



# Manual

Model Number : WMC-AC01

Wireless AC Module

Revision: 1.0

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## 1.0 Scope

### 1.1 Document

This document is to specify the product requirements for **802.11ac PCI Express**. This PCI Express card is based on BCM chip that complied with IEEE 802.11ac from 5GHz, and it is also backward compatible to comply with IEEE 802.11a and IEEE 802.11n standard.

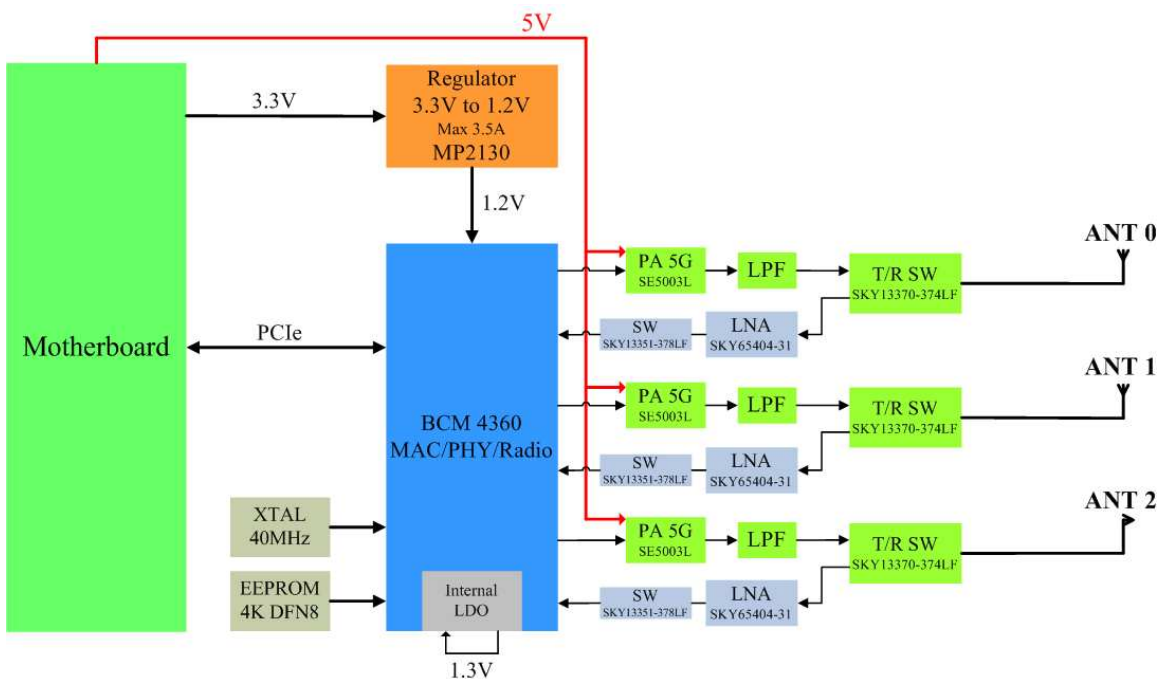
### 1.2 Product Features

- Compatible with IEEE 802.11a high rate standard to provide wireless 54Mbps data rate
- Compatible with IEEE 802.11n draft standard to provide wireless 300Mbps data rate
- Compatible with IEEE 802.11ac draft standard to provide wireless 1300Mbps data rate
- Operation at 5.15~5.85GHz frequency band to meet worldwide regulations
- Supports WEP, 802.1x, WPA and WPA2 enhanced security
- Friendly user configuration and diagnostic utilities
- Support Linux driver.
- Supports PCIe interface .

## 2.0 Requirements

The following sections identify the detailed requirements of the **802.11ac PCI Express**.

