

**Bluetooth Low Energy
BLE 4.2 Radio PCBA**

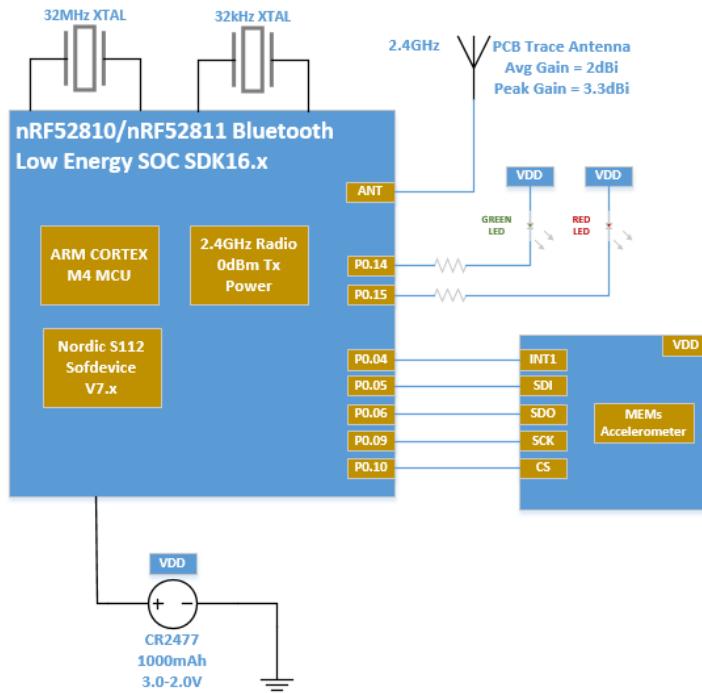
**Model Number: RADMEDIA-BLE-T21,
RADMEDIA-BLE-T22**

User Manual

RADMEDIA-BLE-T21 BLE PCBA utilizes the Nordic nRF52810-QCAA SoC with a PCB trace antenna. RADMEDIA-BLE-T22 BLE PCBA utilizes the Nordic nRF52811-QCAA SoC with a PCB trace antenna. The nRF52811 BLE SoC is simply a slightly newer version of the nRF52810 BLE SoC and provides the exact same radio functionality.

RADMEDIA-BLE-T21/RADMEDIA-BLE-T22 operates as a 'Connectable-Beacon' and transmits its beacon information at a fixed interval that can be adjusted from 1 to 2.2seconds and at a Tx power of 0dBm.

For the nRF52810-QCAA and nRF52811-QCAA SoC, refers to the nRF52810/nRF52811 Product Specification and the SDK is available from the Nordic Semiconductor website.



Main Features

- Complete Bluetooth® low energy SoC (4.2 specification)
- 32-bit ARM Cortex-M4F processor @ 64MHz
- Size : 32pin QFN 5x5x0.85mm
- Operating Frequency : 2,402MHz ~ 2,480MHz
- Up to 24kB SRAM and 192kB Flash
- Certified for FCC and Bluetooth
- Rx sensitivity : Typical -93dBm
- Operational Temperature range : -20°C to 70°C
- CR2477 primary coin cell
- Red and Green visual indicators(LED's)
- Optional MEMs accelerometer

Applications

- Asset Tracking
- Remote Monitoring

The (Family model **RADMEDIA-BLE-T21/RADMEDIA-BLE-T22**) two models of Main Board share the same PCB layout.

The only difference is the RADMEDIA-BLE-T22 uses a slightly newer BLE SoC in the nRF52811-QCAA.

- **RADMEDIA-BLE-T21 uses the nRF52810-QCAA BLE SoC**
- **RADMEDIA-BLE-T22 uses the nRF52811-QCAA BLE SoC**

Model	Item Description	Placement	Type/ Model	Manufacturer Name	Manufacturers. Part Number	Remark
RADMEDIA-BLE-T21	Bluetooth PCBA with PCB Trace Antenna	U2	-T21	Nordic Semiconductor	nRF52810-QCAA	N/A
RADMEDIA-BLE-T22	Bluetooth PCBA with PCB Trace Antenna	U2	-T22	Nordic Semiconductor	nRF52811-QCAA	N/A

