## Description

- **Model : RBHP-B216C**
- **Bluetooth: v4.2+EDR**
- **WLAN : 802.11 a/b/g/n/ac**
- **Frequency Range : 2400MHz ~ 5835MHz**
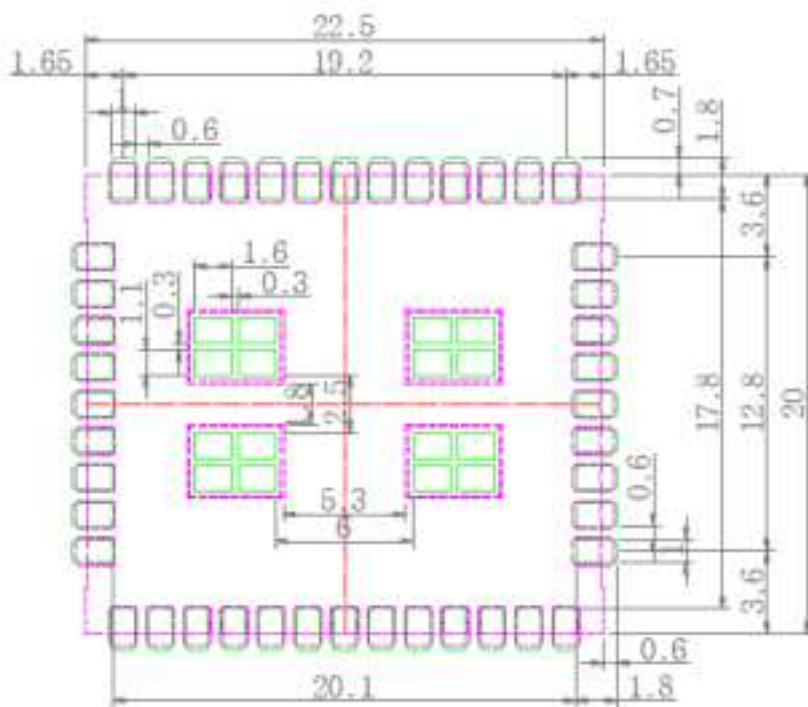- **Device Type : OEM Device installed in vehicles**

## Features

- **Dimension : 22.5mm x 20.0mm x 2.7mm**
- **Temperature Range : -40℃ ~ +85℃**
- **Supply Voltage : VBAT 3.0V to 3.6V**
- **Output Power**
  **BT: Typ. +1.5dBm(Class 2)**
  **WLAN : 16.0dBm(b), 13dBm(g), 12dBm(n), 13dBm(a), 10dBm(ac)**
- **Interface**
  **PCIe(WLAN), UART(BT), I2S**

## Application

- **Automotive**

## Dimensions

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- **Power Supply Specification**