### 2.1 Functional Block Diagram : BCM-4360 (PCI-e)



## 2.2 General Requirements

### 2.2.1 IEEE 802.11a Section

	Feature	Detailed Description
2.2.1.1	Standard	<ul style="list-style-type: none"> <li>IEEE 802.11a</li> </ul>
2.2.1.2	Radio and Modulation Schemes	<ul style="list-style-type: none"> <li>BPSK, QPSK, 16QAM, 64QAM, with OFDM</li> </ul>
2.2.1.3	Operating Frequency	<ul style="list-style-type: none"> <li>5150~5350MHz, 5470~ 5600MHz &amp; 5650MHz ~ 5725MHz, 5725MHz~5850MHz</li> </ul>
2.2.1.4	Channel Numbers	<ul style="list-style-type: none"> <li>17 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)</li> <li>7 for 802.11n (HT40), 802.11ac (VHT40)</li> <li>3 for 802.11ac (VHT80)</li> </ul>
2.2.1.5	Data Rate	<ul style="list-style-type: none"> <li>54Mbps</li> </ul>
2.2.1.6	Media Access Protocol	<ul style="list-style-type: none"> <li>CSMA/CA with ACK</li> </ul>
2.2.1.7	Transmitter Output Power	<ul style="list-style-type: none"> <li>Frequency 5150~5350MHz, 5470~ 5600MHz &amp; 5650MHz ~ 5725MHz</li> <li>802.11a: 145.719mW</li> <li>802.11n (HT20): 159.813mW</li> <li>802.11n (HT40): 240.954mW</li> <li>802.11ac (VHT80): 144.825mW</li> <li>Frequency 5745~5825MHz</li> <li>802.11a: 499.224mW</li> <li>802.11n (HT20): 497.682mW</li> <li>802.11n (HT40): 780.691mW</li> <li>802.11ac (VHT80): 260.749mW</li> </ul> <p>Note: The maximum RF output power setting is different by channel and individual country regulations.</p>
2.2.1.8	Effective Isotropic Radiated Power	<ul style="list-style-type: none"> <li>EIRP17.5dbm@ CH36~CH64</li> <li>EIRP29.5dbm@ CH149~CH165</li> </ul>
2.2.1.9	Receiver Sensitivity	<ul style="list-style-type: none"> <li>Error Rate = 10% at room temperature.</li> <li>-82dBm at 6Mbps</li> <li>-81dBm at 9Mbps</li> <li>-79dBm at 12Mbps</li> <li>-77dBm at 18Mbps</li> <li>-74dBm at 24Mbps</li> <li>-70dBm at 36Mbps</li> <li>-66dBm at 48Mbps</li> <li>-65dBm at 54Mbps</li> </ul>

### 2.2.2 IEEE 802.11n Section

	Feature	Detailed Description
2.2.2.1	Standard	<ul style="list-style-type: none"> <li>IEEE 802.11n</li> </ul>
2.2.2.2	Radio and Modulation Schemes	<ul style="list-style-type: none"> <li>BPSK, QPSK, 16QAM, 64QAM with OFDM</li> </ul>
2.2.2.3	Operating Frequency	<ul style="list-style-type: none"> <li>5150~5350MHz, 5470~ 5600MHz &amp; 5650MHz ~ 5725MHz, 5725MHz~5850MHz</li> </ul>
2.2.2.4	Channel Numbers	<ul style="list-style-type: none"> <li>17 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)</li> <li>7 for 802.11n (HT40), 802.11ac (VHT40)</li> <li>3 for 802.11ac (VHT80)</li> </ul>
2.2.2.5	Data Rate	<ul style="list-style-type: none"> <li>450 Mbps</li> </ul>
2.2.2.6	Media Access Protocol	<ul style="list-style-type: none"> <li>CSMA/CA with ACK</li> </ul>