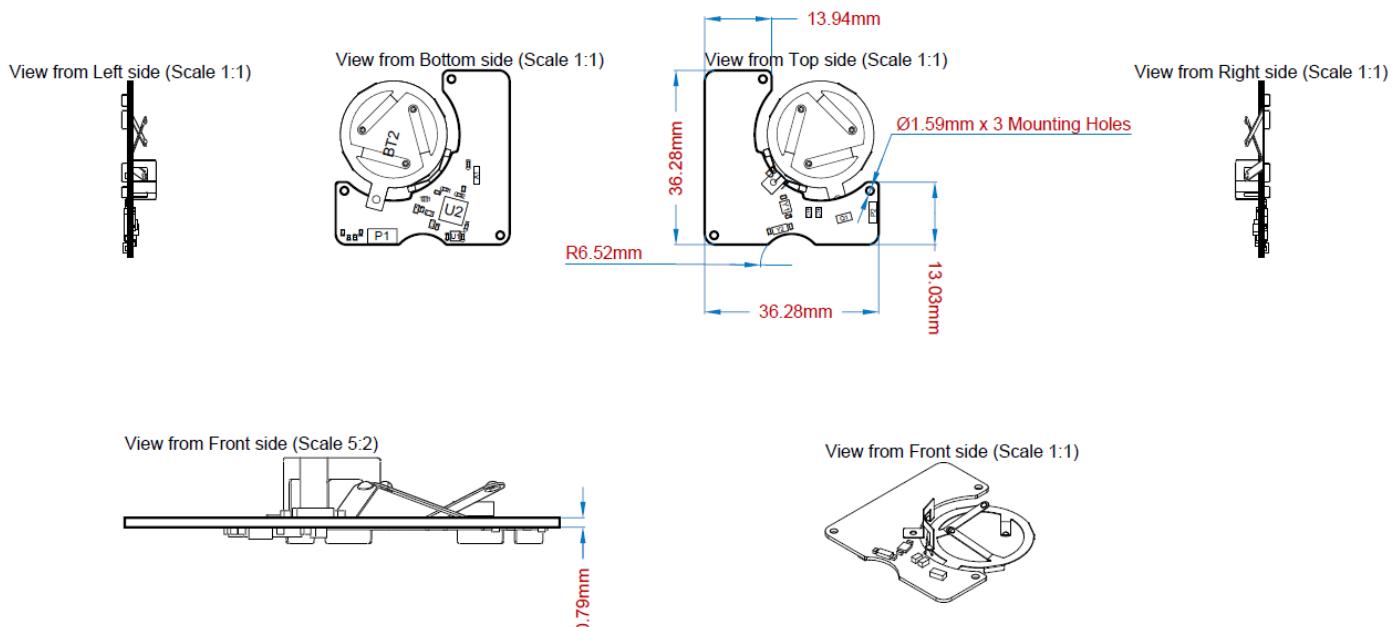
Antenna Approved for use with RADMEDIA-BLE-T21

Part Number	Max Gain (dBi)	Supplier	Notes
PCB Trace	3.3	PCBA Trace	Inverted F PCB Trace Antenna

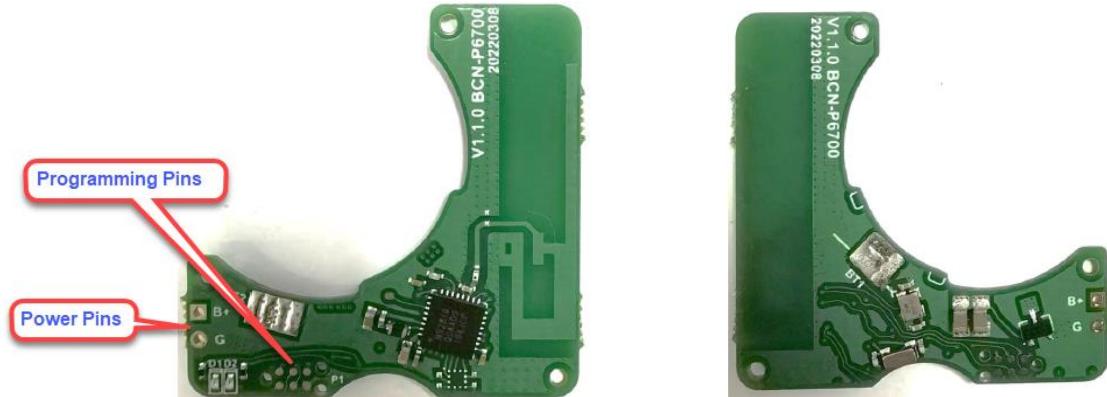
This unit is sold pre-programmed with its Radio Transmit interval, BLE UUID, and Transmit Power defined and is encompassed into a plastic enclosure so there is not a detailed user manual.

RADMEDIA-BLE-T21, T22 Mechanical View

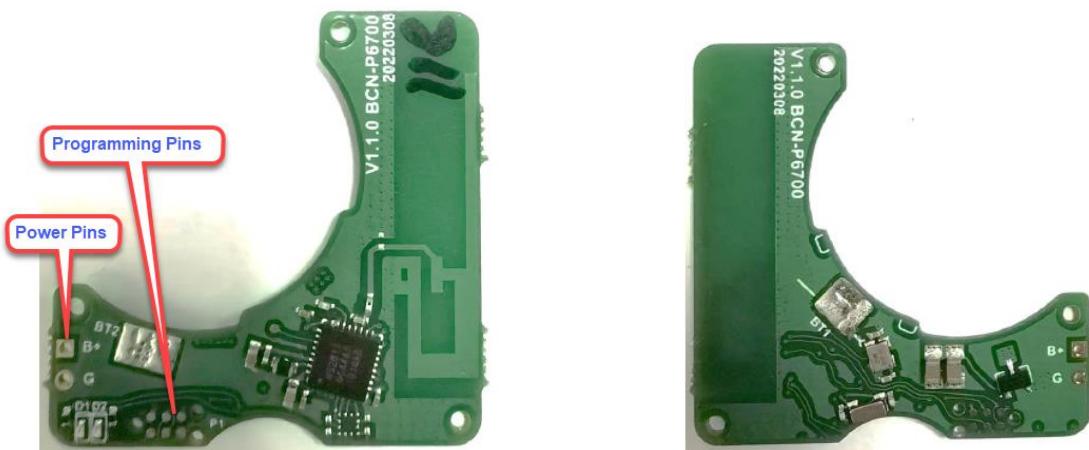
NOTE: There are no accessible GPIO to a user/host outside of power and programming pins.



