APPLIED WIRELESS ID

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ANT-915-CPS rev.1.4a – Data Sheet
Circular Polarized Antenna for RFID

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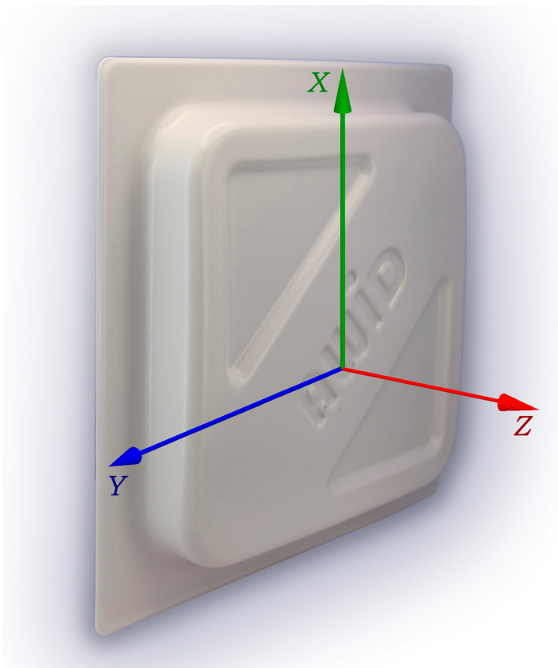


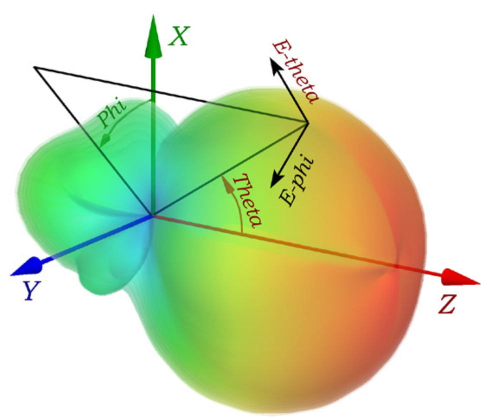
Features

- Maximum achieved realized gain and frequency bandwidth within moderate volume.
- Variation of the Maximum Gain is less than ±0.8dB in Z direction at any Phi angle within operational frequency band.
- Variation of the Maximum Gain is less than ±0.5dB within the frequency band 876-973MHz at the fixed Phi angle.
- It provides very low reflection of the transmitter signal into receiver. The return loss is more than 24dB.
- Light – weight is 482g or 17oz.

Overview

This antenna is designed by RFID company for RFID applications. Requirements for parameters of the antenna were formulated along 10 year experience with design of RFID hardware.
Antenna provides uniform electromagnetic field which guaranties the stability of tag interrogation at any position.
Size, weight and gain of the antenna are optimized for stationary indoor applications.
It is optimized for USA frequency band 902-928MHz, but may be employed for European 865-869MHz and Japanese 950-955MHz frequency bands with some degradation of the gain and VSWR.

Radiation Pattern Definition



Electrical Specifications

Parameter	Value	Units	Notes
Operational Frequency Band	902 – 928	MHz	North America, China, Taiwan, Singapore, Korea, Australia
Polarization	RHCP		Right hand circular polarization
Peak of Linear Polarized Realized Gain	+5.84	dBi	E-theta or E-phi Component (for RFID application) Without coaxial cable
Variation of Maximum Gain	+5.84 to +4.32 Δ=1.52	dBi dB	within Phi angle $\pm 180^{O}$ and the frequency band 902 - 928MHz Free or Open Space condition.
-1dB radiation bandwidth	876-973 Δ=97	MHz MHz	Free or Open Space condition. Fixed Phi angle.
Front to Back Ratio of Radiation	16.0	dB	Free or Open Space condition.
Width of the radiation pattern at -1dB from the maximum	36^{O} ($\pm 18^{O}$)	degree	E-theta Component Free or Open Space condition.
Width of the radiation pattern at -3dB from the maximum	64^{O} ($\pm 32^{O}$)	degree	E-theta Component Free or Open Space condition.
Peak of Circular Polarized Realized Gain.	+8.35	dBic	RHCP component. Free or Open Space condition.
Maximum Axial Ratio at the bore-sight direction	1.52	dB	within frequency band 902 – 928MHz
Maximum Axial Ratio within Cone with Theta=$\pm 30^{O}$	3.0	dB	within frequency band 902 – 928MHz
Maximum input VSWR	1.12		Reference impedance is 50 Ohm. Within frequency band 902 – 928 MHz
Minimum Return Loss	24.9	dB	Reflection of the transmitter signal into receiver within frequency band 902-928MHz.
Maximum Input Power	5.0	Watt	In Operational Frequency Band

