# Application Note no.015

## Chip Antenna Series

## Bluetooth \ WLAN Chip Antenna

## ACA-2012-A1-CC-S

| Prepared | Checked | Approved |
|---|---|---|
| **Leeting** | **D.F** | **Jimmy** |

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Application Note

# Bluetooth \ WLAN Chip Antenna – ACA-2012-A1-CC-S

Revision History: 2010-04-09 Rev.A0

| **Previous Version :** | | |
|---|---|---|
| **Page** | **Subjects (major changes since last revision)** | **Version** |
| All | Make up all document | A0 |
| | | |
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| | | |
| | | |
| | | |
| | | |

# ACA-2012-A1-CC-S Application Note

## Catalog

## Applications

This antenna is designed for Bluetooth\WLAN application and it's suitable for cellular phones, PDA, notebook, navigator, and all devices which have Bluetooth\WLAN function.

## Features

- Omni-directional radiation
- High Efficiency
- Low profile and compact size(2.0 x 1.2 x 0.55mm)
- Low cost
- Lead free soldering compatible
- RoHS compliant
- Tape and reel packing

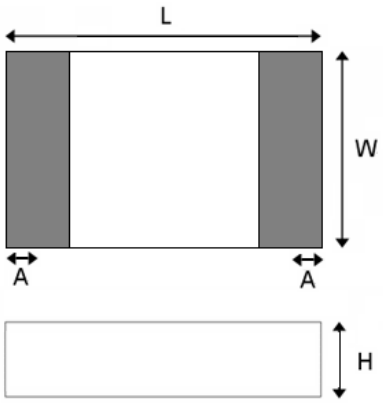
## Electrical Characteristics

| ITEM | SPECIFICATION |
|---|---|
| Frequency Band | 2400MHz～2483MHz |
| VSWR | Less than 4 |
| Polarization | Linear |
| *Peak Gain | 1.72 dBi Typ. |
| *Peak Efficiency | 72.3% Typ. |
| Impedance | 50Ω Typ. |

* Test condition: Test board size 110*55 mm

Matching circuit: Pi matching circuit will be required

## Antenna Dimension




| Chip Antenna | L | W | H | A |
|---|---|---|---|---|
| ACA2012 | 2.0±0.3 | 1.2±0.3 | 0.55±0.2 | 0.4±0.25 |