RADMEDIA-BLE-T21 PCBA Photos



RADMEDIA-BLE-T22 PCBA Photos



PCB Trace Antenna

1. Dimensions

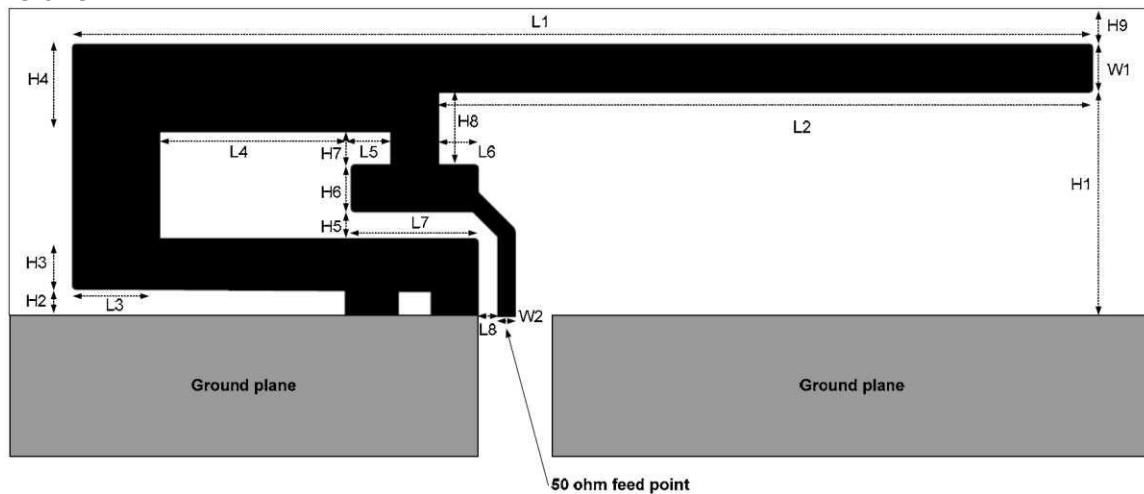


Figure 1. IFA Dimensions

Table 1. IFA Dimensions

H1	5.70 mm	W2	0.46 mm
H2	0.74 mm	L1	25.58 mm
H3	1.29 mm	L2	16.40 mm
H4	2.21 mm	L3	2.18 mm
H5	0.66 mm	L4	4.80 mm
H6	1.21 mm	L5	1.00 mm
H7	0.80 mm	L6	1.00 mm
H8	1.80 mm	L7	3.20 mm
H9	0.61 mm	L8	0.45 mm
W1	1.21 mm		

2. Radiation Pattern

Figure 2 shows how to relate all of the radiation patterns to the orientation of the antenna. The radiation patterns were measured with the RADMEDIA-BLE-T21/RADMEDIA-BLE-T22 device programmed to 0-dBm output power.