Electrical Specifications
within extended operational frequency

Parameter	Value	Units	Notes
Frequency Band	865 – 869	MHz	European countries
Variation of Maximum Linear Polarized Realized Gain	+4.8 to +2.6 Δ=2.1	dBi dB	E-theta or E-phi Component (for RFID application)within Phi angle ±180^{O} and the frequency band 865 - 869MHz Free or Open Space condition.
Maximum of the Circular Polarized Realized Gain.	+7.0	dBic	RHCP component. Free or Open Space condition.
Maximum Axial Ratio at the bore-sight direction	1.99	dB	within frequency band 865 – 869MHz
Minimum Return Loss	21.3	dB	Reflection of the transmitter signal into receiver within frequency band 865-869MHz.
Maximum input VSWR	1.19		Reference impedance is 50 Ohm. Within frequency band 865 – 869 MHz

Parameter	Value	Units	Notes
Frequency Band	950 – 955	MHz	Japan
Variation of Maximum Linear Polarized Realized Gain	+5.62 to +3.38 Δ=2.24	dBi dB	E-theta or E-phi Component (for RFID application)within Phi angle ±180^{O} and the frequency band 950 - 955MHz Free or Open Space condition.
Maximum of the Circular Polarized Realized Gain.	+7.92	dBic	RHCP component. Free or Open Space condition.
Maximum Axial Ratio at the bore-sight direction	2.18	dB	within frequency band 950 – 955MHz
Minimum Return Loss	21.7	dB	Reflection of the transmitter signal into receiver within frequency band 950-955MHz.
Maximum input VSWR	1.18		Reference impedance is 50 Ohm. Within frequency band 950 – 955 MHz

Parameters for RFID Applications

Parameter	Value	Units	Notes
Maximum Read Range	23.5 7.2	feet m	Transmitter Power is 1.0 Watt. RFID Tag is Alien Squiggle Inlay ALN-9540, Higgs-2 RFID IC Free or Open Space condition.
Variation of Maximum Read Range	19.7 – 23.5 6.0 – 7.2	Feet m	within Phi angle $\pm 180^{O}$ and the frequency band 902 - 928MHz
Frequency Bandwidth of ±5% Read Range Variation	876-973	MHz	Free or Open Space condition.
Width of the Cone with ±15% Read Range Variation	$\pm 30^{O}$	degree	Free or Open Space condition.
Front to Back Ratio of Read Range	5.9	times	Free or Open Space condition.
Maximum Axial Ratio of the Read Range	±7	%	In the bore-sight direction within frequency band 902 – 928MHz. Free or Open Space condition.
Reflection Coefficient	1/309	times	Reflection of the transmitter signal into receiver within frequency band 902-928MHz.

