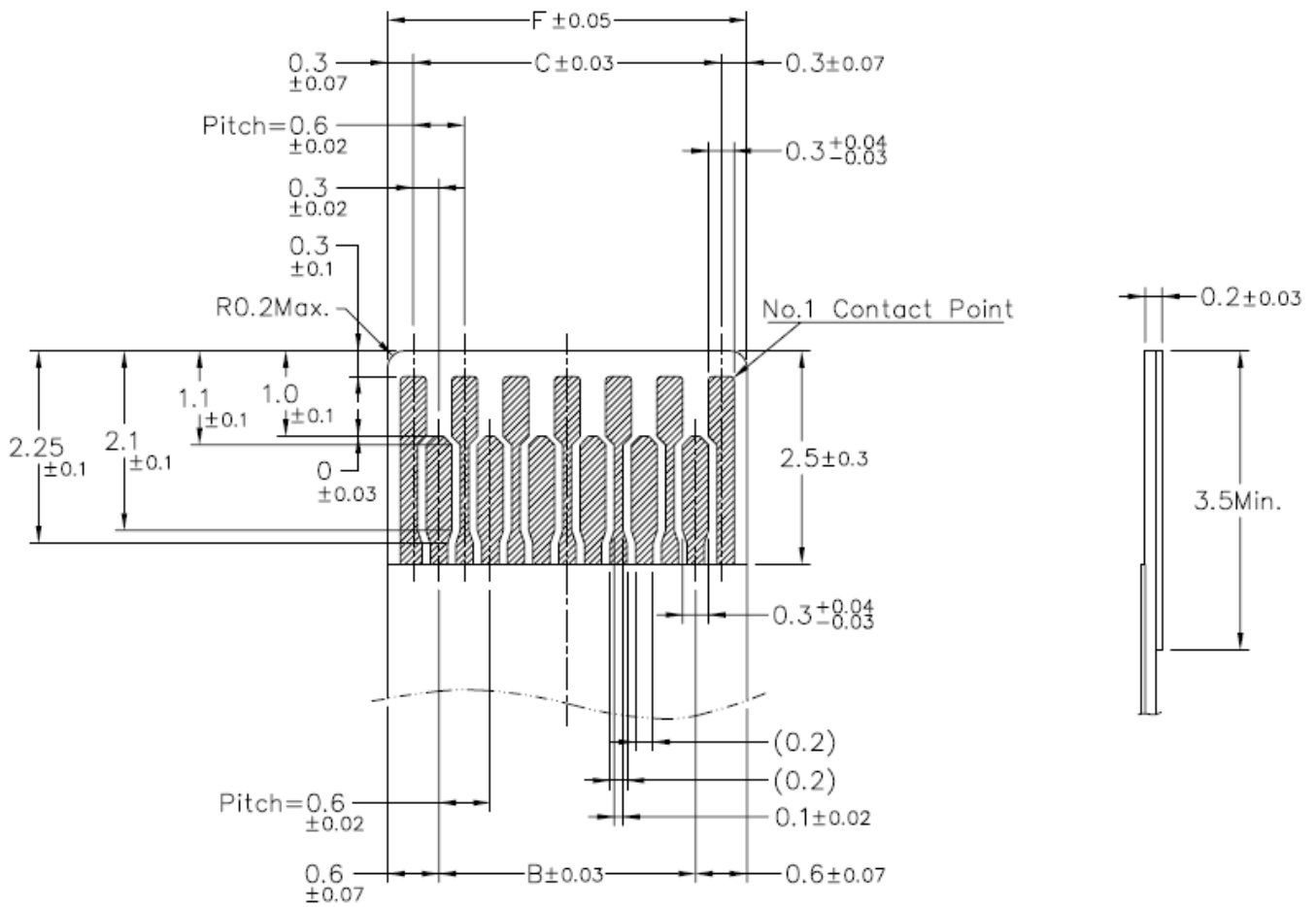
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5.2 Applicable FPC