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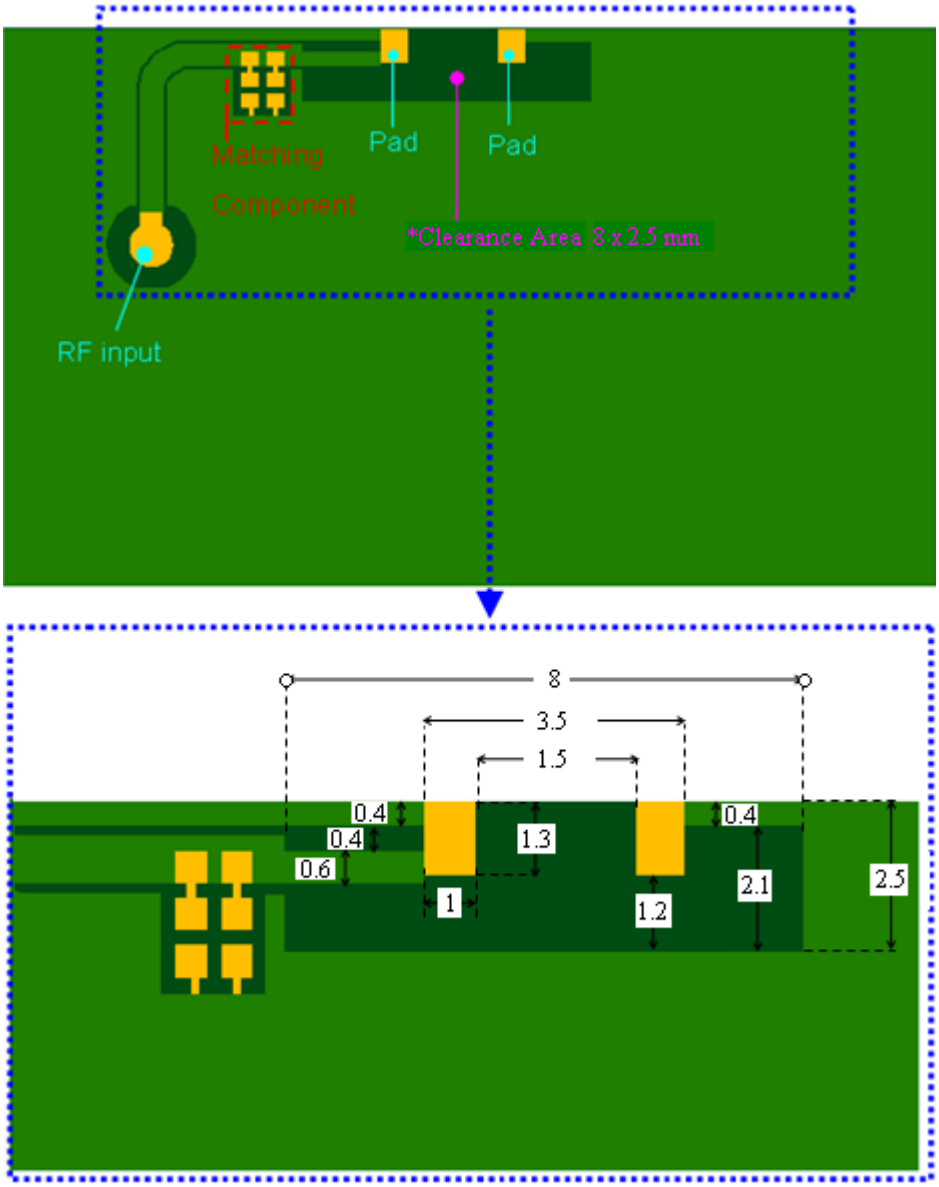
## Recommended PCB layout (unit: mm)




***Clearance 8mm × 2.5mm：All metallization should be removed from all PCB layers.**



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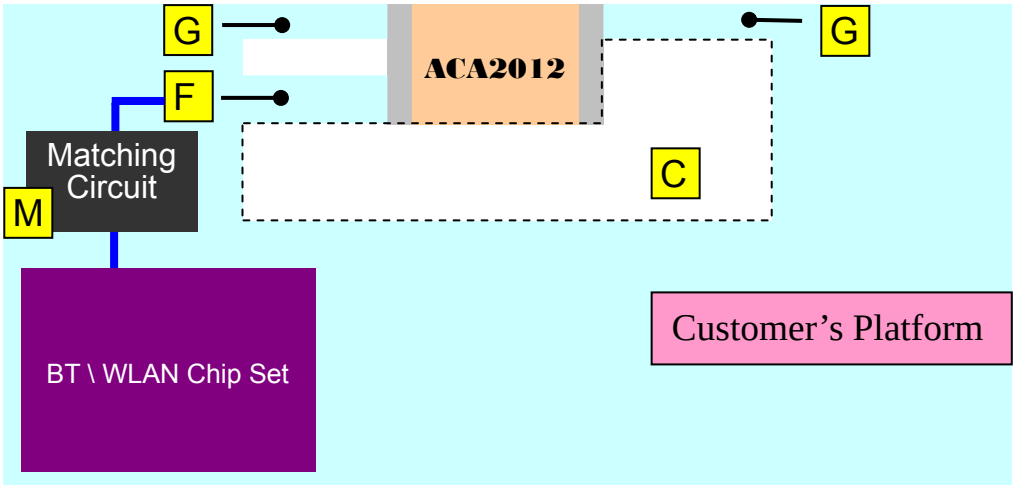
## Layout Description




F. Feeding Pad

The signal from system must feed into the feeding pad.