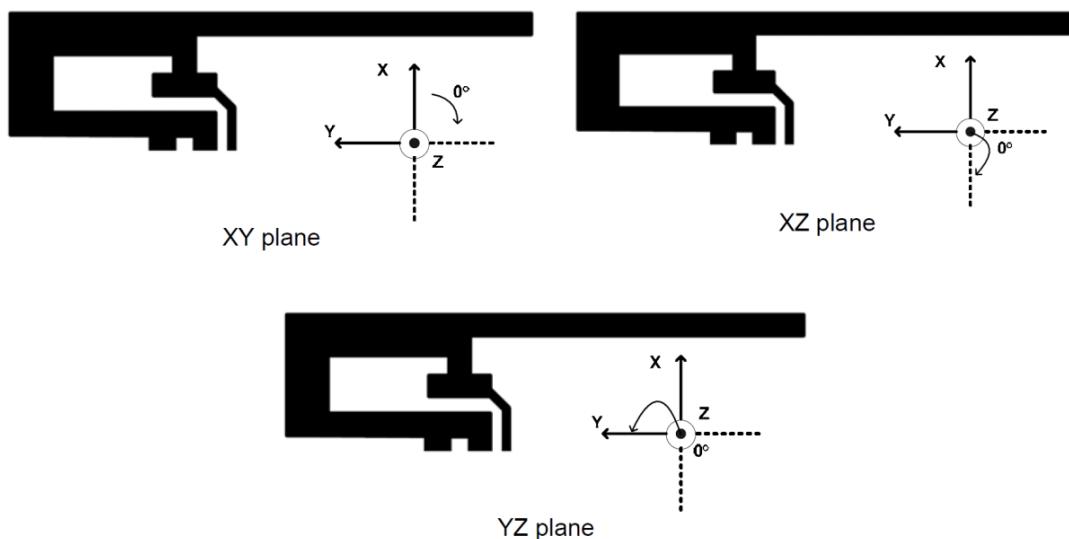


Figure 2. Relating Antenna to Radiation Patterns

Figure 3. XY Plane – Vertical Polarization

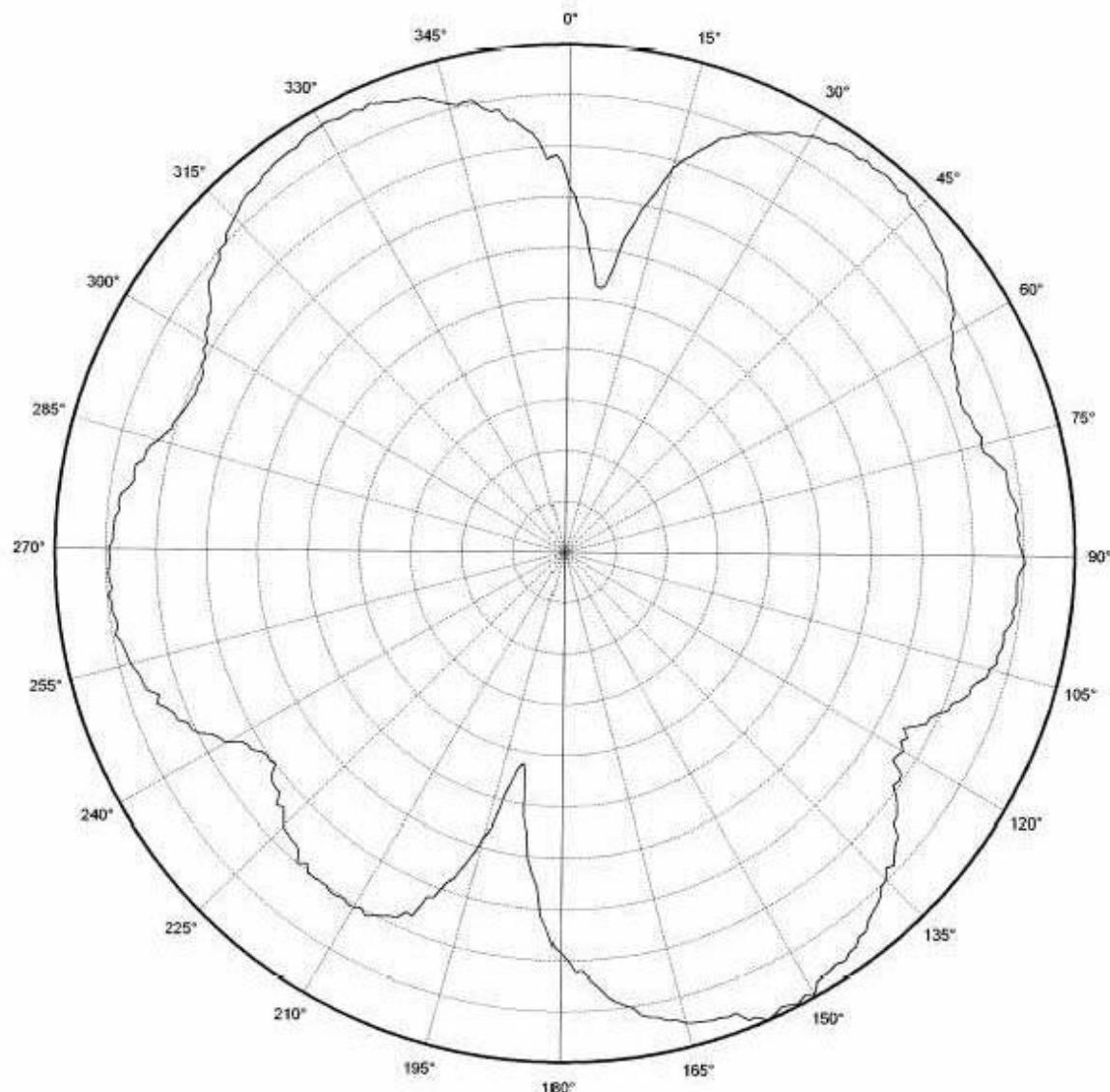


