

# **User manual**

**< WM6687>**

**Dual-Band 802.11ac 4x4 MIMO**

**PCI Express Mini Card**

**Wireless Network Adapter**

**LITE-ON**

**Version: 1.0.0**

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## **Change History**

| <b>Version</b> | <b>Revised Date</b> | <b>Editor</b> | <b>Content Revised</b>   |
|----------------|---------------------|---------------|--------------------------|
| 1.0.0          | 2016/12/15          | Flora Yu      | First Edition (baseline) |
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## 1 Product Descriptions

The **WM6687** provides ultra-high performance transmission rate in the 2.4G or 5GHz band. It is backward compatible with the current 802.11a/b/g/n network devices.

## 2 Application

- Home and/or office wireless networking
- Wireless multimedia
- Wireless extension of existing wired network

## 3 Features

- IEEE 802.11 a/b/g/n/ac standard compliant
- 4x4 MIMO wireless system
- Ultra-high data rate up to 1.7Gbps @5GHz, 256QAM
- Auto fallback data rate under noisy environment
- Support 2.4GHz or 5GHz band operation (dual-band selectable)
- Support WEP ( 64-bit/128-bit ), 802.1x, and WPA/WPA2
- Conformable to industry-standard Mini Card specification
- Independent Tx Power Control on a per channel

## 4 Product Specifications

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Radio Chipset          | BCM43465                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| WLAN Standards         | IEEE 802.11a/b/g/n/ac compliant                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Antenna connector      | U.FL connector                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Data Rate (per stream) | 802.11a: 6, 9, 12, 18, 24, 36, 48, 54 Mbps<br>802.11b: 11, 5.5, 2 & 1 Mbps<br>802.11g: 54, 48, 36, 24, 18, 12, 9 & 6 Mbps<br>802.11n :<br>20 MHz BW: 72.2, 65, 57.8, 43.3, 28.9, 21.7, 14.4, 7.2 Mbps<br>40 MHz BW: 150, 135, 120, 90, 60, 45, 30, 15 Mbps<br>802.11ac :<br>20MHz BW : 86.7, 72.2, 65, 57.8, 43.3, 28.9, 21.7, 14.4, 7.2 Mbps<br>40MHz BW : 200, 180, 150, 135, 120, 90, 60, 45, 30, 15 Mbps<br>80MHz BW : 433, 390, 325, 292.5, 260, 195, 130, 97.5, 65, 32.5 Mbps<br>160MHz BW: 867, 780, 650, 585, 520, 390, 260, 195, 130, 65 Mbps |

| Modulation            | 802.11b: CCK(11&5.5 Mbps), DQPSK (2Mbps), DBPSK (1Mbps),<br>802.11g/n: DBPSK, DQPSK, OFDM, BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM (proprietary)                                                                                                                                                                                                                                                                              |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------------|--------|---------|---------|--------|------------------|---------------|------------------|---------------|-------------|-----|-------------|-----|-------------|-----|
| Operating Frequencies | USA – FCC 2412~2462MHz<br>Canada – IC 2412~2462MHz<br>Europe – ETSI 2412~2472MHz<br>Japan – STD-T66/STD-33m 2412~2484MHz<br><br>5150MHz ~ 5350MHz for US & Canada<br>5150MHz ~ 5350MHz for Europe<br>5470MHz ~ 5725MHz for Europe<br>5030MHz~5091MHz and 5150MHz ~ 5250MHz for Japan<br>5150MHz ~ 5350MHz for Australia<br>5470MHz ~ 5725MHz for Australia (except channel 120, 124 and 128)<br>5725MHz ~ 5825MHz for Australia |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
| Frequency Band        | 2.4GHz or 5GHz                                                                                                                                                                                                                                                                                                                                                                                                                  |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
| Power Consumption     | Operation (max.) < 5.6W (estimated)                                                                                                                                                                                                                                                                                                                                                                                             |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
| Security              | WEP (64-bit/128-bit), 802.1x<br>WPA/WPAs (TKIP, AES)                                                                                                                                                                                                                                                                                                                                                                            |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
| Operating System      | Linux                                                                                                                                                                                                                                                                                                                                                                                                                           |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
| Receive Sensitivity   | <table> <tr> <th>Data Rates</th><th>Receive Sensitivity (min.)</th></tr> <tr> <td>6 Mbps</td><td>-90 dBm</td></tr> <tr> <td>54 Mbps</td><td>-71dBm</td></tr> <tr> <td>802.11n - 20 MHz</td><td>-89 (MSC 0/8)</td></tr> <tr> <td>802.11n - 40 MHz</td><td>-86 (MSC 0/8)</td></tr> <tr> <td>VHT20 MCS 8</td><td>-63</td></tr> <tr> <td>VHT40 MCS 9</td><td>-60</td></tr> <tr> <td>VHT80 MCS 9</td><td>-57</td></tr> </table>      | Data Rates | Receive Sensitivity (min.) | 6 Mbps | -90 dBm | 54 Mbps | -71dBm | 802.11n - 20 MHz | -89 (MSC 0/8) | 802.11n - 40 MHz | -86 (MSC 0/8) | VHT20 MCS 8 | -63 | VHT40 MCS 9 | -60 | VHT80 MCS 9 | -57 |
| Data Rates            | Receive Sensitivity (min.)                                                                                                                                                                                                                                                                                                                                                                                                      |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
| 6 Mbps                | -90 dBm                                                                                                                                                                                                                                                                                                                                                                                                                         |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
| 54 Mbps               | -71dBm                                                                                                                                                                                                                                                                                                                                                                                                                          |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
| 802.11n - 20 MHz      | -89 (MSC 0/8)                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
| 802.11n - 40 MHz      | -86 (MSC 0/8)                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
| VHT20 MCS 8           | -63                                                                                                                                                                                                                                                                                                                                                                                                                             |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
| VHT40 MCS 9           | -60                                                                                                                                                                                                                                                                                                                                                                                                                             |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
| VHT80 MCS 9           | -57                                                                                                                                                                                                                                                                                                                                                                                                                             |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |
| Voltage               | 3.3 VDC from host (+/- 0.2V)                                                                                                                                                                                                                                                                                                                                                                                                    |            |                            |        |         |         |        |                  |               |                  |               |             |     |             |     |             |     |