G. Ground Pad

This pad must connect to ground plane of PCB.

C. Clearance Area

To achieve antenna performance, the clearance area is necessary and all metallization should be removed from all PCB layers.

M. Matching Circuit

Please keep the pads for PI-matching circuit to reduce return loss and shift the band to meet Bluetooth application.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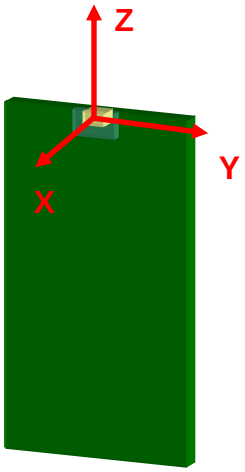
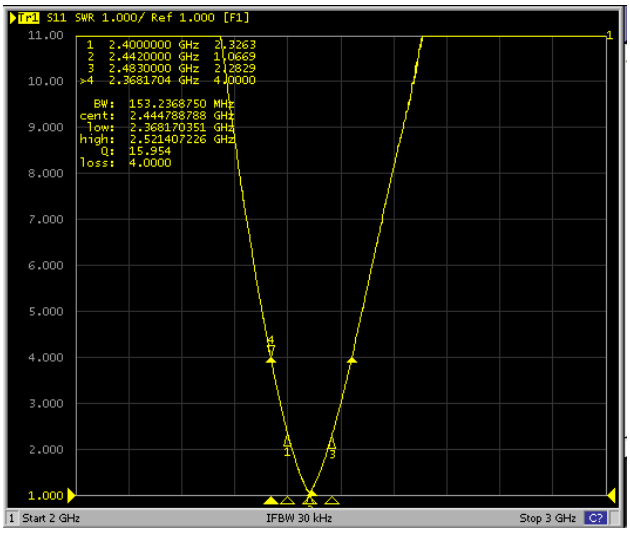
## Performance on Middle of Short Side



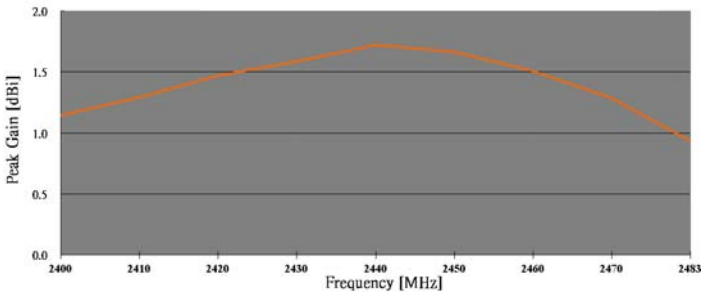

## Typical VSWR



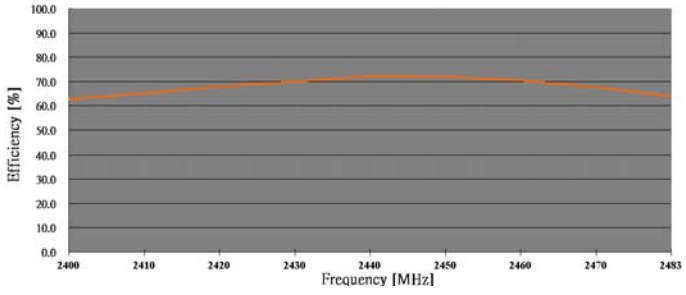

| Frequency | VSWR |
|---|---|
| 2400 MHz | 2.33 |
| 2442 MHz | 1.07 |
| 2483 MHz | 2.28 |

## Typical Free Space Peak Gain and Efficiency

Antenna Peak Gain




Radiation Efficiency




| Frequency | Peak Gain(dBi) | Efficiency(%) |
|---|---|---|
| 2400 MHz | 1.14 | 62.61 |
| 2442 MHz | 1.72 | 72.30 |
| 2483 MHz | 0.94 | 63.88 |