	Feature	Detailed Description
2.2.2.7	Transmitter Output Power	<ul style="list-style-type: none"> <li>• Frequency 5150~5350MHz, 5470~ 5600MHz &amp; 5650MHz ~ 5725MHz</li> <li>• 802.11a: 145.719mW</li> <li>• 802.11n (HT20): 159.813mW</li> <li>• 802.11n (HT40): 240.954mW</li> <li>• 802.11ac (VHT80): 144.825mW</li> <li>• Frequency 5745~5825MHz</li> <li>• 802.11a: 499.224mW</li> <li>• 802.11n (HT20): 497.682mW</li> <li>• 802.11n (HT40): 780.691mW</li> <li>• 802.11ac (VHT80): 260.749mW</li> </ul> <p>Note: The maximum RF output power setting is different by channel and individual country regulations.</p>
2.2.2.8	Receiver Sensitivity	<ul style="list-style-type: none"> <li>• N mode HT20(MHZ) <ul style="list-style-type: none"> <li>-82dBm at (MCS0/8/16)</li> <li>-79dBm at (MCS1/9/17)</li> <li>-77dBm at (MCS2/10/18)</li> <li>-74dBm at (MCS3/11/19)</li> <li>-70dBm at (MCS4/12/20)</li> <li>-66dBm at (MCS5/13/21)</li> <li>-65dBm at (MCS6/14/22)</li> <li>-64dBm at (MCS7/15/23)</li> </ul> </li> <li>• N mode HT40(MHZ) <ul style="list-style-type: none"> <li>-79dBm at (MCS0/8/16)</li> <li>-76dBm at (MCS1/9/17)</li> <li>-74dBm at (MCS2/10/18)</li> <li>-71dBm at (MCS3/11/19)</li> <li>-67dBm at (MCS4/12/20)</li> <li>-63dBm at (MCS5/13/21)</li> <li>-62dBm at (MCS6/14/22)</li> <li>-61dBm at (MCS7/15/23)</li> </ul> </li> </ul>

### 2.2.3 IEEE 802.11ac Section

#	Feature	Detailed Description
2.2.3.1	Standard	<ul style="list-style-type: none"> <li>IEEE 802.11ac</li> </ul>
2.2.3.2	Radio and Modulation Schemes	<ul style="list-style-type: none"> <li>OFDM</li> </ul>
2.2. 3.3	Operating Frequency	<ul style="list-style-type: none"> <li>5150~5350MHz, 5470~ 5600MHz &amp; 5650MHz ~ 5725MHz, 5725MHz~5850MHz</li> </ul>
2.2. 3.4	Channel Numbers	<ul style="list-style-type: none"> <li>17 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)</li> <li>7 for 802.11n (HT40), 802.11ac (VHT40)</li> <li>3 for 802.11ac (VHT80)</li> </ul>
2.2. 3.5	Data Rate	<ul style="list-style-type: none"> <li>1300 Mbps</li> </ul>
2.2. 3.6	Media Access Protocol	<ul style="list-style-type: none"> <li>CSMA/CA with ACK</li> </ul>
2.2.3.7	Transmitter Output Power	<ul style="list-style-type: none"> <li>Frequency 5150~5350MHz, 5470~ 5600MHz &amp; 5650MHz ~ 5725MHz</li> <li>802.11a: 145.719mW</li> <li>802.11n (HT20): 159.813mW</li> <li>802.11n (HT40): 240.954mW</li> <li>802.11ac (VHT80): 144.825mW</li> <li>Frequency 5745~5825MHz</li> <li>802.11a: 499.224mW</li> <li>802.11n (HT20): 497.682mW</li> <li>802.11n (HT40): 780.691mW</li> <li>802.11ac (VHT80): 260.749mW</li> </ul> <p>Note: The maximum RF output power setting is different by channel and individual country regulations.</p>