## 5 Pin Definition

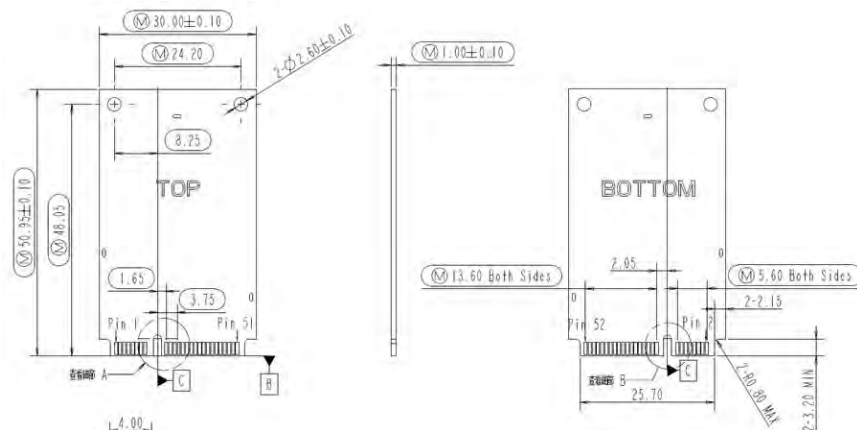
| PCIE pin number | Pin definition | PCIE pin number | Pin definition |
|-----------------|----------------|-----------------|----------------|
| 1               | PCIE_WAKE_L    | 27              | GND            |
| 2               | VDD3_3         | 28              | NC             |
| 3               | NC             | 29              | GND            |
| 4               | GND            | 30              | NC             |
| 5               | NC             | 31              | PCIE_RDP       |
| 6               | NC             | 32              | NC             |
| 7               | PCIE_CLKREQ_L  | 33              | PCIE_RDN       |
| 8               | NC             | 34              | GND            |
| 9               | GND            | 35              | GND            |
| 10              | NC             | 36              | NC             |
| 11              | REFCLKN        | 37              | GND            |
| 12              | NC             | 38              | NC             |
| 13              | REFCLKP        | 39              | VDD3_3         |

|    |              |    |          |
|----|--------------|----|----------|
| 14 | NC           | 40 | GND      |
| 15 | GND          | 41 | VDD3_3   |
| 16 | NC           | 42 | NC       |
| 17 | NC           | 43 | GND      |
| 18 | GND          | 44 | LED_WLAN |
| 19 | NC           | 45 | NC       |
| 20 | RF_DISABLE_L | 46 | NC       |
| 21 | GND          | 47 | NC       |
| 22 | PCIE_PERST_L | 48 | NC       |
| 23 | TDP          | 49 | NC       |
| 24 | VDD3_3       | 50 | GND      |
| 25 | TDN          | 51 | NC       |
| 26 | GND          | 52 | VDD3_3   |

## 6 Physical & Environment

### 6.1 PCB Dimension:

- Standard mPCIe form factor: 30 × 50.95 mm (width × length)



### 6.2 Operation Temperature & Humidity

- Temperature : 32°F to 113°F (0 °C to 45 °C)
- Humidity : 10% ~ 90% R.H.