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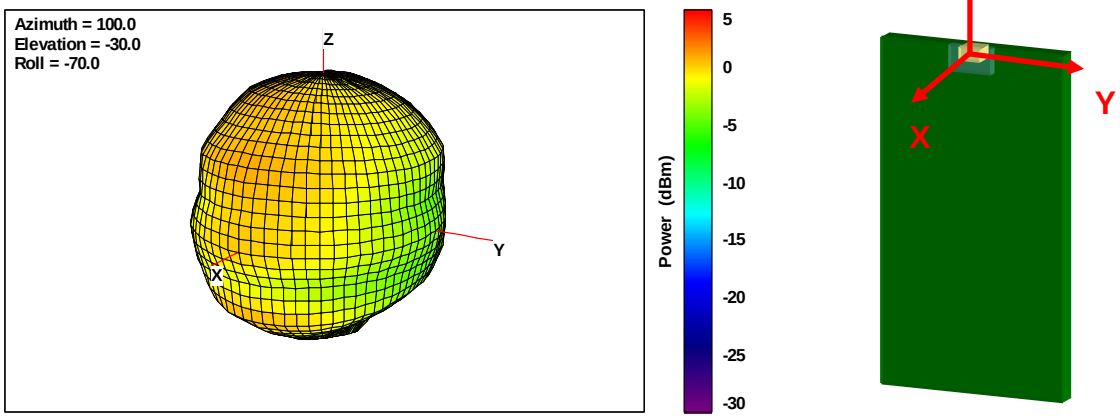
## Typical Free Space 3D Radiation Pattern

2442 MHz



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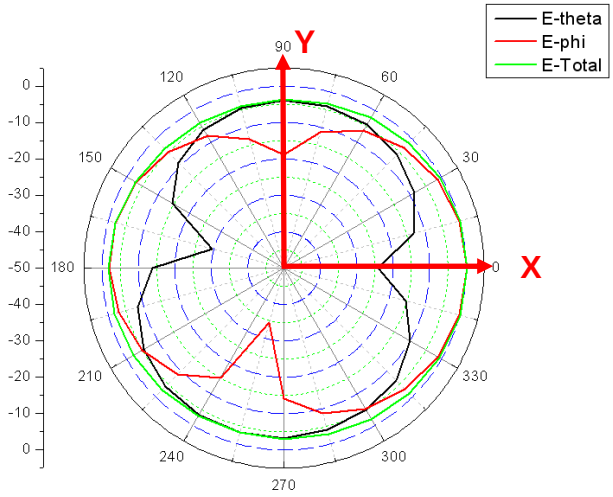
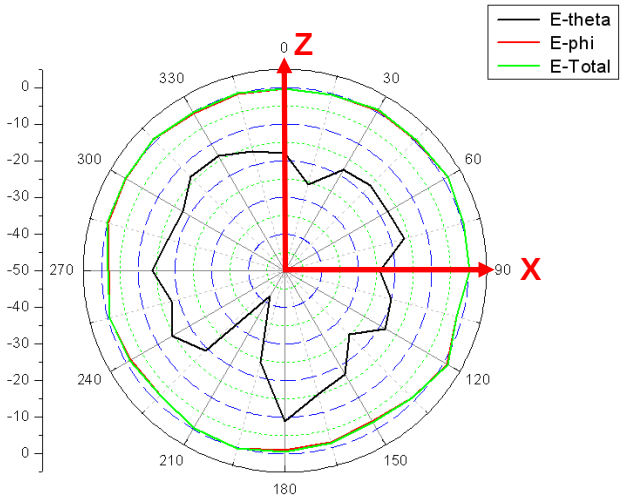
## Typical Free Space 2D Radiation Pattern

