802.11 a/b/g/n/ac 2x2 dual band WLAN PCIe Card

WM862FEMD Application Note

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Title: WM862FEMD-Application Note_V01_20170622
Version: v0.1
Date: 06/22/2017

Revision History

Rev.	Date	Author	Revision Description
v0.1	June,22, 2017	Jerry Zeng	Initial Draft

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1. Hardware Features

1.1 Product specification

Radio Chipset	QCA9882
WLAN Standards	IEEE 802.11a/b/g/n/ac compliant
Antenna connector	U.FL connector
Modulation	802.11a/b/g/n/ac: CCK(11&5.5 Mbps), DQPSK (2Mbps), DBPSK (1Mbps), DSSS, DBPSK, DQPSK, OFDM, BPSK, QPSK, 16QAM, 64QAM, 256QAM
Power Consumption	Operation (max.) < 3W
Voltage	3.3 VDC from host (+/- 0.2V)

1.2 RF specification

Radio spec is listed as following,

802.11n Radio Specifications	
Operating Frequency	• 2.412 GHz to 2.462 GHz
Operating Channels	• Based on regulatory domain
Modulation	• Orthogonal Frequency Division Multiplexing (OFDM)
Transmit Power	• 23.29dBm(Max. power)
Configurable Association Rates	• Modulation Coding Scheme MCS 0 – MCS 15 (6.5Mbps – 300Mbps)
802.11b Radio Specifications	
Operating Frequency	• 2.412 GHz to 2.462 GHz

Operating Channels	• Based on regulatory domain
Transmit Power	•24.89dBm(Max. power)
Modulation	• Direct-Sequence-Spread-Spectrum (DSSS)
Configurable Association Rates	• 11 Mbps, 5.5 Mbps, 2 Mbps, and 1 Mbps with automatic fallback
802.11g Radio Specifications	
Configurable Association Rates	• 2.412 GHz to 2.462 GHz
Operating Channels	• Based on regulatory domain
Modulation	• Orthogonal Frequency Division Multiplexing (OFDM)
Operating Frequency Transmit Power	•24.44dBm(Max. power)
Configurable Association Rates	• 54 Mbps, 48 Mbps, 36 Mbps, 24 Mbps, 18 Mbps, 12 Mbps, 9 Mbps and 6 Mbps with automatic fallback

802.11ac Radio Specifications	
Operating Frequency	• 5.18 GHz to 5.825 GHz
Operating Channels	• Based on regulatory domain
Modulation	• Orthogonal Frequency Division Multiplexing (OFDM)
Transmit Power	• 22.87dBm(Max. power)
Configurable Association Rates	• Modulation Coding Scheme MCS 0 – MCS 19 (6.5Mbps – 866.7Mbps)
802.11n Radio Specifications	
Operating Frequency	• 5.18 GHz to 5.825 GHz
Operating Channels	• Based on regulatory domain
Modulation	• Orthogonal Frequency Division Multiplexing (OFDM)
Transmit Power	• 22.87dBm(Max. power)
Configurable Association Rates	• Modulation Coding Scheme MCS 0 – MCS 15 (6.5Mbps – 300Mbps)
802.11a Radio Specifications	

Operating Frequency	• 5.18 GHz to 5.825 GHz
Operating Channels	• Based on regulatory domain
Modulation	• Orthogonal Frequency Division Multiplexing (OFDM)
Transmit Power	• 22.23dBm(Max. power)
Configurable Association Rates	• 54 Mbps, 48 Mbps, 36 Mbps, 24 Mbps, 18 Mbps, 12 Mbps, 9 Mbps and 6 Mbps with automatic fallback

1.3 PCIe Pin Definition

Table 1-1 WM862FEMD Pin Definition

RF CARD pin definition				
PCIe Signal Name	Pin #	Description	I/O	NOTE
WAKE_L	1	wake event system	O	
CLKREQ_L	7	Reference clock request signal	O	
REFCLK-	11	PCI Express differential reference clock	I	
REFCLK+	13	PCI Express differential reference clock	I	
GPIO0	20	WLAN_DISABLE_L	I	
RESET_L	22	Functional reset to the card	I	
PER0N	23	PCI Express x1 data interface	I	
PER0P	25	PCI Express x1 data interface	I	
PET0N	31	PCI Express x1 data interface	O	
PET0P	33	PCI Express x1 data interface	O	

WLAN_LED	44	provide status indicators via LED devices Active low signals	O	
USB_DN	36	USB signal	I/O	NOT USED
USB_DP	38	USB signal	I/O	NOT USED
3.3V	2,24,41,52	power source		
GND	4,9,15,18,21,26,27,29 34,35,40,43,50	GND		

1.4 PCIe Signal Description

The WM862FEMD PCI Express interface pins are described in “Pin Definition” at Table1-1. The interface pins grouped by functional type shows as below.

