Product External Specifications
For
802.11ac PCI Express Card

(Broadcom BCM4352)

Model Number : WMC-AC02

Revision: 1.0

Revision History

Rev.	Date	Author	Reason for Changes
1.0	July. 16, 2012	Mi-ling Li	• Initial Draft
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Contents

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 General Requirements

2.1.1 IEEE 802.11a Section

	Feature	Detailed Description
2.1.1.1	Standard	• IEEE 802.11a
2.1.1.2	Radio and Modulation Schemes	• BPSK, QPSK, 16QAM, 64QAM, with OFDM
2.1.1.3	Operating Frequency	• 5150MHz~5250MHz,5725MHz~5850MHz
2.1.1.4	Channel Numbers	• Ch36~CH64/CH149~CH165
2.1.1.5	Data Rate	• 54, 48, 36, 24, 18, 12, 9, and 6 Mbps
2.1.1.6	Media Access Protocol	• CSMA/CA with ACK
2.1.1.7	Transmitter Output Power	• Frequency 5150~5250MHz **IEEE 802.11a:** 15.70 dBm • Frequency 5725MHz~5850MHz **IEEE 802.11a:** 25.56 dBm
2.1.1.8	Effective Isotropic Radiated Power	• EIRP17.5dbm@ CH36~CH64 • EIRP29.5dbm@ CH149~CH165
2.1.1.9	Receiver Sensitivity	• Error Rate = 10% at room temperature. –82dBm at 6Mbps –81dBm at 9Mbps –79dBm at 12Mbps –77dBm at 18Mbps –74dBm at 24Mbps –70dBm at 36Mbps –66dBm at 48Mbps –65dBm at 54Mbps

2.1.2 IEEE 802.11n Section

	Feature	Detailed Description
2.1.2.1	Standard	• IEEE 802.11n
2.1.2.2	Radio and Modulation Schemes	• BPSK, QPSK, 16QAM, 64QAM with OFDM
2.1.2.3	Operating Frequency	• 5150MHz~5250MHz,5725MHz~5850MHz
2.1.2.4	Channel Numbers	• Ch36~CH48 , CH149~CH165 for IEEE 802.11a/n
2.1.2.5	Data Rate	• 6.5~300 Mbps
2.1.2.6	Media Access Protocol	• CSMA/CA with ACK
2.1.2.7	Transmitter Output Power	• Frequency 5150~5250MHz **IEEE 802.11n MCS0 20MHz:** 16.06 dBm **IEEE 802.11n MCS0 40MHz:** 16.87 dBm • Frequency 5725~5850MHz **IEEE 802.11n MCS0 20MHz:** 25.57 dBm **IEEE 802.11n MCS0 40MH:** 25.56 dBm Note: The maximum RF output power setting is different by channel and individual country regulations.
2.1.2.8	Effective Isotropic Radiated Power	• EIRP20.5dbm@ CH36~CH48 • EIRP29.5dbm@ CH149~CH165
2.1.2.9	Receiver Sensitivity	• N mode HT20(MHZ) -82dBm at (MCS0/8/16) -79dBm at (MCS1/9/17) -77dBm at (MCS2/10/18) -74dBm at (MCS3/11/19) -70dBm at (MCS4/12/20) -66dBm at (MCS5/13/21) -65dBm at (MCS6/14/22) -64dBm at (MCS7/15/23) • N mode HT40(MHZ) -79dBm at (MCS0/8/16) -76dBm at (MCS1/9/17) -74dBm at (MCS2/10/18) -71dBm at (MCS3/11/19) -67dBm at (MCS4/12/20) -63dBm at (MCS5/13/21) -62dBm at (MCS6/14/22) -61dBm at (MCS7/15/23)