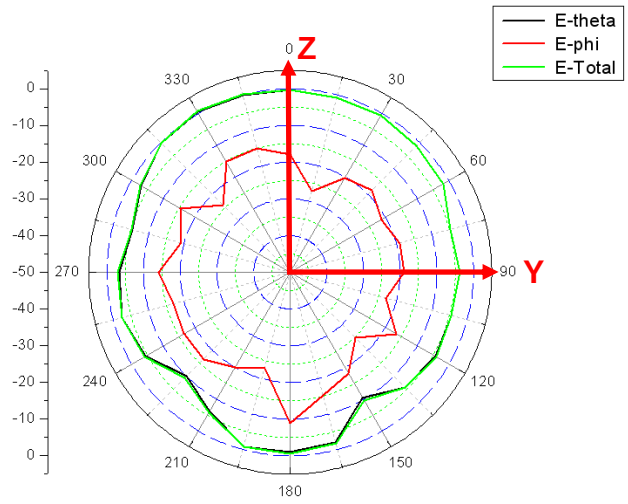
X-Y Plane 2442 MHz

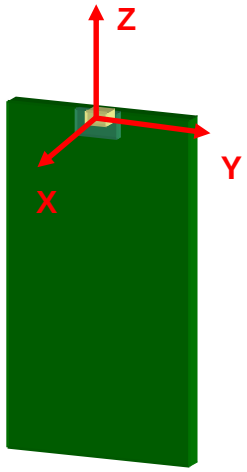



X-Z Plane 2442 MHz




Y-Z Plane 2442 MHz



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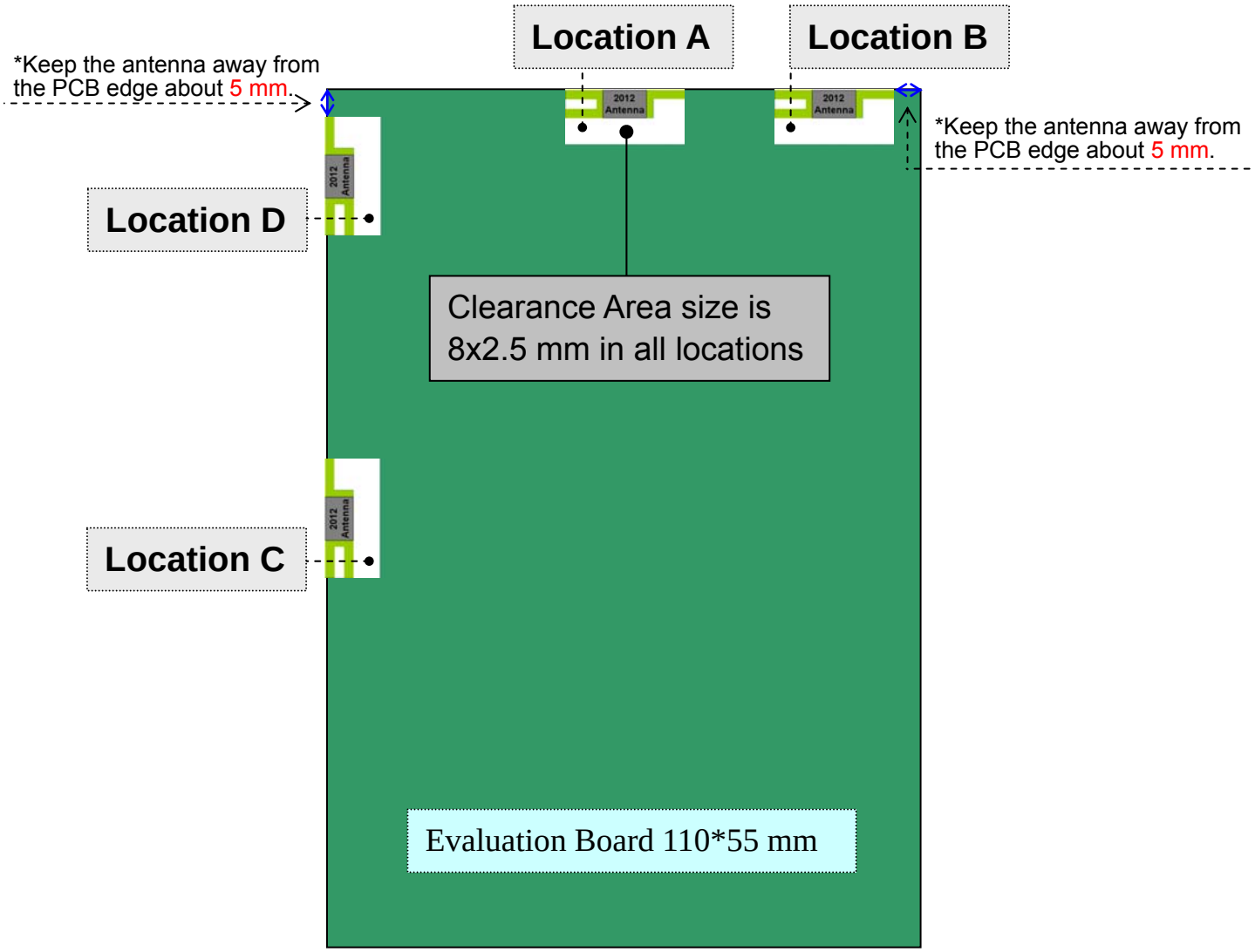
## The Efficiency and Bandwidth for Different Location