Table 1-2 Type of PCI Express Interface Signals

Type	Pins
Differential reference clock (100MHz)	REFCLK-
	REFCLK+
Differential receive	PETp0
	PETn0
Differential transmit	PERn0
	PERp0
Reference clock request	CLKREQ_L
Request to service a function initiated wake event	WAKE_L
PCI Express fundamental reset	RESET_L

1.5 PCB Specification

The PCB Dimension (W x L x D) (mm) : 30mm x 50.95mm x 1mm

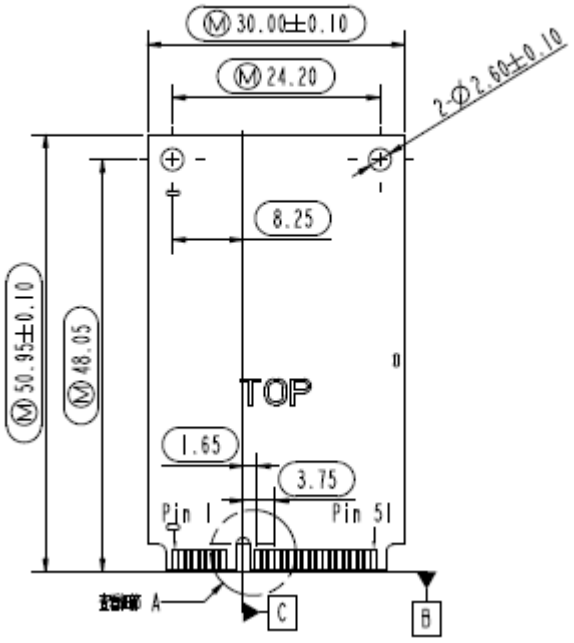

Figure 1-1 WM862FEMD PCB Outlin

2. Application Note

2.1 Login

IP address: 192.168.1.1

Telnet login: username & password are not needed.

2.2 WiFi setting commands

Only need to run below commands once.

```
uci set wireless.@wifi-device[2].country=US
uci set wireless.@wifi-device[2].hwmode=11ac
uci set wireless.@wifi-device[2].disabled=0
uci set wireless.@wifi-device[2].htmode=VHT80
uci set wireless.@wifi-device[2].channel=149
uci set wireless.@wifi-device[2].txchainmask=3
uci set wireless.@wifi-device[2].rxchainmask=3
uci set wireless.@wifi-iface[2].wds=1
uci set wireless.@wifi-iface[2].mode=ap
uci set wireless.@wifi-iface[2].ssid=WP8333-wifi2
uci set wireless.@wifi-iface[2].encryption=none
uci set wireless.@wifi-iface[2].device=wifi2

uci commit wireless
wifi
iwconfig
```

a) Set country code

```
uci set wireless.@wifi-device[2].country=US
uci commit wireless
wifi

uci set wireless.@wifi-device[2].country=GB
uci commit wireless
wifi
```

Regulatory domain	Country code
FCC	US
CE	GB
IC	CA
Japan	JP (for 2.4G radio) 4015 (for 5G radio)

b) Set wireless mode

- Radio 3:

```
uci set wireless.@wifi-device[2].hwmode=11ac
uci commit wireless
wifi
```

Note: available hwmode for Radio 3: **11b**, **11g**, **11ng, 11a**, **11na**, **11ac**

c) Set bandwidth and channel

- Radio 3:

```
uci set wireless.@wifi-device[2].htmode=VHT80
uci set wireless.@wifi-device[2].channel=149
uci commit wireless
wifi
```

Note: available htmode for Radio 3: **VHT80**, **HT40+**, **HT40-**, **HT20**
VHT80 is only applicable for 11ac mode.