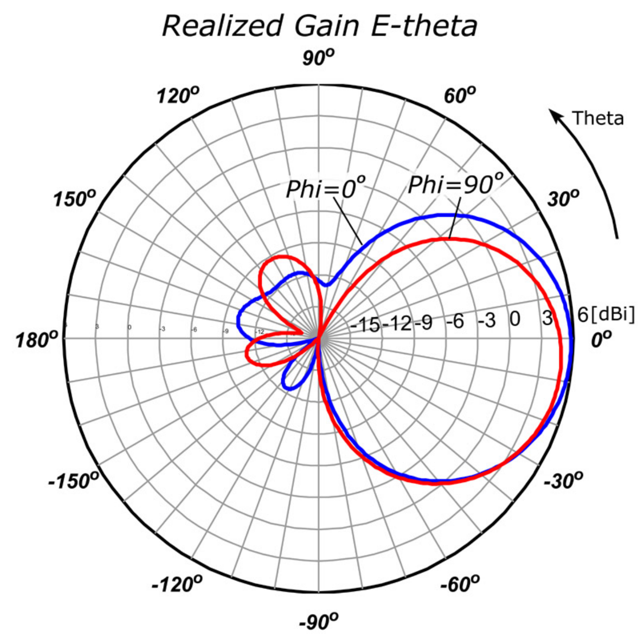
Environmental Specifications

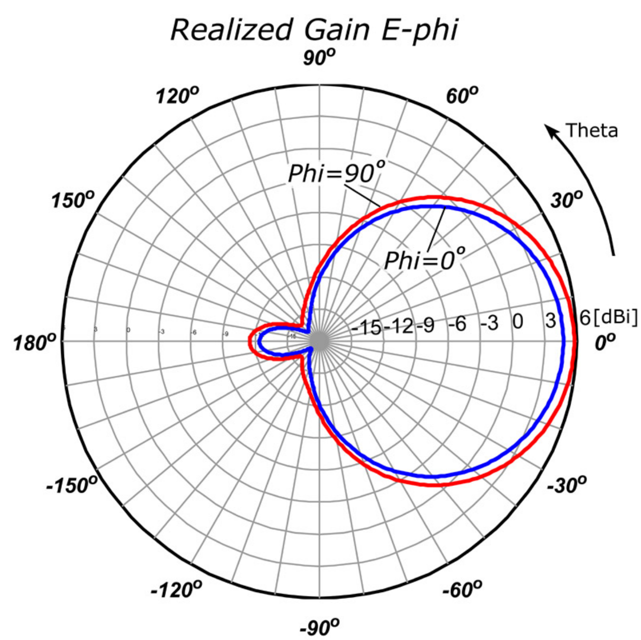
Parameter	Value	Units	Notes
Operation temperature	-10 +70	^{o}C	Ambient
Humidity	5-90	%	Relative, non-condensing
RoHS	Yes		North America, China, Taiwan
IP Rating	IP50		Antenna may be employed for indoor installations.

Mechanical Specifications

Parameter	Value	Units	Notes
Dimension	10.25 x 10.25 x 1.42 260 x 260 x 36	in mm	Details on mechanical drawing
Weight	17 482	oz g	Without mounting components and RF cable
RF Connector	TNC		50 Ohm, Reverse Polarity
Enclosure Material	Plastic Aluminum Alloy		Electrical parameters of antenna depend on Dielectric Constant and Loss of material and dimension of enclosure.

2-D Radiation Patterns in free space

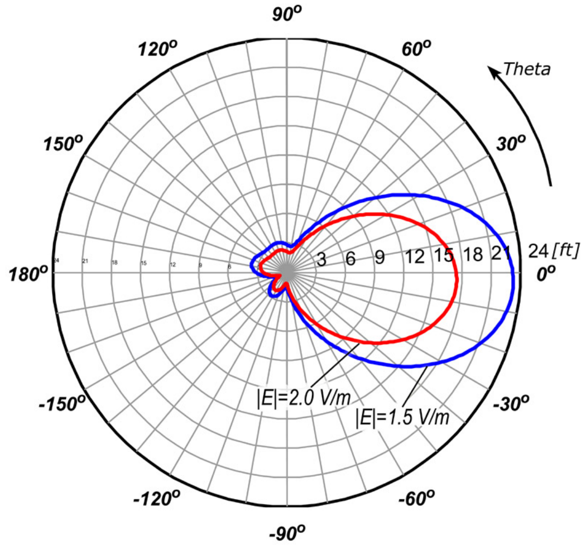




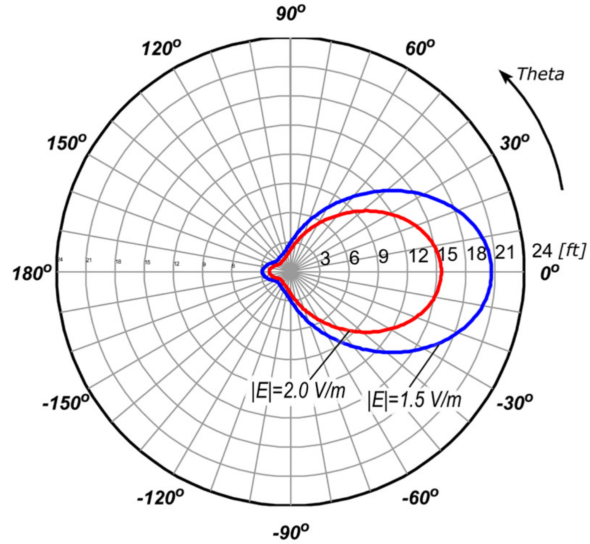
- Frequency is 915 MHz.
- Free space condition.