* All electrical characteristic depend on INPAQ 110 x 55 mm evaluation board with matching circuit.




| Locations / Test Item | | | Short side | | Long side | |
|---|---|---|---|---|---|---|
| | | | A | B | C | D |
| Bandwidth (MHz) VSWR< 4 | | | 153 | 92 | 106 | 90 |
| Gain | Linear (dBi) | Peak | 1.72 | 1.28 | 1.14 | 2.08 |
| | | Avg. | -1.41 | -2.21 | -1.95 | -3.00 |
| Efficiency | Linear (%) | | 72.3 | 60.1 | 63.86 | 51.22 |



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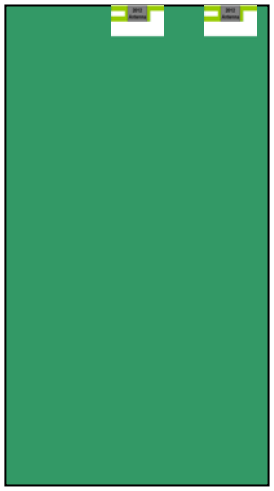
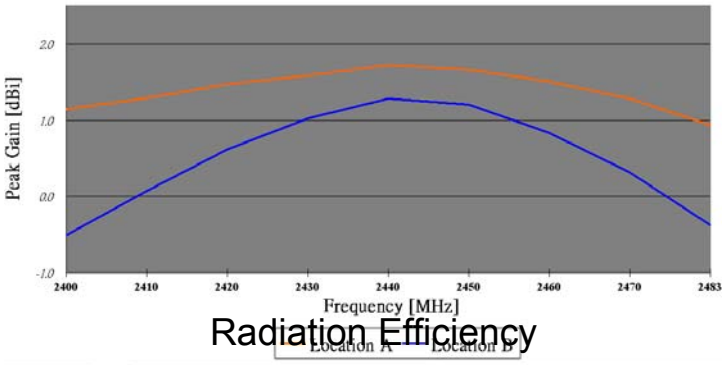
## Peak Gain and Efficiency on Short Side