One Buck regulator, multiple LDO regulators, and a power management unit(PMU) are integrated into the BCM88359. All regulators are programmable via the PMU. These blocks simplify power supply design for Bluetooth and WLAN functions in embedded designs.
 A single VBAT(3.0V to 3.6V DC max) and VIO supply (1.8V to 3.3V) can be used, with all additional voltages being provided by the regulators in the BCM88359.
 Three control signals, BT_REG_ON, WL_REG_ON, and WPT_REG_ON(that is, WPT_1P8), are used to power-up the regulators and
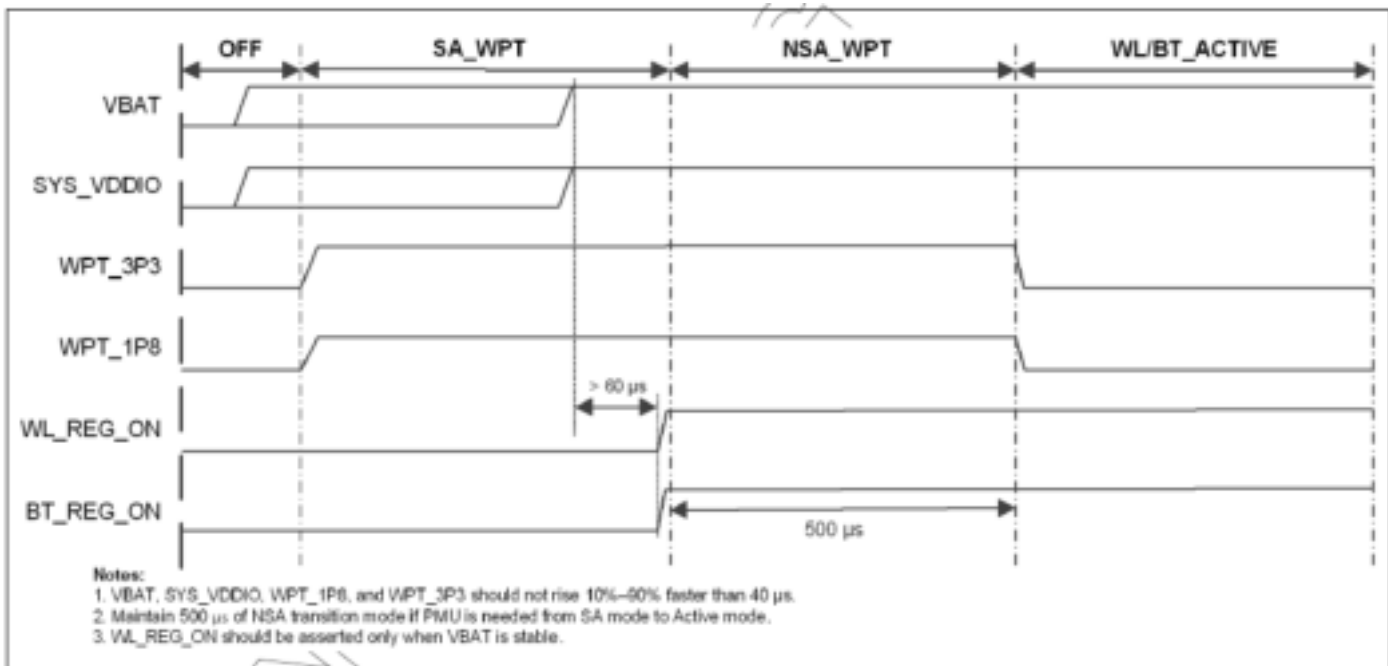take the respective section out of reset. The CBUCK CLDO and LNLDO power up available. All regulators are powered down only when both BT_REG_ON an WL_REG_ON are deasserted.
The CLDO and LNLDO may be turned off/on based on the dynamic demands of the digital baseband.
The BCM88359 allows for an extremely low power-consumption mode by completely shutting down the CBUCK, CLDO, and LNLDO regulators. When in this state, MEMLPLDO and LPLDO(which is a low-power linear regulator supplied by the system VIO supply) provide the BCM88359 with all the voltage it requires, further reducing leakage currents.

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| DC supply for VBAT and PA driver supply | VBAT | −0.5 to +6.0 | V |
| DC supply voltage for digital I/O | VDDIO | −0.5 to 3.9 | V |
| DC supply voltage for RF switch I/Os | VDDIO_RF | −0.5 to 3.9 | V |
| DC input supply voltage for CLDO and LNLDO | – | −0.5 to 1.575 | V |
| DC supply voltage for RF analog | VDDRF | −0.5 to 1.32 | V |
| DC supply voltage for core | VDDC | −0.5 to 1.32 | V |
| WRF_TCXO_VDD | – | −0.5 to 3.63 | V |
| Maximum undershoot voltage for I/O[a] | $V_{undershoot}$ | −0.5 | V |
| Maximum overshoot voltage for I/Q[a] | $V_{overshoot}$ | VDDIO + 0.5 | V |
| Maximum junction temperature | $T_j$ | 125 | °C |
| DC supply voltage for wireless charging | WPT_3p3 | −0.5 to 3.9 | V |
| DC supply voltage for wireless charging | WPT_1p8 V | −0.5 to 3.9 | V |
| DC supply voltage for WCC I/O | WCC_VDDIO V | −0.5 to 3.9 | V |

a. Duration not to exceed 25% of the duty cycle.

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## *Boot sequence



Notes:
1. VBAT, SYS_VDDIO, WPT_1P8, and WPT_3P3 should not rise 10%–90% faster than 40 µs.
2. Maintain 500 µs of NSA transition mode if PMU is needed from SA mode to Active mode.
3. WL_REG_ON should be asserted only when VBAT is stable.