2.3 Continuous Rx command

2.4G:

```
uci set wireless.wifi2.disabled=0 &&
uci set wireless.wifi2.hwmode='11ng' &&
uci set wireless.wifi2.htmode='HT40+' &&
uci set wireless.wifi2.channel='1' &&
uci set wireless.@wifi-iface[2].mode='monitor' &&
```

```
uci commit wireless &&
wifi
```

Note: available hwmode for Radio 3 2G: **11b**, **11g**, **11ng,**

available htmode for Radio 3 2G: **HT40+**, **HT40-**, **HT20**

5G:

```
uci set wireless.wifi2.disabled=0 &&
uci set wireless.wifi2.hwmode='11ac' &&
uci set wireless.wifi2.htmode='VHT80' &&
uci set wireless.wifi2.channel='149' &&
uci set wireless.@wifi-iface[2].mode='monitor' &&
uci commit wireless &&
wifi
```

Note: available hwmode for Radio 3 5G: **11a**, **11na**, **11ac**

available htmode for Radio 3 5G: **VHT80**, **HT40+**, **HT40-**, **HT20**

FCC Statement:

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.

For product available in the USA/Canada market, only channel 1~11 can be operated. Selection of other channels is not possible.
This device is restricted for indoor use.

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 28 cm between the radiator & your body.

IMPORTANT NOTE:
This module is intended for OEM integrator only and limited to host with brand: LITE-ON, MOJO and model: WP8333V1, C-110. The OEM integrator is still responsible for the FCC compliance requirement of the end product, which integrates this module.

USERS MANUAL OF THE END PRODUCT:
In the users manual of the end product, the end user has to be informed to keep at least 28 cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied.

The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

LABEL OF THE END PRODUCT:
The final end product must be labeled in a visible area with the following " Contains TX FCC ID: PPQ-WM862FEMD ".

The FCC part 15.19 statement below has to also be available on the label: This device complies with Part 15 of 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.

Antenna list:

Ant.	Brand	Model Name	Antenna Type	Connector	Radio
1	Master Wave Technology CO., LTD	98P7NPIPF000	PCB Antenna	I-PEX	R1
2	Master Wave Technology CO., LTD	98P7NPIPF001	PCB Antenna	I-PEX	R1
3	Master Wave Technology CO., LTD	98P7PUIPF000	PCB Antenna	I-PEX	R2
4	Master Wave Technology CO., LTD	98P7QUIPF000	PCB Antenna	I-PEX	R2
5	Master Wave Technology CO., LTD	98P7RPIPF000	PCB Antenna	I-PEX	R3
6	Master Wave Technology CO., LTD	98P7RPIPF001	PCB Antenna	I-PEX	R3
7	Master Wave Technology CO., LTD	98P7SMIPF000	PCB Antenna	I-PEX	R4

Ant.	Gain (dBi)												
	Radio 1			Radio 2				Radio 3					Radio 4
	2.4G	5G B1	5G B4	5G B1	5G B2	5G B3	5G B4	2.4G	5G B1	5G B2	5G B3	5G B4	BT
1	6.3	4.3	5.3	-	-	-	-	-	-	-	-	-	-
2	6.5	4.9	6.1	-	-	-	-	-	-	-	-	-	-
3	-	-	-	5.6	5.8	6.1	5.9	-	-	-	-	-	-
4	-	-	-	5.6	6.0	5.4	4.6	-	-	-	-	-	-
5	-	-	-	-	-	-	-	6.5	4.7	4.7	5.6	6.0	-
6	-	-	-	-	-	-	-	6.5	4.8	5.4	5.8	5.5	-
7	-	-	-	-	-	-	-	-	-	-	-	-	2.1

Note1: The EUT has seven antennas.

IC Statement:

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.

For product available in the USA/Canada market, only channel 1~11 can be operated. Selection of other channels is not possible.

Pour les produits disponibles aux États-Unis / Canada du marché, seul le canal 1 à 11 peuvent être exploités. Sélection d'autres canaux n'est pas possible.

This radio transmitter (IC: 4491A-WM862FEMD) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain 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.