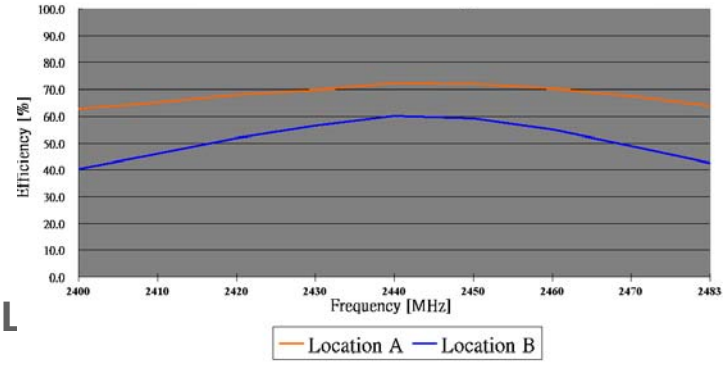
Antenna Peak Gain

Location A Location B






Radiation Efficiency

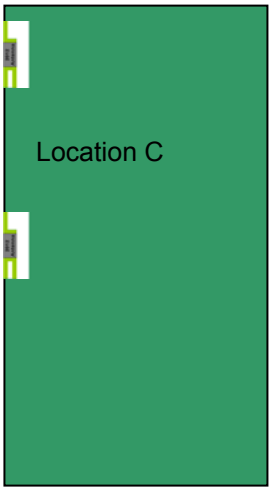


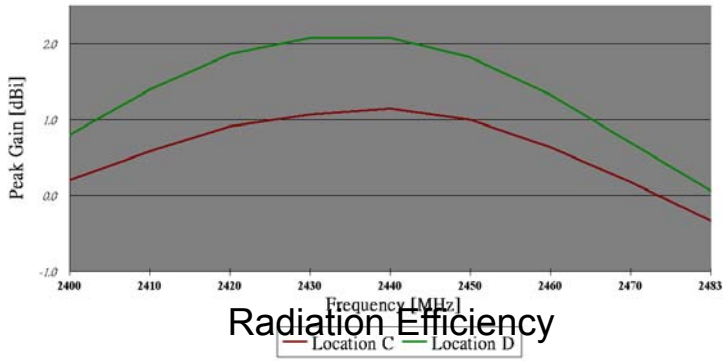

## Peak Gain and Efficiency on L

Antenna Peak Gain

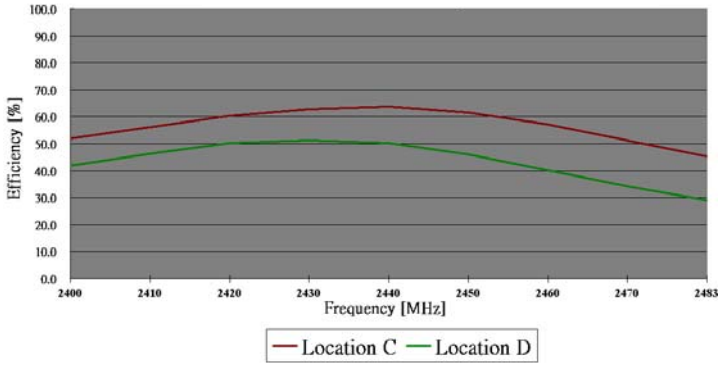
Location D

Location C






Radiation Efficiency