2-D Read Range Patterns

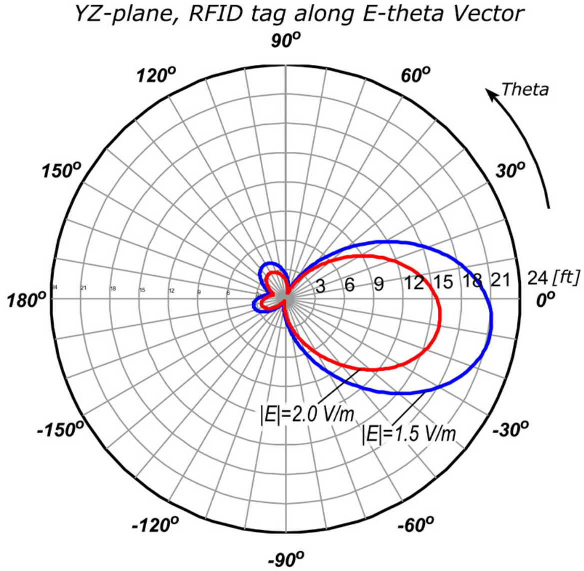
XZ-plane, RFID tag along E-theta Vector



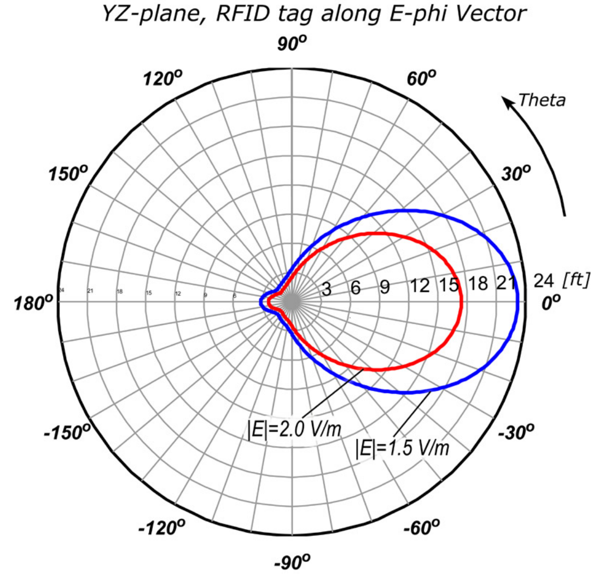
XZ-plane, RFID tag along E-phi Vector



YZ-plane, RFID tag along E-theta Vector



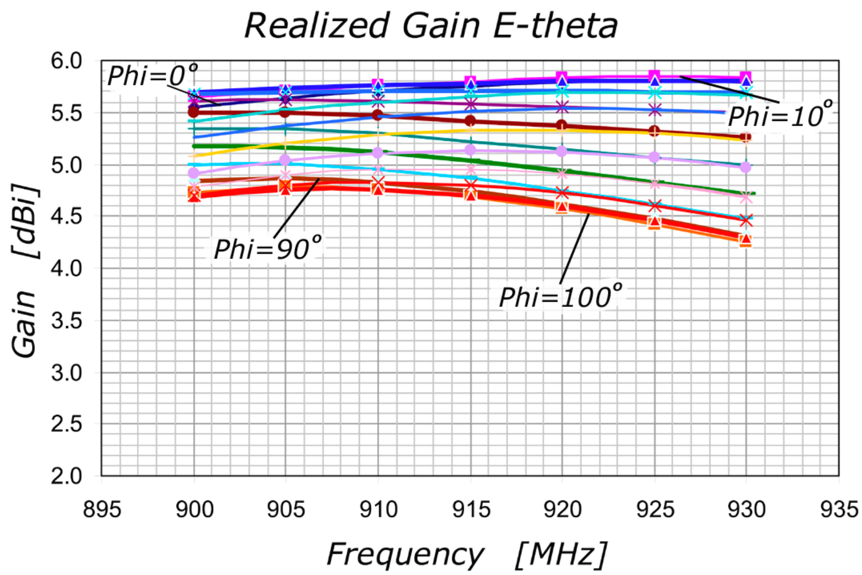
YZ-plane, RFID tag along E-phi Vector



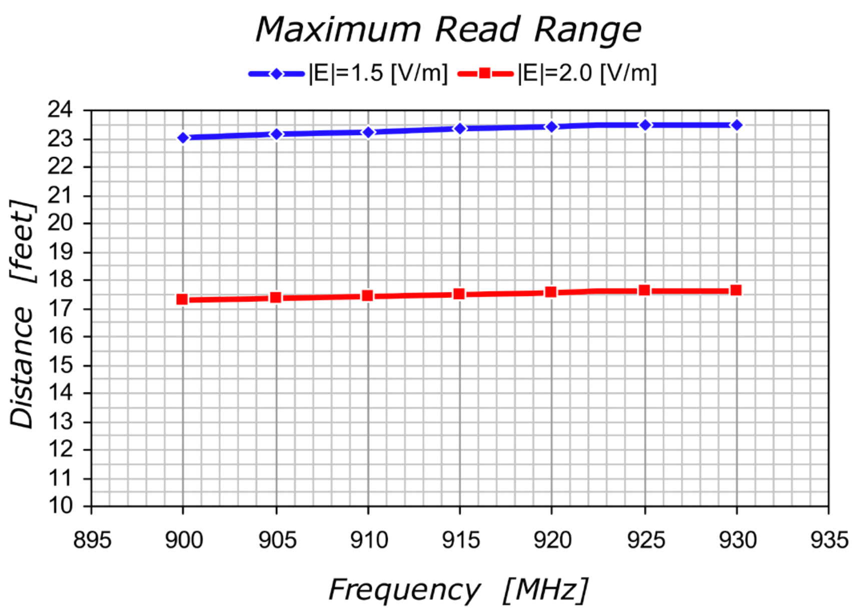
The Read Range Patterns illustrate the reading zones for two tags. One zone is for the tags require the activation field strength 1.5 [V/m]. It corresponds approximately to the Alien Squiggle Inlay "ALN-9540" with Higgs-2 RFID IC or NXP SL3ICS1202. Second zone is for tags require the activation field strength 2.0 [V/m]. It corresponds approximately to the tag with Impinj "Monza-2" RFID IC.
Radiation conditions are:

- Transmitter Power is 1.0 Watt.
- Frequency is 915 MHz
- Free Space

Frequency Response Diagram



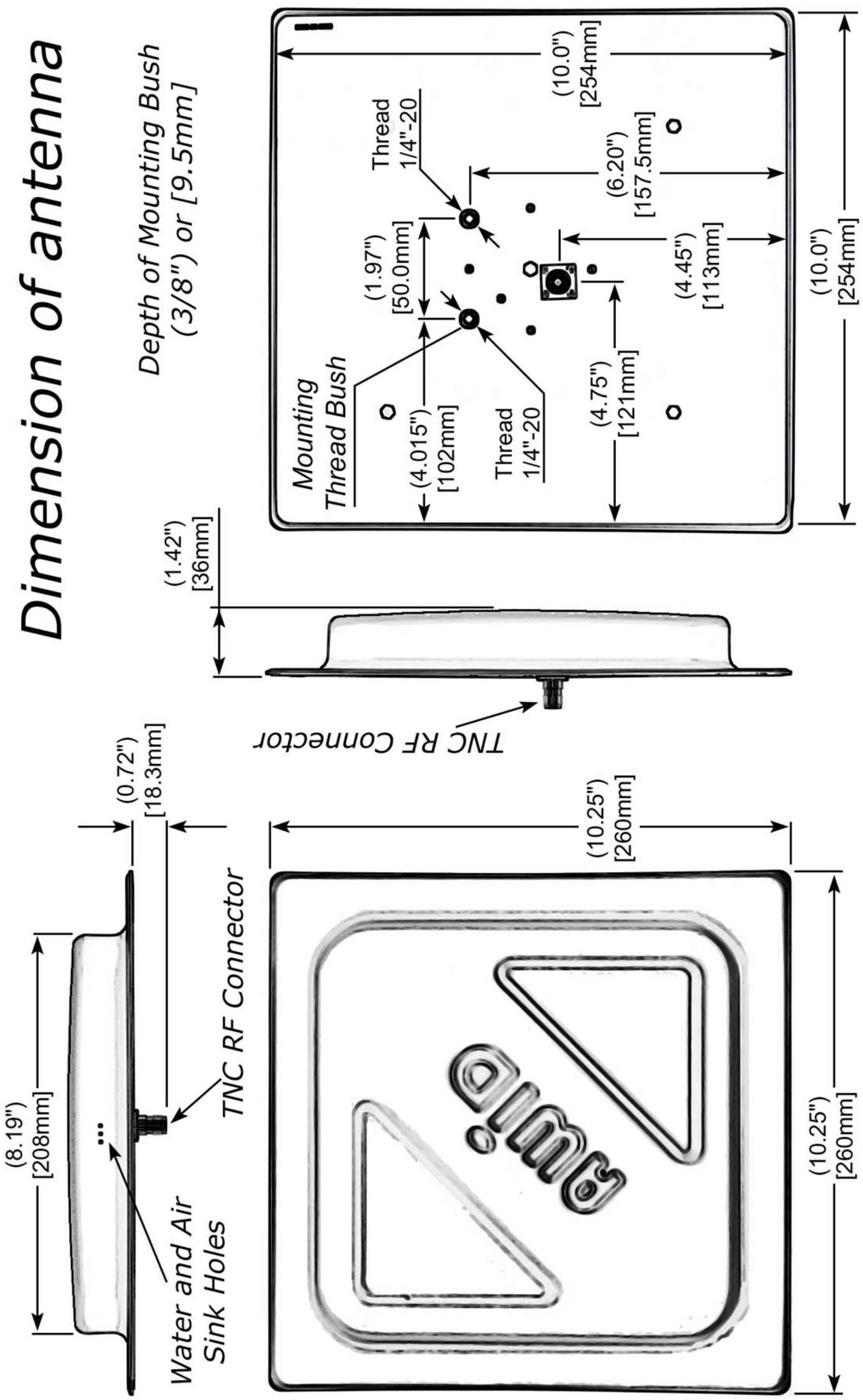
Angle Phi variation is from 0^{O} to $+180^{O}$, angle Theta is 0^{O}.