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## *General Features*

**RBHP-B216C satisfies the following standards**

**1)Bluetooth Features**
- **Bluetooth Power Class 2.**
- **Provisioned for low energy angle-of –arrival applications.**
- **Complies with Bluetooth Core Specification Version 4.2 with provisions for supporting future specifications.**
- **Supports extended synchronous connections(eSCO), for enhanced voice quality by allowing for retransmission of dropped packets.**
- **Adaptive frequency hopping(AFH) for reducing radio frequency interference.**
- **Interface support, host controller interface(HCI) using a USB or high-speed UART interface and PCM for audio data**
- **Supports multiple simultaneous Advanced Audio Distribution Profiles(A2DP) for stereo sound.**

**2) WLAN Features**
- **Support for IEEE 802.11a/b/g/n/ac**
- **Dual-stream spatial multiplexing up to 867Mbps data rate.**
- **Tx and Rx low-density parity check(LDPC) support for improved range and power efficiency.**
- **Supports IEEE 802.11ac/n beamforming.**
- **Supports real simultaneous dual-band(RSDB).**
- **On-chip power amplifiers and low-noise amplifiers for both bands.**
- **PCle mode complies with PCI Express base specification revision 3.0 for x1 lane and power management running at Gen1 speeds**
- **Security**
  - **WPA, WAPI STA, and WPA2(Personal) support for powerful encryption and authentication.**
  - **AES and TKIP in hardware for faster data encryption and IEEE 802.11i compatibility**
  - **Reference WLAN subsystem provides Cisco Compatible Extensions (CCX, CCX2.0, CCX3.0, CCX4.0)**
  - **Reference WLAN subsystem provides Wi-Fi Protected Setup(WPS)**

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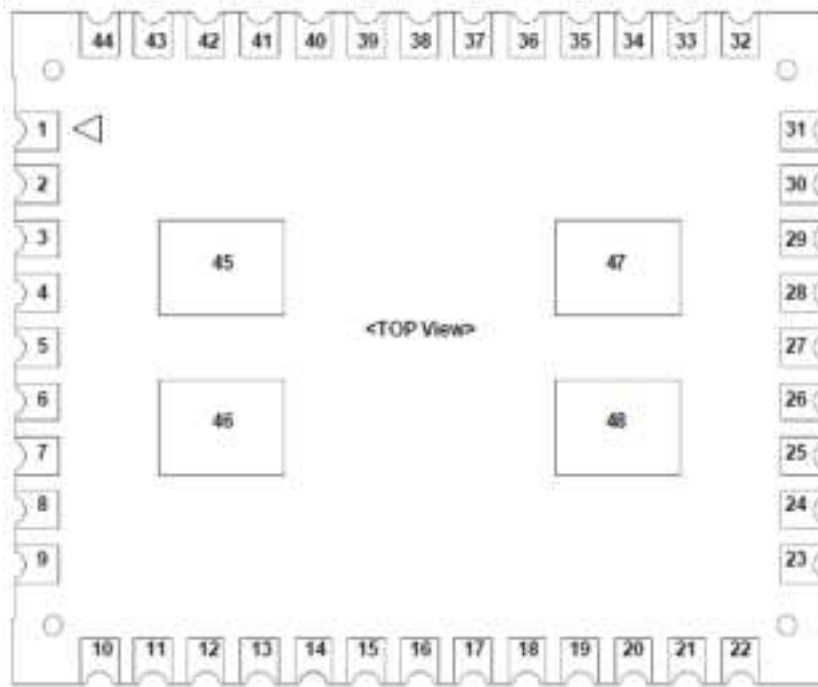
## PIN Description



| No. | Pin Name | I/O | Description |
|-----|----------|-----|-------------|
| 1 | PCIE_CLK_P | I | PCIE differential clock input positive |
| 2 | PCIE_CLK_N | I | PCIE differential clock input negative |
| 3 | PCIE_TD_N | O | PCIE Transmitter differential negative |
| 4 | PCIE_TD_P | O | PCIE Transmitter differential positive |
| 5 | SDIO_CLK | I/O | SDIO clock line |
| 6 | SDIO_CMD | I/O | SDIO command line |
| 7 | SDIO_DATA3 | I/O | SDIO data line 3 |
| 8 | SDIO_DATA2 | I/O | SDIO data line 2 |
| 9 | SDIO_DATA1 | I/O | SDIO data line 1 |
| 10 | SDIO_DATA0 | I/O | SDIO data line 0 |
| 11 | BT_DEV_WAKE | I | Bluetooth device wake from host |