Figure 4. XY Plane Horizontal Polarization

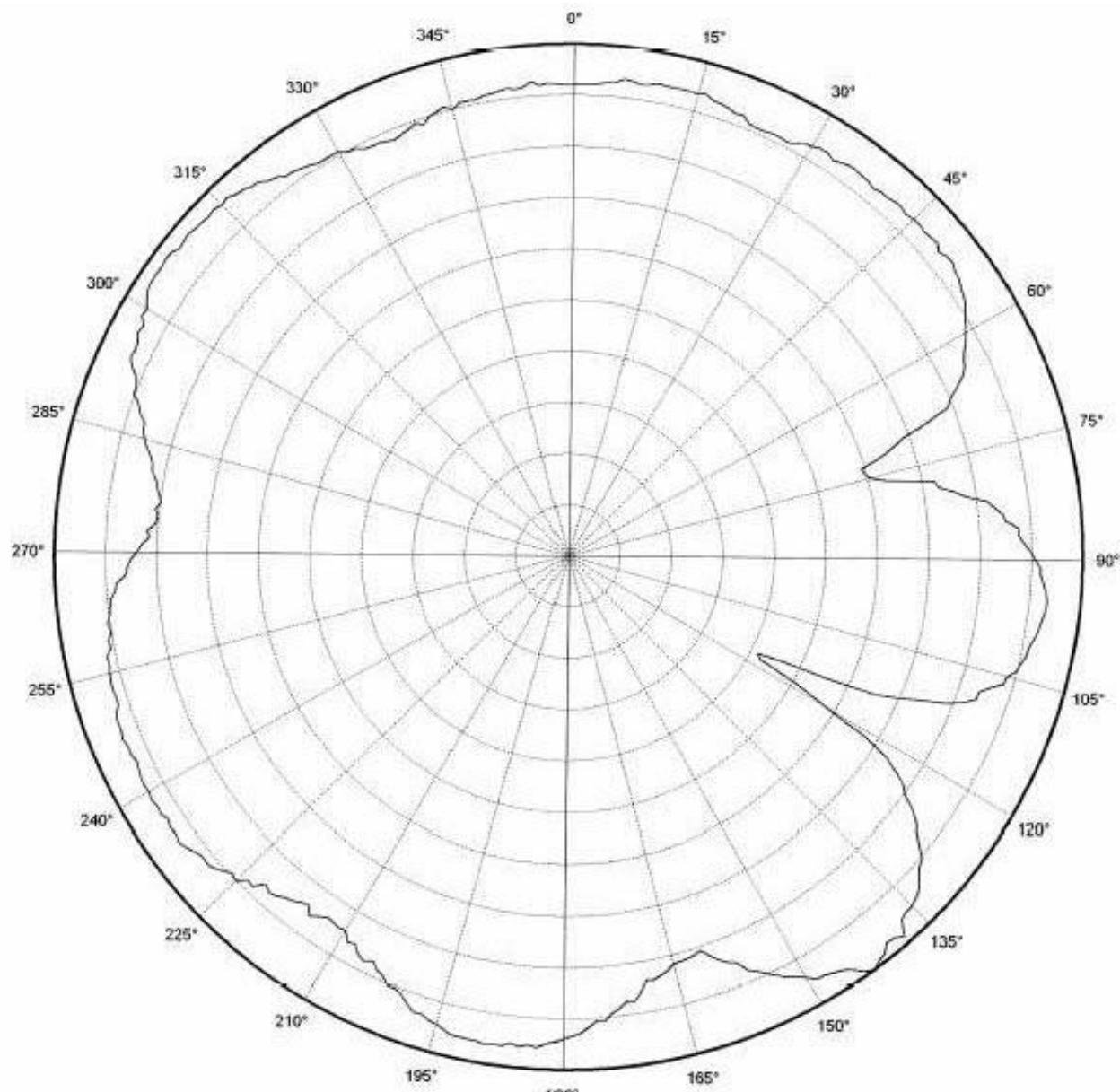
**Horizontal Polarization****CF 2450.000 MHz****4 dB/ div****Ref Lev: +11.1 dBm**