2.1.3 IEEE 802.11ac Section

#	Feature	Detailed Description
2.1.3.1	Standard	• IEEE 802.11ac
2.1.3.2	Radio and Modulation Schemes	• BPSK, QPSK, 16QAM, 64QAM , up to 256QAM with OFDM
2.1. 3.3	Operating Frequency	• 5150MHz~5250MHz, 5725MHz~5850MHz
2.1. 3.4	Channel Numbers	• CH42 , CH155 for IEEE 802.11a/n
2.1. 3.5	Data Rate	• 6.5~1300 Mbps
2.1. 3.6	Media Access Protocol	• CSMA/CA with ACK
2.1.3.7	Transmitter Output Power	• 5150MHz~5250MHz **IEEE 802.11ac MCS0 VHT 20MHz:** 15.81 dBm **IEEE 802.11ac MCS0 VHT 40MHz:** 16.85 dBm **IEEE 802.11ac MCS0 VHT 80MHz:** 15.13 dBm • Frequency 5725~5850MHz **IEEE 802.11ac MCS0 20MHz:** 25.59 dBm **IEEE 802.11ac MCS0 40MHz:** 25.51 dBm **IEEE 802.11ac MCS0 80MHz:** 24.96 dBm Note: The maximum RF output power setting is different by channel and individual country regulations.
2.1. 3..8	Effective Isotropic Radiated Power	• EIRP20.5dBm@ CH36~CH48 • EIRP29.5dBm@CH149~CH165
2.1. 3..9	Receiver Sensitivity	**VHT 20** -82dBm at (MCS0) -79dBm at (MCS1) -77dBm at (MCS2) -74dBm at (MCS3) -70dBm at (MCS4) -66dBm at (MCS5) -65dBm at (MCS6) -64dBm at (MCS7) -59dBm at (MCS8) -57dBm at (MCS9) **VHT 40** -79dBm at (MCS0) -76dBm at (MCS1) -74dBm at (MCS2) -71dBm at (MCS3) -67dBm at (MCS4) -63dBm at (MCS5) -62dBm at (MCS6) -61dBm at (MCS7) -56dBm at (MCS8) -54dBm at (MCS9) **VHT 80** -76dBm at (MCS0) -73dBm at (MCS1) -71dBm at (MCS2) -68dBm at (MCS3) -64dBm at (MCS4) -60dBm at (MCS5) -59dBm at (MCS6)

#	Feature	Detailed Description
		-58dBm at (MCS7) -53dBm at (MCS8) -51dBm at (MCS9)

2.1.4 General Section

#	Feature	Detailed Description
2.1.4.1	Antenna Connector	• Three UFL compatible antenna connectors
2.1.4.2	Operating Voltage	• 5VDC +/- 5%
2.1.4.3	Current Consumption	• 5.1W is use on continue TX
2.1.4.4	Form Factor and Interface	• Mini-card form factor with signal of PCI-e Gen1 X1 lane

2.2 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.

2.2.1 Security

#	Feature	Detailed Description
2.2.1.1	Encryption	• RC4 encryption algorithm • Support 64-bit and 128-bit WEP encryption • Support open system (OSA) and shared key authentication (SKA)
2.2.1.2	WEP Management	• Four WEP keys can be selected • STA with WEP off will never associate any AP with WEP enabled • WEP Key Format: Option for Hex format
2.2.1.3	802.1x	• Support EAP-TLS, EAP-TTLS, and EAP-PEAP
2.2.1.4	WPA/WPA2	• Support WPA/WPA2-PSK and WPA/WPA2-EAP • Support Cipher Mode AES and TKIP

2.3 Mechanical Requirements

#	Feature	Detailed Description
2.3.1	Length	• 59.95 mm (PCB)
2.3.2	Width	• 30 mm (PCB)
2.3.3	Height	• 1mm (PCB)

2.4 Compatibility Requirements

This device passes the following compatibility requirements.

#	Feature	Detailed Description
2.4.1	Wi-Fi	• Meet Wi-Fi certification for IEEE 802.11a/n product
2.4.2	Physical Layer and Functionality	• Meet Alpha Networks Engineering Test Plan and Test Report
2.4.3	Green Part	• Compliance to RoHS.