### 6.3 Storage Temperature & Humidity

- Temperature : -4°F to 158°F (-20 °C to 70 °C)
- Humidity : 10% ~ 95% R.H.

## 7 Certification Requirements

- USA (Non DFS)

- USA (DFS)
- Canada (IC)
- Japan (TELEC)

*Note, cert for module slave mode only, system products with/after the module installed/embedded need to re-cert and under customer's expense.*

**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.

**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 25 cm between the radiator & your body.

**IMPORTANT NOTE:**

This module is intended for OEM integrator. The OEM integrator is responsible for the compliance to all the rules that apply to the product into which this certified RF module is integrated.

Additional testing and certification may be necessary when multiple modules are used.

**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 25 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.

If the labelling area is small than the palm of the hand, then additional FCC part 15.19 statement is required to be available in the users manual: 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.

**LABEL OF THE END PRODUCT:**

The final end product must be labeled in a visible area with the following " Contains TX FCC ID: PPQ-WM6687 ".

If the labelling area is larger than the palm of the hand, then the following FCC part 15.19 statement 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:

| Set | Brand        | Model Name (P/N)   | Antenna Type    | Connector    | Gain (dBi) | Remark                                 |
|-----|--------------|--------------------|-----------------|--------------|------------|----------------------------------------|
| 1   | PSA          | RFDPA171300SBLB802 | Dipole Antenna  | Reversed-SMA | Note 1     | -                                      |
| 2   | ethertronics | M830520            | Ceramic Antenna | N/A          | Note 1     | Connect with Black Cable or Grey Cable |

## Note 1:

| Set | Gain (dBi) |      | Cable loss |      | True Gain (dBi) |      | Remark             |
|-----|------------|------|------------|------|-----------------|------|--------------------|
|     | 2.4GHz     | 5GHz | 2.4GHz     | 5GHz | 2.4GHz          | 5GHz |                    |
| 1   | 4.03       | 5.4  | 0.5        | 0.5  | 3.53            | 4.9  | -                  |
| 2   | 1.1        | 3.2  | 1.2        | 2.2  | -0.1            | 1    | Black Cable (Long) |
|     |            |      | 0.5        | 0.9  | 0.6             | 2.3  | Gray Cable (Short) |

## Note 2:

The EUT has two sets of antennas and there are four antennas for each set.

The Set 2 antennas can connect with black and gray cable. After evaluating, gray cable was select as the representative cable for the test and its data was recorded in this report.

**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-WM6687) 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-WM6687) 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:**

| Set | Brand        | Model Name (P/N)   | Antenna Type    | Connector    | Gain (dBi) | Remark                                 |
|-----|--------------|--------------------|-----------------|--------------|------------|----------------------------------------|
| 1   | PSA          | RFDPA171300SBLB802 | Dipole Antenna  | Reversed-SMA | Note 1     | -                                      |
| 2   | ethertronics | M830520            | Ceramic Antenna | N/A          | Note 1     | Connect with Black Cable or Grey Cable |

Note 1:

| Set | Gain (dBi) |      | Cable loss |      | True Gain (dBi) |      | Remark             |
|-----|------------|------|------------|------|-----------------|------|--------------------|
|     | 2.4GHz     | 5GHz | 2.4GHz     | 5GHz | 2.4GHz          | 5GHz |                    |
| 1   | 4.03       | 5.4  | 0.5        | 0.5  | 3.53            | 4.9  | -                  |
| 2   | 1.1        | 3.2  | 1.2        | 2.2  | -0.1            | 1    | Black Cable (Long) |
|     |            |      | 0.5        | 0.9  | 0.6             | 2.3  | Gray Cable (Short) |

Note 2:

The EUT has two sets of antennas and there are four antennas for each set.

The Set 2 antennas can connect with black and gray cable. After evaluating, gray cable was select as the representative cable for the test and its data was recorded in this report.

**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.*

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 25 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 25 cm de distance entre la source de rayonnement et votre corps.

**IMPORTANT NOTE:**

This module is intended for OEM integrator. The OEM integrator is responsible for the compliance to all the rules that apply to the product into which this certified RF module is integrated.

Additional testing and certification may be necessary when multiple modules are used.

25 cm minimum distance has to be able to be maintained between the antenna and the users for the host this module is integrated into. Under such configuration, the IC RSS-102 radiation exposure limits set forth for an population/uncontrolled environment can be satisfied.

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 25 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-WM6687 ".

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