The Blue Curve corresponds to the tags require the activation field strength 1.5 [V/m]. The Red Curve corresponds to the tags require the activation field strength 2.0 [V/m].
Radiation conditions are:

- Transmitter Power is 1.0 Watt.
- Free Space

Dimension of antenna



Notes

Return Loss parameter requirements

The RFID transceiver transmits the signal to the antenna. Most of the transmitted energy will be radiated from the antenna into the space. Small portion of the transmitted energy will be reflected back from the not perfectly matched input port of antenna back to the receiver of the RFID transceiver. The amount of this reflected energy is defined by return loss, or VSWR of the antenna.

Conventional wireless communication systems, in which the transmitted signal and the received signal are separated in time or/and by the frequency of the carrier, may employ antennas with VSWR with range 1.5-2.0 as good or tolerable, because more than 90% of transceiver power will be accepted by antenna.

For RFID system such value of VSWR is too high, as the part of the noisy and strong transmitted signal is coming back to the sensitive receiver. This will degrade the performance of RFID system, which noise floor is defined not by the noise figure of the receiver LNA or the mixer, but by the portion of the noisy signal from the transmitter, "leaked" into the receiver. In some cases, high level of reflection may damage the receiver components.

Antenna has to have VSWR less than 1.20-1.30 or the return loss more than 18-20dB for RFID applications. For instance, the reduction of antenna VSWR from 2.0 to 1.2 may improve the signal to noise ratio in the receiver by 11.3dB. This will significantly reduce the errors of decoding of the signals coming from the tags and increase the speed of interrogation.

Objects, positioned close to this antenna at the distance few inches away, may reduce the return loss from 25dB to 20dB. Users should be sure that the RFID transceiver is able to tolerate the signal at the receiver up to +10dBm.

Note for installation to prevent the degradation of antenna performance.

It is based on Near Electric and Magnetic Fields distribution.

1. Requirement to the position of nonconductive objects (plastics, ceramic, glass etc.).

This antenna is designed for plastic enclosure with certain shape and dielectric constant and loss tangent of plastic material. Any deviation from the dedicated enclosure will affect the performance of the antenna. Antenna may be installed into different or additional plastic enclosure, but may require minor correction of the tuning components.

The following statements are applicable for additional objects in vicinity of antenna.

- Any nonconductive objects have to be position 0.3in/8mm away from sides of the antenna.
- Any nonconductive objects have to be position 0.8in/20mm away from the front surface of the antenna.

2. Requirement to the position of conductive objects (metals, conductive solutions, conductive paints etc.).

- Any conductive objects have to be position 6in/150mm away from sides of the antenna.
- Any conductive objects have to be position 12in/300mm away from the front surface of the antenna.

This antenna is covered by US patent 7403158.