Figure 5. XZ Plane Vertical Polarization

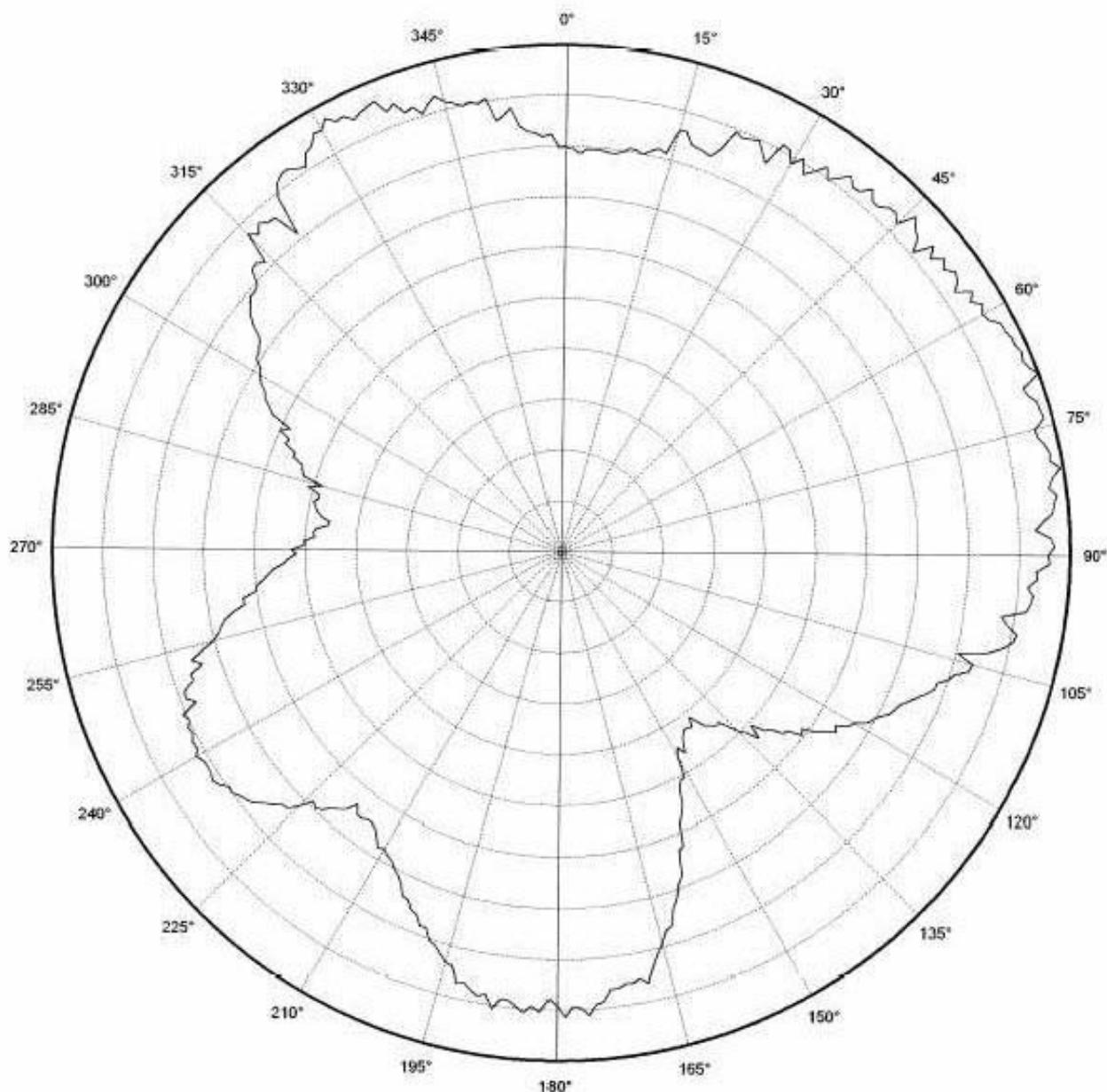


Figure 6. XZ Plane Horizontal Polarization

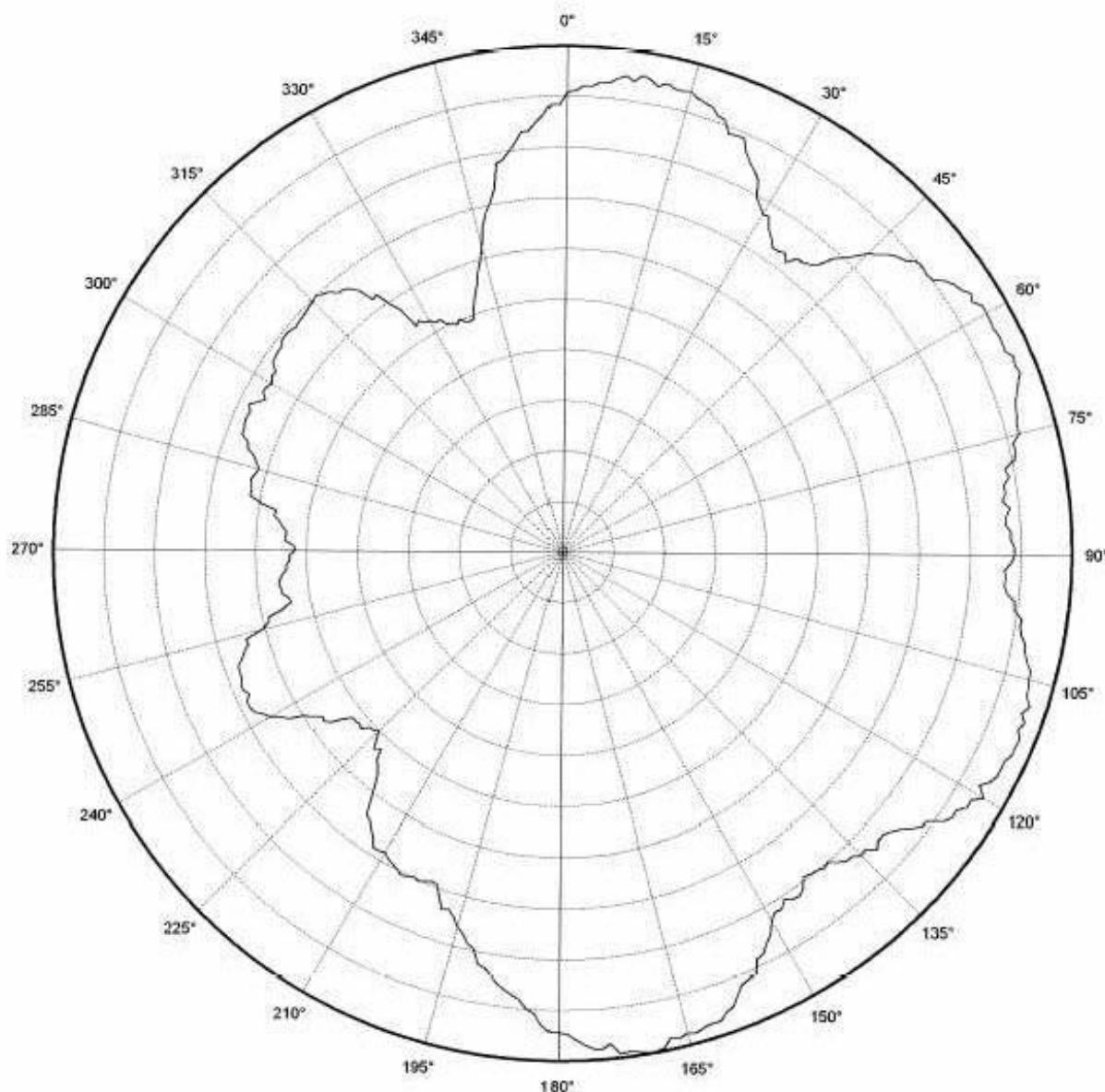
**Horizontal Polarization****CF 2450.000 MHz****3 dB/ div****Ref Lev: -115 dBm**