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## PIN Description

| | | | |
|---|---|---|---|
| 12 | BT_HOST_WAKE | O | Bluetooth host wake from device |
| 13 | VBAT | I | Positive supply<br>- Supply voltage : Typical 3.3V. |
| 14 | VBAT | I | Positive supply<br>- Supply voltage : Typical 3.3V. |
| 15 | GND | - | Ground |
| 16 | N.C. | - | Not Connected (Reserved) |
| 17 | WL_REG_ON | I | WLAN Power on reset(Power rail : VDDIO)<br>- Internal 200KΩ pull-down |
| 18 | BT_REG_ON | I | Bluetooth Power on reset(Power rail : VDDIO)<br>- Internal 200KΩ pull-down |
| 19 | BT_PCM_CLK | I/O | PCM clock, can be master (output) or slave (input) |
| 20 | BT_PCM_SYNC | I/O | PCM sync signal, can be master (output) or slave (input) |
| 21 | BT_PCM_IN | I/O | PCM data input |
| 22 | BT_PCM_OUT | I/O | PCM data output |
| 23 | WL_ANT_CORE0 | RF | WLAN RF ANT 0 and BT RF ANT |
| 24 | GND | - | Ground |
| 25 | LPO | I | Low power clock input(32.768KHz, 0V ~ 1.8V peak to peak) |
| 26 | GND | - | Ground |
| 27 | WL_DEV_WAKE | I | WLAN device wake from host |
| 28 | WL_HOST_WAKE | O | WLAN host wake from device |
| 29 | GND | - | Ground |
| 30 | GND | - | Ground |
| 23 | WL_ANT_CORE1 | RF | WLAN RF ANT 1 |
| 32 | SDIO_PAD | I | SDIO_PADVDDIO<br>:If VIO_SD=1.8V→high, If VIO_SD=3.3V→low |
| 33 | BT_UART_RTS_N | I/O | Bluetooth UART request to send |
| 34 | BT_UART_CTS_N | I/O | Bluetooth UART clear to send |
| 35 | BT_UART_RXD | I/O | Bluetooth UART signal input |
| 36 | BT_UART_TXD | I/O | Bluetooth UART signal output |

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## PIN Description

| No. | Pin Name | I/O | Description |
|-----|----------|-----|-------------|
| 37 | VIO | I | BT, WLAN VDDIO supply voltage.(3.3V or 1.8V)<br> - BT and WLAN should be same power rail |
| 38 | SDIO_DIS | I | SDIO_DIABLE<br>: Low : SDIO Enabled, High : SDIO Disabled |
| 39 | PCIE_EN | I | PCIE_ENABLE<br>: Low : PCIE Disabled, High : PCIE Enabled |
| 40 | PCIE_PME_L | O | PCIE power management event output |
| 41 | PCIE_PERST_N | I | PCIE system reset. |
| 42 | PCIE_CLKREQ | O | PCIE clock request signal |
| 43 | PCIE_RD_P | I | PCIE Receiver differential positive |
| 44 | PCIE_RD_N | I | PCIE Receiver differential negative |
| 45 | GND | - | Ground |
| 46 | GND | - | Ground |
| 47 | GND | - | Ground |
| 48 | GND | - | Ground |

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**FCC MODULAR APPROVAL INFORMATION EXAMPLES for Manual**
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.
(2) This device must accept any interference received, including interference that may cause undesired operation.

**CAUTION:** Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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 or more 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 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.

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## OEM INTEGRATION INSTRUCTIONS:

This device is intended only for OEM integrators under the following conditions:

The module must be installed in the host equipment such that 20 cm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the internal on-board antenna that has been originally tested and certified with this module. External antennas are not supported. As long as these 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 (for example, digital device emissions, PC peripheral requirements, etc.). The end-product may need Verification testing, Declaration of Conformity testing, a Permissive Class II Change or new Certification. Please involve a FCC certification specialist in order to determine what will be exactly applicable for the end-product.

## Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot 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. In such cases, please involve a FCC certification specialist in order to determine if a Permissive Class II Change or new Certification is required.

## Upgrade Firmware:

The software provided for firmware upgrade will not be capable to affect any RF parameters as certified for the FCC for this module, in order to prevent compliance issues.

## 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: YZP-RBHPB216C1".

## Information that must be placed in the end user manual:

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.

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**FCC MODULAR APPROVAL INFORMATION EXAMPLES for Manual**

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.

(2) This device must accept any interference received, including interference that may cause undesired operation.

**CAUTION**: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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 or more 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.