*Le présent émetteur radio (*IC: 4491A-WM862FEMD*) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.*

Antenna list:

Ant.	Brand	Model Name	Antenna Type	Connector	Radio
1	Master Wave Technology CO., LTD	98P7NPIPF000	PCB Antenna	I-PEX	R1
2	Master Wave Technology CO., LTD	98P7NPIPF001	PCB Antenna	I-PEX	R1
3	Master Wave Technology CO., LTD	98P7PUIPF000	PCB Antenna	I-PEX	R2
4	Master Wave Technology CO., LTD	98P7QUIPF000	PCB Antenna	I-PEX	R2
5	Master Wave Technology CO., LTD	98P7RPIPF000	PCB Antenna	I-PEX	R3

Ant.	Brand	Model Name	Antenna Type	Connector	Radio
6	Master Wave Technology CO., LTD	98P7RPIPF001	PCB Antenna	I-PEX	R3
7	Master Wave Technology CO., LTD	98P7SMIPF000	PCB Antenna	I-PEX	R4

Ant.	Gain (dBi)												
	Radio 1			Radio 2				Radio 3					Radio 4
	2.4G	5G B1	5G B4	5G B1	5G B2	5G B3	5G B4	2.4G	5G B1	5G B2	5G B3	5G B4	BT
1	6.3	4.3	5.3	-	-	-	-	-	-	-	-	-	-
2	6.5	4.9	6.1	-	-	-	-	-	-	-	-	-	-
3	-	-	-	5.6	5.8	6.1	5.9	-	-	-	-	-	-
4	-	-	-	5.6	6.0	5.4	4.6	-	-	-	-	-	-
5	-	-	-	-	-	-	-	6.5	4.7	4.7	5.6	6.0	-
6	-	-	-	-	-	-	-	6.5	4.8	5.4	5.8	5.5	-
7	-	-	-	-	-	-	-	-	-	-	-	-	2.1

Note1: The EUT has seven antennas.

Dynamic Frequency Selection (DFS) for devices operating in the bands 5250- 5350 MHz, 5470-5600 MHz and 5650-5725 MHz.

Sélection dynamique de fréquences (DFS) pour les dispositifs fonctionnant dans les bandes 5250-5350 MHz, 5470-5600 MHz et 5650-5725 MHz.

The device for 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.

les dispositifs fonctionnant dans la bande 5150-5250 MHz sont réservés uniquement pour une utilisation à l'intérieur afin de réduire les risques de brouillage préjudiciable aux systèmes de satellites mobiles utilisant les mêmes canaux.

The maximum antenna gain permitted for devices in the bands 5250-5350 MHz and 5470-5725 MHz shall be such that the equipment still complies with the e.i.r.p. limit.

le gain maximal d'antenne permis pour les dispositifs utilisant les bandes 5250-5350 MHz et 5470-5725 MHz doit se conformer à la limite de p.i.r.e.

The maximum antenna gain permitted for devices in the band 5725-5850 MHz shall be

such that the equipment still complies with the e.i.r.p. limits specified for point-to-point and non-point-to-point operation as appropriate.

le gain maximal d'antenne permis (pour les dispositifs utilisant la bande 5725-5850 MHz) doit se conformer à la limite de p.i.r.e. spécifiée pour l'exploitation point à point et non point à point, selon le cas.

Users should also be advised 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.

De plus, les utilisateurs devraient aussi être avisés que les utilisateurs de radars de haute puissance sont désignés utilisateurs principaux (c.-à-d., qu'ils ont la priorité) pour les bandes 5250-5350 MHz et 5650-5850 MHz et que ces radars pourraient causer du brouillage et/ou des dommages aux dispositifs LAN-EL.

For indoor use only.

Pour une utilisation en intérieur uniquement.

IMPORTANT NOTE:

IC Radiation Exposure Statement:

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 28 cm between the radiator & your body.

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 28 cm de distance entre la source de rayonnement et votre corps.

IMPORTANT NOTE:

This module is intended for OEM integrator only and limited to host with brand: LITE-ON, MOJO and model: WP8333V1, C-110. The OEM integrator is still responsible for the IC compliance requirement of the end product, which integrates this module.

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 28 cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the IC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any

changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. 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.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains IC: 4491A-WM862FEMD ".

The Host Model Number (HMN) must be indicated at any location on the exterior of the end product or product packaging or product literature which shall be available with the end product or online.

Japan Statement:

5GHz band (W52, W53): Indoor use only