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Bluefin 2G WLAN module

Theory of operation

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Hitachi Energy

1 Purpose

The purpose of this hardware integration guide is to provide comprehensive instructions for the successful integration of an FCC and ISED pre-certified WLAN module into a target system. This document aims to ensure that integrators can seamlessly incorporate the WLAN module into their designs while adhering to regulatory requirements and achieving optimal performance.

2 Theory of Operation

The Bluefin 2G WLAN module is intended to be installed in an enclosure. It is an 802.11 b/g/n wireless radio subcircuit that is integrated into product mainboard. The devices in which the Bluefin 2G WLAN module is integrated may operate as wireless clients, wireless repeaters called “nodes” or as wireless transceivers called “gateways”. Gateways require an Ethernet connection be made to a wired IP network or a cellular connection to a service provider’s network.

Unlike conventional access points, which require a wired backbone, Hitachi's technology can be used to create large networks with wired connections to only a few of the access points.

Hitachi Energy RF products are sold only for professional installation by a qualified RF technician. The antennas may not be altered or replaced with other antennas. Installation instructions and configuration requirements are provided with every Hitachi Energy RF end-product.

The 802.11 b/g/n radio board supports 2x2 MIMO and MRC reception (Maximal Ratio Combining). Both antenna ports are used for transmitting and receiving.

3 Integration instructions

3.1 General

The following sections address integration instructions. The Bluefin 2G WLAN module will not be sold as an individual product to third parties. This module is meant to be embedded inside a host router developed by the Hitachi Energy Wireless team. Hence the integration instructions are documented here in the theory-of-operation document prepared by Hitachi Energy.

3.2 List of applicable rules and required notices

3.2.1 FCC Notice to Users and Operators

These devices comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) these devices may not cause harmful interference, and (2) these devices 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 when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their own expense. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to correct the interference by using one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase separation between the equipment and receiver.

- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician.

These Part 15 radio devices operate on a non-interference basis with other devices operating at this frequency. Any changes or modification to said product not expressly approved by Hitachi Energy could void the user's authority to operate this device.

3.2.2 Industry Canada Notice to users and operators

These Class B digital apparatus meet all requirements of the Canadian Interference Causing Equipment Regulations.

Operation is subject to the following two conditions: (1) these devices may not cause harmful interference, and (2) these devices must accept any interference received, including interference that may cause undesired operation.

Cet appareillage numérique de la classe B répond à toutes les exigences de l'interférence canadienne causant des réglements d'équ ipement. L'opération est sujette aux deux conditions suivantes : (1) cet disposi-tif peut ne pas cau-ser l'interférence nocive, et (2) ce dispositif doit accepter n'importe quelle interférence reçue, y compris l'interférence qui peut causer l'opération peu désirée.

These devices have been designed to operate with the antennas listed in this document. Antennas having a gain greater than 7.4 dBi in the 2.4 GHz band are strictly prohibited for use with Bluefin 2G WLAN.

These devices comply with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

1. These devices may not cause interference, and

2. These devices must accept any interference, including interference that may cause undesired operation of the

device.

Ces appareils ont été conçus pour fonctionner avec les antennes listées dans ce document. Les antennes ou ayant un gain supérieur à 7.4 dBi dans la bande 2,4 GHz sont strictement interdites pour l'utilisation avec le Bluefin 2G.

Cet appareil est conforme à Industrie Canada une licence standard RSS exonérés(s). Son fonctionnement est soumis aux deux conditions suivantes:

1. Cet appareil ne doit pas provoquer d'interférences
2. Cet appareil doit accepter toute interférence reçue, y compris les interférences pouvant provoquer un fonc-tionnement indésirable de l'appareil.

3.3 Specific Operational Use Conditions

The Bluefin 2G radio module is a Hitachi Energy radio board. It operates in BSS Master and Client mode, as defined by the IEEE 802.11 b/g/n standard, allowing communication with nodes, gateways and with client devices such as laptops and PDAs. Data packets are routed through the wireless module by the microprocessor and routing software running on the main circuit board. The routing software allows the Hitachi Energy end-product devices to discover neighboring devices and select the optimum network path through which to route packets.

The Bluefin 2G module comes with standard MMCX type connectors for modular use. It has been designed to oper-ate with the antennas listed in this document. Antennas having a gain greater than 7.4 dBi in the 2.4 GHz band are strictly prohibited for use with the Bluefin 2G module.

3.4 Limited module procedures

The Bluefin 2G module is a single module that will be tested for modular approval.

3.5 Trace antenna designs

This does not apply to the Bluefin 2G module or its host.

3.6 RF exposure considerations

The Federal Communications Commission (FCC) with its action in ET Docket 96-8 has adopted a safety standard for

human exposure to RF electromagnetic energy emitted by FCC certified equipment. The Bluefin 2G module meets the uncontrolled environmental limits found in OET-65 and ANSI C95.1, 1991. Proper operation of this device according to the instructions found in this manual will result in user exposure that is substantially below the FCC recommended limits.

To comply with FCC, Industry Canada and other national RF exposure safety requirements the antennas for this device must be installed to provide a separation distance of at least 25 cm from persons and shall not be co-located with other transmitting antennas except as shown in FCC/IC multi-transmitter guidelines.

IC Radiation Exposure Statement:

This equipment complies with the IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 25 cm between the radiator and your body.

Énoncé d'exposition aux rayonnements: Cet équipement est conforme aux limites d'exposition aux rayonnements ioniques RSS-102 Pour un environnement incontrôlé. Cet équipement doit être installé et utilisé avec un Distance minimale de 25 cm entre le radiateur et votre corps.

3.7 Antennas

The Hitachi Energy RF products are sold only for professional installation by a qualified RF technician. Installation instructions and configuration requirements are provided with every Hitachi Energy RF end-product device.