2.5 Requirements of Reliability, Maintainability and Quality

#	Feature	Detailed Description
2.5.1	MTBF	• Mean Time Between Failure > 30,000 hours
2.5.2	Maintainability	• There is no scheduled preventive maintenance required
2.5.3	Quality	• The product quality is followed-up by ALPHA factory quality control system

2.6 Environmental Requirements

#	Feature	Detailed Description
2.6.1	Operating Temperature Conditions	• The product is capable of continuous reliable operation when operating in ambient temperature of 0 ℃ to +40℃.
2.6.2	Non-Operating Temperature Conditions	• 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 ℃ to +75 ℃.
2.6.3	Operating Humidity conditions	• The product is capable of continuous reliable operation when subjected to relative humidity in the range of 10% and 90% non-condensing.
2.6.4	Non-Operating Humidity Conditions	• The product is not damaged nor the performance is degraded after exposure to relative humidity ranging from 5% to 95% non-condensing

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.

This device and its antenna(s) must not be co-located or operation in conjunction with any other antenna or transmitter.

This device is going to be operated in 5.15~5.25GHz frequency range, it is restricted in indoor environment only.

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.

Chain	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	Loss of External Cable (dB)	True Gain (dBi)	Remark
1	WHA YU	SSR-30247	PCB Antenna	I-PEX	4	0.18	3.82	TX / RX
2	WHA YU	SSR-30247	PCB Antenna	I-PEX	4	0.18	3.82	TX / RX

Note: The EUT has two Chains.

IMPORTANT NOTE:
This module is intended for OEM integrator. The OEM integrator is still responsible for the FCC compliance requirement of the end product, which integrates this module.

20cm 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 FCC 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 20cm 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 size of the end product is smaller than 8x10cm, 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: RRK-2012070022 ". If the size of the end product is larger than 8x10cm, 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.

IC Statement

This Class [B] digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe [B] est conforme à la norme NMB-003 du Canada.

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.

This device and its antenna(s) must not be co-located or operation in conjunction with any other antenna or transmitter.
Cet appareil et son antenne (s) ne doit pas être co-localisés ou fonctionnement en association avec une autre antenne ou transmetteur.

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 20cm between the radiator & your body.
Declaración de exposición a la radiación de Canada:
Este equipo cumple con los límites de exposición a la radiación de la IC establecidos para un ambiente no controlado.
Este equipo se debe instalar y operar con una distancia mínima de 20 cm entre el radiador y su cuerpo.

The device could automatically discontinue transmission in case of absence of information to transmit, or operational failure. Note that this is not intended to prohibit transmission of control or signaling information or the use of repetitive codes where required by the technology.
Le dispositif pourrait automatiquement cesser d'émettre en cas d'absence d'informations à transmettre, ou une défaillance opérationnelle. Notez que ce n'est pas l'intention d'interdire la transmission des informations de contrôle ou de signalisation ou l'utilisation de codes répétitifs lorsque requis par la technologie.

The device for the band 5150-5250 MHz is only for indoor usage to reduce 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 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.
le gain maximal d'antenne permis (pour les dispositifs utilisant la bande 5725-5825 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.

IMPORTANT NOTE:

This module is intended for OEM integrator. The OEM integrator is still responsible for the IC compliance requirement of the end product, which integrates this module.

20cm 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 20cm 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. IC statement is required to be available in the users manual: This Class B digital apparatus complies with Canadian ICES-003. 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 IC : 4833A-WMCAC02A1".

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.
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.

This radio transmitter (identify the device by certification number, or model number if Category II) 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.
Le présent émetteur radio (identifier le dispositif par son numéro de certification ou son numéro de modèle s'il fait partie du matériel de catégorie I) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type 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.

Chain	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	Loss of External Cable (dB)	True Gain (dBi)	Remark
1	WHA YU	SSR-30247	PCB Antenna	I-PEX	4	0.18	3.82	TX / RX
2	WHA YU	SSR-30247	PCB Antenna	I-PEX	4	0.18	3.82	TX / RX

Note: The EUT has two Chains.