Figure 7. YZ Plane Vertical Polarization

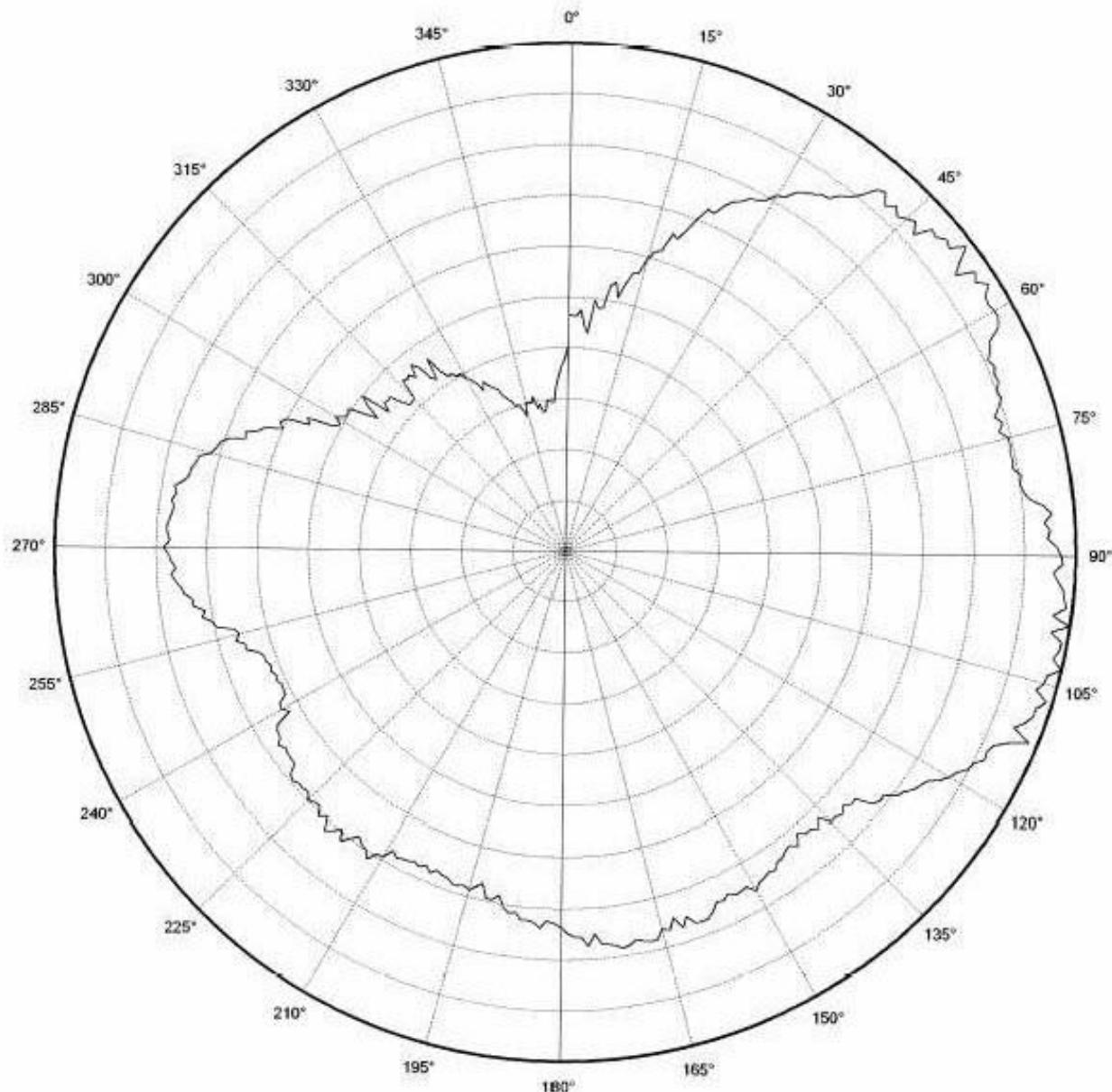
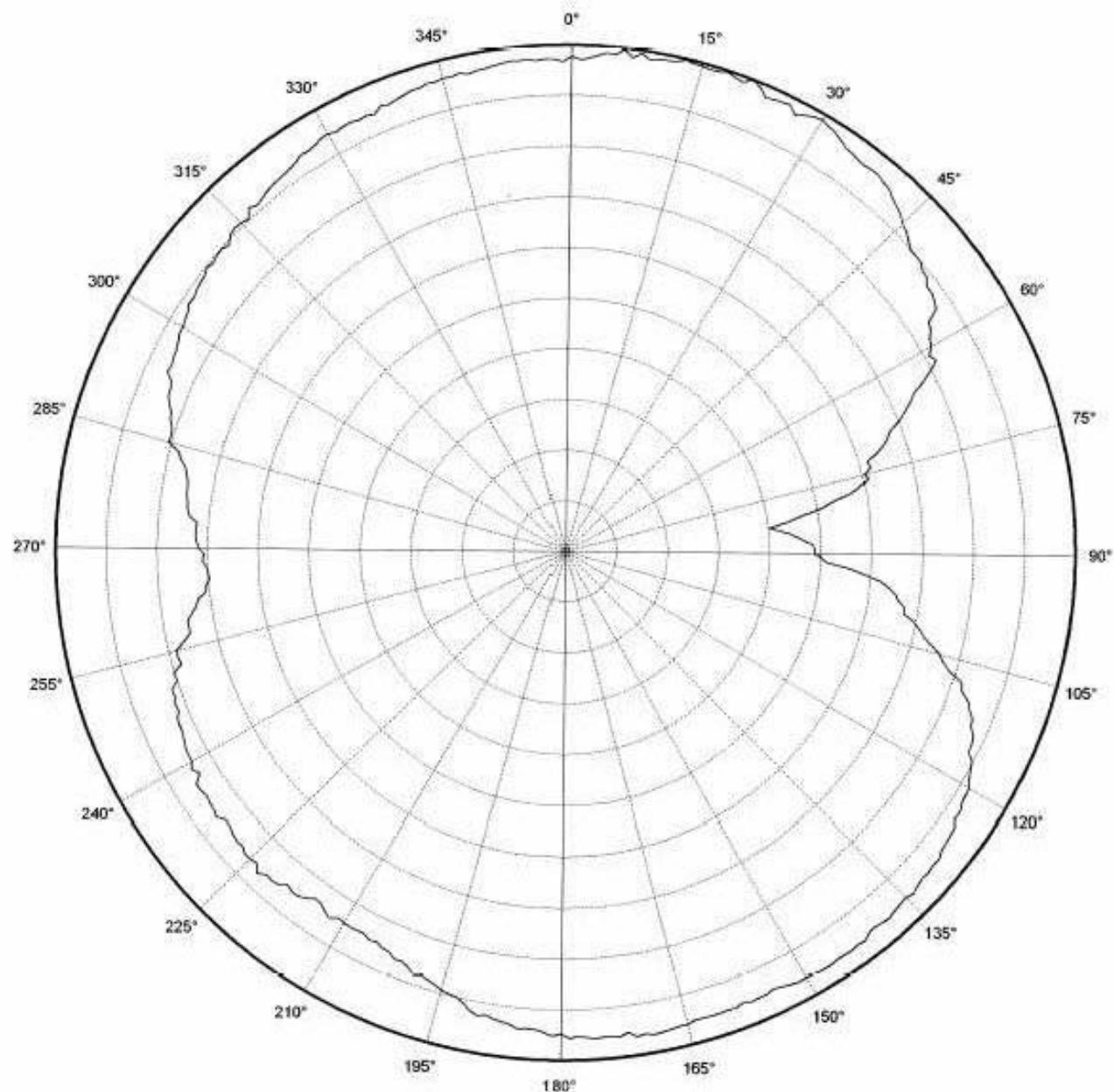
**Vertical Polarization**

