

4X4-5GH Dual-Band 4x4 with 4 SS MIMO 802.11a/n/ac WLAN SoC

Device Specification

1 Introduction

1.1 General description

The 4X4-5GH with Qualcomm® VIVE™ 802.11ac technology is a highly integrated wireless local area network (WLAN) system-on-chip (SoC) for 5 GHz 802.11ac. The 4X4-5GH is a synthesizer WLAN radio with 160 MHz and 80+80 MHz support. It includes a CPU and memory for WLAN media access layer (MAC) and physical layer (PHY) management and provides host offload of other highlevel networking tasks. It enables high-performance 4x4 MIMO with 4 spatial streams for wireless applications demanding the highest robust link quality and maximum throughput and range, plus 4 spatial stream MU-MIMO. The 4X4-5GH integrates a multi-protocol MAC, PHY, analog-to-digital/ digital-to-analog converters (ADC/DAC), 4x4 MIMO radio transceivers, and PCIE interface in an allCMOS device for low power consumption and small form-factor applications.

The 4X4-5GH implements half-duplex OFDM, supporting 1.733 Gbps for 802.11ac 160/80+80/80 MHz channel operation in 5 GHz mode, and IEEE 802.11a/n/ac data rates. Additional features include 802.11ac explicit transmit beamforming (TxBF), 802.11 compatible implicit TxBF, multi-user MIMO (MU-MIMO), Dynamic Bandwidth Switching, Per Packet Switching between 4SS/80 MHz and 2SS/160/80+80 MHz, Maximal Likelihood (ML) decoding, Low-Density Parity Check (LDPC), Maximal Ratio Combining (MRC), Space Time Block Code (STBC), and On-Chip OneTime Programmable (OTP) memory to eliminate the need for an external flash and to further reduce the external component count and BOM cost. The 4X4-5GH supports 802.11 wireless MAC protocol, 802.11i security, Wi-Fi offload, error recovery, and 802.11e quality of service (QoS).

The 4X4-5GH supports up to four simultaneous spatial streams integrating four Tx and four Rx chains for high throughput and extended coverage. Tx chains combine PHY in-phase (I) and quadrature (Q) signals, convert them to the desired frequency, and drive the RF signal through external power amplifiers (PAs). Rx chains receive from antennas through external LNAs. The frequency synthesizer supports 1-MHz steps to match frequencies defined by IEEE 802.11a/b/g/n/ac specifications. The 4X4-5GH supports frame data transfer to and from the host using a PCIE interface that supports interrupt generation and reporting and status reporting. Other external interfaces include EEPROM and GPIOs.

1.2 Features

General

- 4x4 SU-/MU-MIMO technology improves effective throughput and range over existing 802.11a/n/ac products
- Support for up to four spatial streams
- Support for 48-MHz crystal
- 156-pin, 12 mm x 12 mm DRQFN package
- Package footprint compatible with QCA9994

WLAN

- Dual-synthesizer WLAN radio with 80+80 MHz support
- Supports 20/40/80/80+80 MHz at 5 GHz
- Supports up to 256 QAM
- Data rates of up to 1.733 Gbps in 802.11ac 80 MHz channels using reduced (short) guard interval (GI)
- Multi-user MIMO (MU-MIMO) beamformer
- 802.11ac explicit transmit beamforming (TxBF) and legacy implicit TxBF for both beamformer and beamformee
- TCP and UDP checksum offload
- Dynamic bandwidth switching
- Per-packet switching between 4SS/80 MHz, 2SS/160 or 80+80 MHz
- Maximal likelihood (ML) decoding
- Supports spatial multiplexing, cyclic-delay diversity (CDD), low-density parity check (LDPC), maximal ratio combining (MRC), Space Time Block Code (STBC)
- AMSDU and AMPDU frame aggregation
- 802.11e-compatible bursting
- Digital predistortion
- Support for locationing (RSSI and RTT-based, 802.11REVmc compliant)

Supported Standards

- 802.11a/n/ac
- Support for IEEE 802.11d, e, h, i, j, k, r, u, v time stamp, w, and z standards

CPU/Memory

- Integrated CPU for Wi-Fi offload with memory
- On-chip OTP memory

Safety Notices

1. Read, follow, and keep these instructions.
2. Heed all warnings.
3. Only use attachments/accessories specified by the manufacturer.