#	Feature	Detailed Description
2.2. 3..9	Receiver Sensitivity	<p><b>VHT 20</b></p> <ul style="list-style-type: none"> <li>-82dBm at (MCS0)</li> <li>-79dBm at (MCS1)</li> <li>-77dBm at (MCS2)</li> <li>-74dBm at (MCS3)</li> <li>-70dBm at (MCS4)</li> <li>-66dBm at (MCS5)</li> <li>-65dBm at (MCS6)</li> <li>-64dBm at (MCS7)</li> <li>-59dBm at (MCS8)</li> <li>-57dBm at (MCS9)</li> </ul> <p><b>VHT 40</b></p> <ul style="list-style-type: none"> <li>-79dBm at (MCS0)</li> <li>-76dBm at (MCS1)</li> <li>-74dBm at (MCS2)</li> <li>-71dBm at (MCS3)</li> <li>-67dBm at (MCS4)</li> <li>-63dBm at (MCS5)</li> <li>-62dBm at (MCS6)</li> <li>-61dBm at (MCS7)</li> <li>-56dBm at (MCS8)</li> <li>-54dBm at (MCS9)</li> </ul> <p><b>VHT 80</b></p> <ul style="list-style-type: none"> <li>-76dBm at (MCS0)</li> <li>-73dBm at (MCS1)</li> <li>-71dBm at (MCS2)</li> <li>-68dBm at (MCS3)</li> <li>-64dBm at (MCS4)</li> <li>-60dBm at (MCS5)</li> <li>-59dBm at (MCS6)</li> <li>-58dBm at (MCS7)</li> <li>-53dBm at (MCS8)</li> <li>-51dBm at (MCS9)</li> </ul>

#### 2.2.4 General Section

#	Feature	Detailed Description
2.2.4.1	Antenna Connector	<ul style="list-style-type: none"> <li>• Three UFL compatible antenna connectors</li> </ul>
2.2.4.2	Operating Voltage	<ul style="list-style-type: none"> <li>• 5VDC +/- 5%</li> </ul>
2.2.4.3	Current Consumption	<ul style="list-style-type: none"> <li>• 5.1W is use on continue TX</li> </ul>
2.2.4.4	Form Factor and Interface	<ul style="list-style-type: none"> <li>• Mini-card form factor with signal of PCI-e Gen1 X1 lane</li> </ul>

### 2.3 Software Requirements

The Configuration Software supports Linux driver. This configuration software includes the following functions:

- **Information**  
Information allows you to monitor network status.

- **Configuration**  
Configuration allows you to configure parameters for wireless networking.
- **Security**  
Supports enhanced security WEP, 802.1x, WPA and WPA2.

### 2.3.1 Security

#	Feature	Detailed Description
2.3.1.1	Encryption	<ul style="list-style-type: none"> <li>• RC4 encryption algorithm</li> <li>• Support 64-bit and 128-bit WEP encryption</li> <li>• Support open system (OSA) and shared key authentication (SKA)</li> </ul>
2.3.1.2	WEP Management	<ul style="list-style-type: none"> <li>• Four WEP keys can be selected</li> <li>• STA with WEP off will never associate any AP with WEP enabled</li> <li>• WEP Key Format: Option for Hex format</li> </ul>
2.3.1.3	802.1x	<ul style="list-style-type: none"> <li>• Support EAP-TLS, EAP-TTLS, and EAP-PEAP</li> </ul>
2.3.1.4	WPA/WPA2	<ul style="list-style-type: none"> <li>• Support WPA/WPA2-PSK and WPA/WPA2-EAP</li> <li>• Support Cipher Mode AES and TKIP</li> </ul>

### 2.4 Mechanical Requirements

#	Feature	Detailed Description
2.4.1	Length	<ul style="list-style-type: none"> <li>• 77 mm (PCB)</li> </ul>
2.4.2	Width	<ul style="list-style-type: none"> <li>• 66 mm (PCB)</li> </ul>
2.4.3	Height	<ul style="list-style-type: none"> <li>• 1mm (PCB)</li> </ul>

### 2.5 Compatibility Requirements

This device passes the following compatibility requirements.