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Applicable FPC

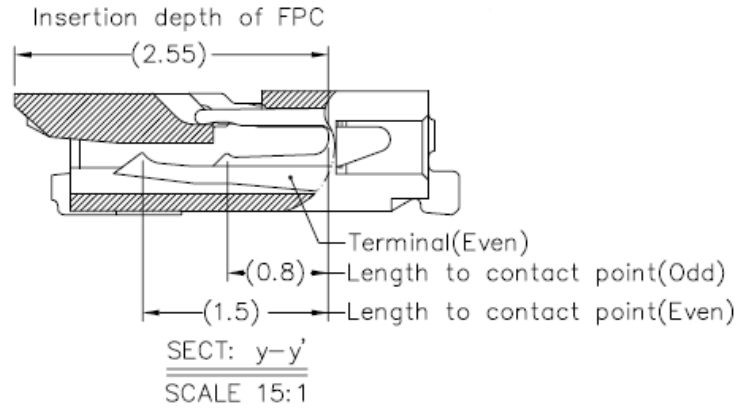
No of Contacts	B	C	F
17	4.2mm	4.8mm	5.4mm

5.3 Connector Insertion Depth of FPC

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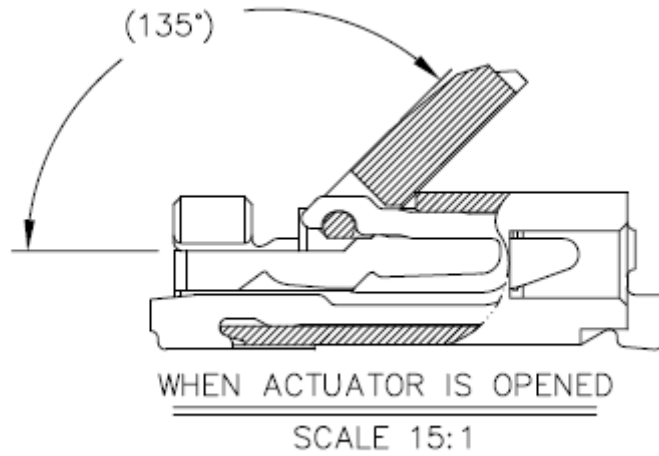
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5.4 When Connector Actuator is opened



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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.

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 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.

IMPORTANT NOTE:

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

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,
- 3) For all products market in US, OEM has to limit the operation channels in CH1 to CH11 for

2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end-user regarding to Regulatory Domain change.

As long as 3 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: TLZ-NM387".

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.

Industry Canada statement:

This device complies with RSS-210 of the Industry Canada 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.

Ce dispositif est conforme à la norme CNR-210 d'Industrie Canada applicable aux appareils radio exempts de licence. Son fonctionnement est sujet aux deux conditions suivantes: (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

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IMPORTANT NOTE:

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 minimum distance 20cm between the radiator & your body.

NOTE IMPORTANTE:

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

This device is intended only for OEM integrators under the following conditions: (For module device use)

- 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,
- 3) For all products market in Canada, OEM has to limit the operation channels in CH1 to CH11 for 2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end-user

regarding to Regulatory Domain change.

As long as 3 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.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

- 1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
- 2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne,
- 3) Pour tous les produits vendus au Canada, OEM doit limiter les fréquences de fonctionnement CH1 à CH11 pour bandes de fréquences 2.4G grâce aux outils de microprogrammation fournis. OEM ne doit pas fournir d'outil ou d'informations à l'utilisateur final en ce qui concerne le changement de réglementation de domaine.

Tant que les 3 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

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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 Canada authorization is no longer considered valid and the IC 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 Canada authorization.

NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

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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 IC: 6100A-NM387".

Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut

être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 6100A-NM387".

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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.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

This radio transmitter (AW-NM387,IC:6100A-NM387) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Ant.	Manufacture	Model	Peak Gain(dBi)	Antenna Type
1	MAGLAYERS	MSA-4008-25GC1-A1	2.98	PiFa
2	MAGLAYERS	MSA-3305-2G4C1-A1	2.28	PiFa
3	INPAQ	WA-P-LA-02-019	2.3	PiFa
4	INPAQ	EAMS13001	1.05	PiFa
5	WNC	81XCAE15.G07	-2.5	PiFa
6	WNC		1.67	PiFa
7	Etertronics Inc.	6036B0067403	0.26	PiFa
8	Walsin Tech.Corp	RFPCA2207101FABE01	1.39	PiFa
9	Anden	150872-30	1.25	PiFa

All antenna's impedance is 50 ohms.