The 802.11 b/g/n radio board supports 2x2 MIMO and MRC reception (Maximal Ratio Combining). Both antenna ports are used for transmitting and receiving.

The following antennas are approved for use with the module: A pair of 7.4 dBi omnidirectional 2.4 GHz antennas, Hitachi Energy part no 150637-00. Characteristics:

- Frequency: 2.4 - 2.5GHz
- VSWR: <2:1
- GAIN: 7.4 dBi
- Polarization: Vertical, Linear
- Antenna Pattern: Omnidirectional

3.7.1 Antenna installation instructions

The Antenna ports on the Bluefin 2G module are of type MMCX. Short cables route the RF signals to external ports on the host device. Depending on the host device, the external ports are of type RP-SMA or N.

The host device supports remotely mounted antennas. When remote mounting, keep in mind that there will be attenuation of the radio frequency signal caused by the impedance of the coaxial cables. Hitachi Energy recommends the following:

- Use LMR-400 or other similar low-loss cables when remote mounting the antennas
- Use the shortest length of cable possible to minimize RF signal loss due to cable impedance.
- Always include RF surge protection devices when remote-mounting antennas.
- Always provide a reliable earth ground to the host device, surge protection devices and other active equipment.

To avoid antenna obstruction issues, the antennas should be mounted with at least 4 ft / 1.2 m horizontal clearance around the antennas. This can be accomplished by leveraging or adding a horizontal brace to the installation. The design and installation of the brace itself is outside of the scope of these instructions.

3.8 Label and compliance information

If using a permanently affixed label, the modular transmitter must be labeled with its own FCC/IC identification number, and, if the FCC/IC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior

label can use wording such as the following: “Contains Transmitter Module FCC ID: P9J-642402, IC: 4751A-642402” Any similar wording that expresses the same meaning may be used. The Grantee may either provide such a label, an example of which must be included in the application for equipment authorization, or, must provide adequate instructions along with the module which explain this requirement. In the latter case, a copy of these instructions must be included in the application for equipment authorization.

Si vous utilisez une étiquette fixée en permanence, le transmetteur modulaire doit être étiqueté avec son propre numéro d'identification FCC / IC, et, si le numéro d'identification FCC / IC n'est pas visible lorsque le module est installé à l'intérieur d'un autre appareil, alors l'extérieur de l'appareil dans sur lequel le module est installé doit également afficher une étiquette faisant référence au module fourni. Cette étiquette extérieure peut utiliser un libellé tel que le suivant: «Contient le module émetteur ID FCC: P9J-642402, IC: 4751A-642402.» Toute formulation similaire qui exprime le même sens peut être utilisée. Le bénéficiaire peut soit fournir une telle étiquette, dont un exemple doit être inclus dans la demande d'autorisation d'équipement, soit fournir des instructions adéquates avec le module expliquant cette exigence. Dans ce dernier cas, une copie de ces instructions doit être jointe à la demande d'autorisation d'équipement.

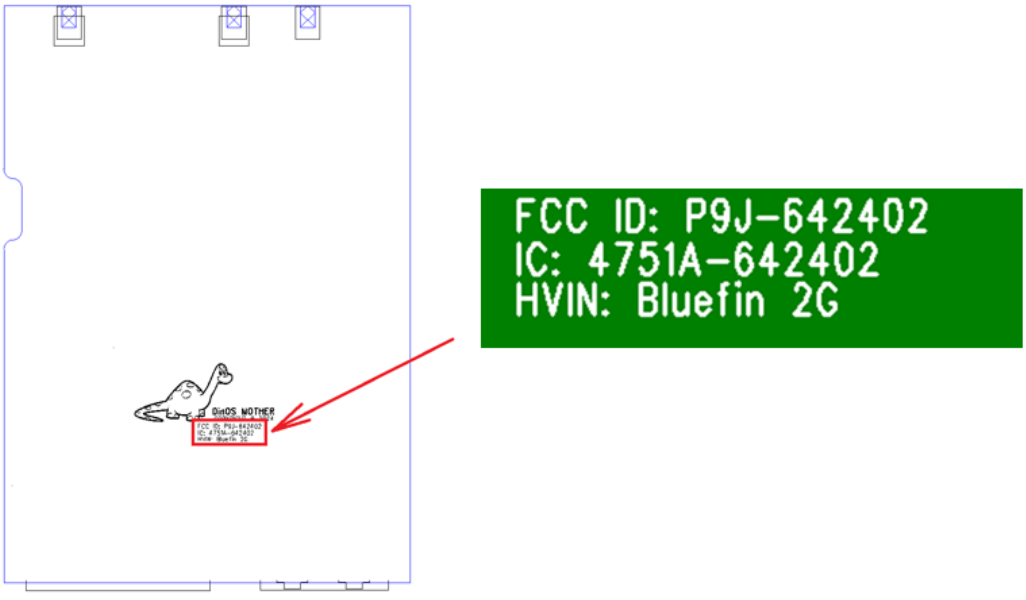

Figure 1 Top side of silk screen
Vue latérale supérieure de la sérigraphie

3.9 Test modes and additional testing requirements

The Bluefin 2.4G module is not a standalone module. All testing procedures for the module and its host will be developed by Hitachi Energy and is company confidential.

3.10 Additional testing, Part 15 Subpart B disclaimer

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 when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their own expense. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to correct the interference by using one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician.

These Part 15 radio devices operate on a non-interference basis with other devices operating at this frequency. Any changes or modification to said product not expressly approved by Hitachi Energy could void the user's authority to operate this device. 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 when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their own expense. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to correct the interference by using one of the following measures:

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4 Revisions

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01	All	Initial	Jan 2025
02	All	Major update, new template and content, new title	Feb 2025