Figure 8. YZ Plane Horizontal Polarization

**Horizontal Polarization****CF 2450.000 MHz****5 dB/ div****Ref Lev: +11.1 dBm**

3. PCB Antenna Bandwidth

One way of measuring the bandwidth after the antenna is implemented on a PCB and connected to a transmitter is to write test software that steps a carrier across the frequency band of interest. By using the maximum hold function on a spectrum analyzer, the variation in output power across frequency can easily be measured.

Figure 9 shows how the output power varies on the IFA when the PCB is horizontally oriented and the receiving antenna has horizontal polarization. This measurement was not performed in an anechoic chamber, thus the graph shows only the relative variation for the given frequency band.

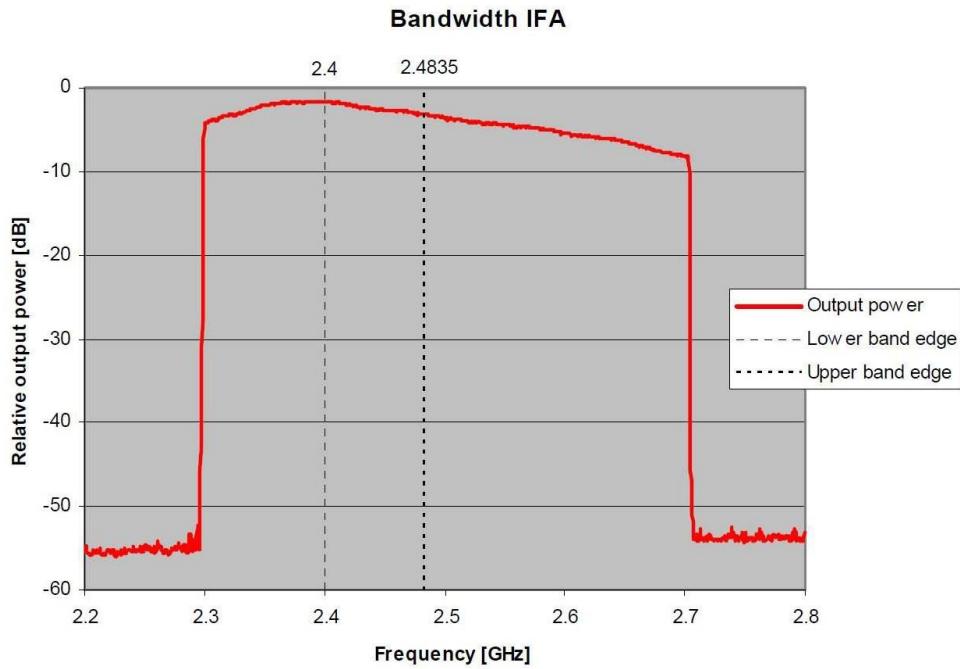


Figure 9. Bandwidth of PCB Antenna

4. Conclusion PCB Trace Antenna

Table 2 lists the most important properties for the IFA.

Table 2. Summary of IFA Properties

Gain in XY plane	1.1 dBi
Gain in XZ plane	3.3 dBi
Gain in YZ plane	1.6 dBi
Reflection	< -15 dB
Antenna size	25.7 x 7.5 mm

Federal Communication Commission Interference Statement

This equipment was 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

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 a minimum distance of 20 centimeters between the radiator and your body.

This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

Country Code selection feature to be disabled for products marketed to the US/CANADA.

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

- 1.The antenna must be installed such that 20 centimeters is maintained between the antenna and users, and
- 2.The transmitter module may not be co-located with any other transmitter or antenna,
- 3.For all products market in US, OEM must limit the operation channels in CH0 to CH39 for 2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end user regarding to Regulatory Domain change.

If the conditions above are met, further transmitter test are not 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 cannot 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 cannot be used on the final product. In these circumstances, the OEM integrator is 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 a 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 Transmitter Module FCC ID: 2AHP7-BLET21"

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.

Requirement per KDB996369 D03

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).it specifically establish the 6dB Bandwidth, Peak Output Power, Radiated Spurious Emission, Power Spectral Density, Restricted Band of Operation and Band Edge (Out of Band Emissions) and Measurement.

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 EUT has a PCB Trace antenna. Yes, the module contains a permanently attached Antenna. The antenna max gain is 3.3dB.

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 does not include a RF shield. The module is a Limited Single Modular.

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 includes the layout of the PCB trace design, antenna, connectors, and isolation requirements.

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: 2AHP7-BLET21.

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 EUT has a pcb trace antenna. The module contains a permanently attached pcb trace antenna with a max Gain of +3.3dBi.

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 text: FCC ID: 2AHP7-BLET21

Information on test modes and additional testing requirements⁵

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

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 circuitry), 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 circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.