**WARNING**

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

"CAUTION : Exposure to Radio Frequency Radiation.
Antenna shall be mounted in such a manner to minimize the potential for human contact during normal operation. The antenna should not be contacted during operation to avoid the possibility of exceeding the FCC radio frequency exposure limit.

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## IC Information

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.

*Cet appareil est conforme avec Industrie Canada exempts de licence standard RSS (s). L'opération est soumise aux deux conditions suivantes:*

*(1) cet appareil ne peut causer d'interférences, et*

*(2) cet appareil doit accepter toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement de l'appareil.*

The end product must be labeled to display the Industry Canada certification number of the module.
Contains transmitter module IC: 7414C-RBHPB216C1

*Le dispositif d'accueil doivent être étiquetés pour afficher le numéro de certification d'Industrie Canada du module. Contient module émetteur IC: 7414C-RBHPB216C1*

## Information for OEM Integrator

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.

End product labelling
The label for end product must include
"Contains FCC ID: YZP-RBHPB216C1, Contains IC: 7414C-RBHPB216C1".

"CAUTION: Exposure to Radio Frequency Radiation.
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20cm between the radiator and your body. 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."

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**Requirement per KDB996369 D03**

**2.2 List of applicable FCC rules**

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.3

Explanation: This module meets the requirements of FCC part 15C(15.247). part 15E(15.407)

**2.3 Summarize the specific operational use conditions**

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in
5 GHz DFS bands.

Explanation: The transmitter antenna of the EUT is WLAN 2.4 GHz Band & WLAN 5 GHz Band is PCB antenna and Bluetooth & Bluetooth LE & WLAN 5 GHz Band is PIFA antenna.

It consists of the FAKRA Type RF cable between the EUT and the antenna, and the connector is molded so that it cannot be replaced by the user.

**2.4 Limited module procedures**

If a modular transmitter is approved as a "limited module," then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

Explanation: The module is not a limited module.

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## 2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects:

layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);

b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);

c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;

d) Appropriate parts by manufacturer and specifications;

e) Test procedures for design verification; and

f) Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Explanation: Yes, The module with trace antenna designs, and This manual has been shown the layout of trace design, antenna, connectors, and isolation requirements.

## 2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is: YZP-RBHPB216C1."

**2.7 Antennas**

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an "omni-directional antenna" is not considered to be a specific "antenna type")).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: The transmitter antenna of the EUT is WLAN 2.4 GHz Band & WLAN 5 GHz Band is PCB antenna and Bluetooth & Bluetooth LE & WLAN 5 GHz Band is PIFA antenna.

It consists of the FAKRA Type RF cable between the EUT and the antenna, and the connector is molded so that it cannot be replaced by the user.

**2.8 Label and compliance information**

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation:The host system using this module, should have label in a visible area indicated the following texts:
"Contains FCC ID: YZP-RBHPB216C1, Contains IC: 7414C-RBHPB216C1"

**2.9 Information on test modes and additional testing requirements**

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.

Explanation: Top band can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

**2.10 Additional testing, Part 15 Subpart B disclaimer**

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuity, so the module does not require an evaluation by FCC Part 15 Subpart B. The host shoule be evaluated by the FCC Subpart B.

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This radio transmitter [7414C-RBHPB216C1] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

WLAN 2.4 GHz Band & WLAN 5 GHz Band: PCB Antenna
Bluetooth & WLAN 5 GHz Band: PIFA Antenna

It consists of the FAKRA Type RF cable between the EUT and the antenna, and the connector is molded so that it cannot be replaced by the user.

ANTENNA GAIN

Bluetooth LE:          2.20 dBi
Bluetooth:             2.20 dBi
WLAN 2.4 GHz:          4.80 dBi

5 150 MHz ~ 5 250 MHz Band
Antenna 0              5.40 dBi
Antenna 1              5.70 dBi
Multiple Antenna       8.56 dBi

5 250 MHz ~5 350 MHz Band
Antenna 0              5.60 dBi
Antenna 1              4.80 dBi
Multiple Antenna       8.23 dBi

5 470 MHz ~5 725 MHz Band
Antenna 0              5.70 dBi
Antenna 1              5.30 dBi
Multiple Antenna       8.51 dBi

5 725 MHz ~5 850 MHz Band
Antenna 0              5.20 dBi
Antenna 1              5.40 dBi
Multiple Antenna       8.31 dBi

Antenna Impedance : 50 Ohm

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