#	Feature	Detailed Description
2.5.1	Wi-Fi	<ul style="list-style-type: none"> <li>• Meet Wi-Fi certification for IEEE 802.11a/n product</li> </ul>
2.5.2	Physical Layer and Functionality	<ul style="list-style-type: none"> <li>• Meet Alpha Networks Engineering Test Plan and Test Report</li> </ul>
2.5.3	Green Part	<ul style="list-style-type: none"> <li>• Compliance to RoHS.</li> </ul>

### 2.6 Requirements of Reliability, Maintainability and Quality

#	Feature	Detailed Description
2.6.1	MTBF	<ul style="list-style-type: none"> <li>• Mean Time Between Failure &gt; 30,000 hours</li> </ul>
2.6.2	Maintainability	<ul style="list-style-type: none"> <li>• There is no scheduled preventive maintenance required</li> </ul>
2.6.3	Quality	<ul style="list-style-type: none"> <li>• The product quality is followed-up by ALPHA factory quality control system</li> </ul>

### 2.7 Environmental Requirements

#	Feature	Detailed Description
2.7.1	Operating Temperature Conditions	<ul style="list-style-type: none"> <li>• The product is capable of continuous reliable operation when operating in ambient temperature of 0 °C to +40°C.</li> </ul>
2.7.2	Non-Operating Temperature Conditions	<ul style="list-style-type: none"> <li>• Neither subassemblies is damaged nor the operational performance is degraded when restored to the operating temperature after exposing to storage temperature in the range of -20 °C to +75 °C.</li> </ul>
2.7.3	Operating Humidity	<ul style="list-style-type: none"> <li>• The product is capable of continuous reliable operation when subjected to relative humidity in the range of 10% and 90% non-condensing.</li> </ul>



#	Feature	Detailed Description
	conditions	
2.7.4	Non-Operating Humidity Conditions	<ul style="list-style-type: none"> <li data-bbox="627 282 1445 342">• The product is not damaged nor the performance is degraded after exposure to relative humidity ranging from 5% to 95% non-condensing</li> </ul>

## **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.

For operation within 5.15 ~ 5.25GHz / 5.47 ~5.725GHz frequency range, it is restricted to indoor environment. The band from 5600-5650MHz will be disabled by the software during the manufacturing and cannot be changed by the end user. This device meets all the other requirements specified in Part 15E, Section 15.407 of the FCC Rules.

The transceiver antenna must be placed above the PCBA board ,it can not be obscured by the PCBA board and any metal parts.

The antennas spacing must keep from 3cm to 12cm.

If antenna installed inside a box , the box shall not contain any metal characteristics.

**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.
- 3) Module approval valid only when module antenna is installed at least 3 cm apart and 2 of them are oriented in horizontal polarization as tested in the filing. Also, the installed antenna cannot be covered or obstructed by any component which can reduce or affect the antenna radiating strength or pattern.

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: RRK2012060056-1”. 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.

### **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.

### **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.

### **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) Module approval valid only when the module is installed in the tested host or compatible series of host

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.

**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 coimplanté avec un autre émetteur ou antenne.
- 3) L'approbation du module est valable uniquement lorsque le module est installé dans l'équipement teste ou dans des équipements compatibles testes.

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.

**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.

**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: 4833A-WMCAC01A1".

**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: 4833A-WMCAC01A1".

**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.

### **Caution :**

- (i) 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;
- (ii) the maximum antenna gain permitted for devices in the bands 5250-5350 MHz and 5470-5725 MHz shall comply with the e.i.r.p. limit; and
- (iii) the maximum antenna gain permitted for devices in the band 5725-5825 MHz shall comply with the e.i.r.p. limits specified for point-to-point and non point-to-point operation as appropriate.
- (iv) 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.

### **Avertissement:**

Le guide d'utilisation des dispositifs pour réseaux locaux doit inclure des instructions précises sur les restrictions susmentionnées, notamment :

- (i) les dispositifs fonctionnant dans la bande 5 150-5 250 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;
- (ii) le gain maximal d'antenne permis pour les dispositifs utilisant les bandes 5 250-5 350 MHz et 5 470-5 725 MHz doit se conformer à la limite de p.i.r.e.;
- (iii) le gain maximal d'antenne permis (pour les dispositifs utilisant la bande 5 725-5 825 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.

(iv) 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 5 250-5 350 MHz et 5 650-5 850 MHz et que ces radars pourraient causer du brouillage et/ou des dommages aux dispositifs LAN-EL.