WARNING: Do not use this product in location that can be submerged by water.



WARNING: Avoid using this product during an electrical storm. There may be a remote risk of electric shock from lightning.

Electrical Safety Information

1. Compliance is required with respect to voltage, frequency, and current requirements indicated on the manufacturer's label. Connection to a different power source than those specified may result in improper operation, damage to the equipment or pose a fire hazard if the limitations are not followed.
2. There are no operator serviceable parts inside this equipment. Service should be provided only by a qualified service technician.
3. This equipment is provided with a detachable power cord which has an integral safety ground wire intended for connection to a grounded safety outlet.
 - a. Do not substitute the power cord with one that is not the provided approved type. Never use an adapter plug to connect to a 2-wire outlet as this will defeat the continuity of the grounding wire.
 - b. The equipment requires the use of the ground wire as a part of the safety certification, modification or misuse can provide a shock hazard that can result in serious injury or death.
 - c. Contact a qualified electrician or the manufacturer if there are questions about the installation prior to connecting the equipment.
 - d. Protective earthing is provided by Listed AC adapter. Building installation shall provide appropriate short-circuit backup protection.
 - e. Protective bonding must be installed in accordance with local national wiring rules and regulations.

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.

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 20 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 20 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 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: SWX-M445GH ".

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.

Professional installation is required

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.

This radio transmitter (IC: 6545A-M445GH) 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: 6545A-M445GH) 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	Gain (dBi)
1	-	-	PIFA Antenna	N/A	8
2	-	-	PIFA Antenna	N/A	8
3	-	-	PIFA Antenna	N/A	8
4	-	-	PIFA Antenna	N/A	8

Note: The EUT has four antennas.

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.

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 20 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 20 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.

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 20 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: 6545A-M445GH ".

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.

Limited Warranty

UBIQUITI NETWORKS, Inc (“UBIQUITI NETWORKS”) warrants that the product(s) furnished hereunder (the “Product(s)”) shall be free from defects in material and workmanship for a period of one (1) year from the date of shipment by UBIQUITI NETWORKS under normal use and operation. UBIQUITI NETWORKS’ sole and exclusive obligation and liability under the foregoing warranty shall be for UBIQUITI NETWORKS, at its discretion, to repair or replace any Product that fails to conform to the above warranty during the above warranty period. The expense of removal and reinstallation of any Product is not included in this warranty. The warranty period of any repaired or replaced Product shall not extend beyond its original term.

Warranty Conditions

The above warranty does not apply if the Product:

- (I) has been modified and/or altered, or an addition made thereto, except by Ubiquiti Networks, or Ubiquiti Networks’ authorized representatives, or as approved by Ubiquiti Networks in writing;
- (II) has been painted, rebranded or physically modified in any way;
- (III) has been damaged due to errors or defects in cabling;
- (IV) has been subjected to misuse, abuse, negligence, abnormal physical, electromagnetic or electrical stress, including lightning strikes, or accident;
- (V) has been damaged or impaired as a result of using third party firmware;
- (VI) has no original Ubiquiti MAC label, or is missing any other original Ubiquiti label(s); or
- (VII) has not been received by Ubiquiti within 30 days of issuance of the RMA.

In addition, the above warranty shall apply only if: the product has been properly installed and used at all times in accordance, and in all material respects, with the applicable Product documentation; all Ethernet cabling runs use CAT5 (or above), and for outdoor installations, shielded Ethernet cabling is used, and for indoor installations, indoor cabling requirements are followed.

Returns

No Products will be accepted for replacement or repair without obtaining a Return Materials Authorization (RMA) number from UBIQUITI NETWORKS during the warranty period, and the Products being received at UBIQUITI NETWORKS’ facility freight prepaid in accordance with the RMA process of UBIQUITI NETWORKS. Products returned without an RMA number will not be processed and will be returned freight collect or subject to disposal. Information on the RMA process and obtaining an RMA number can be found at: **www.ubnt.com/support/warranty**.

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