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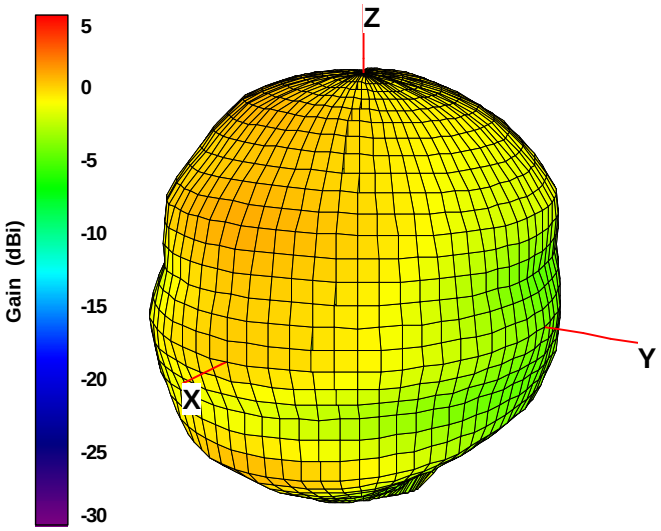
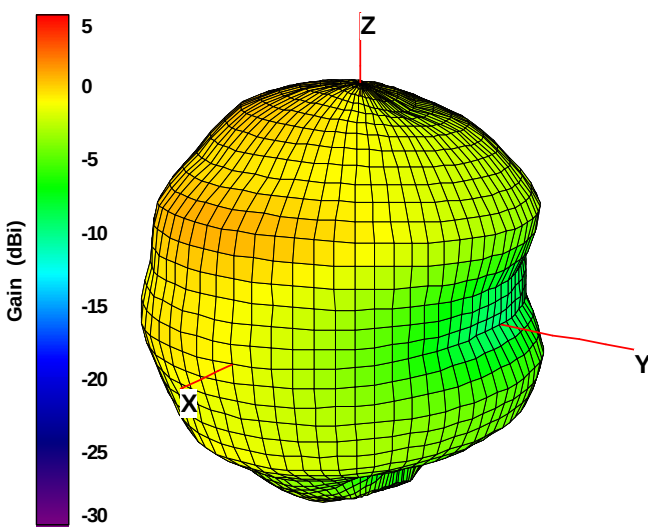
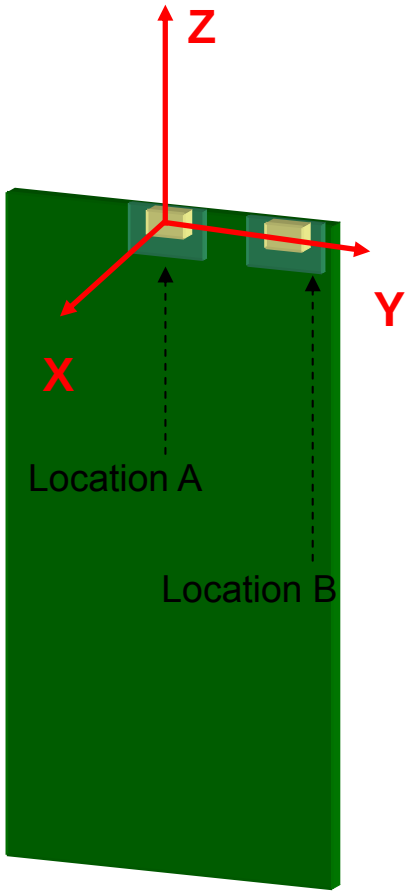
## 3D Gain Pattern on Short Side

| Location A | 2442 MHz |
|---|---|




| Location B | 2442 MHz |
|---|---|



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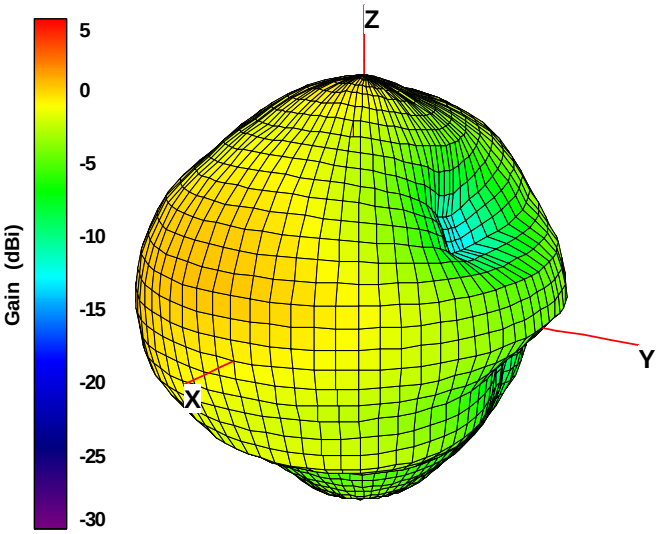
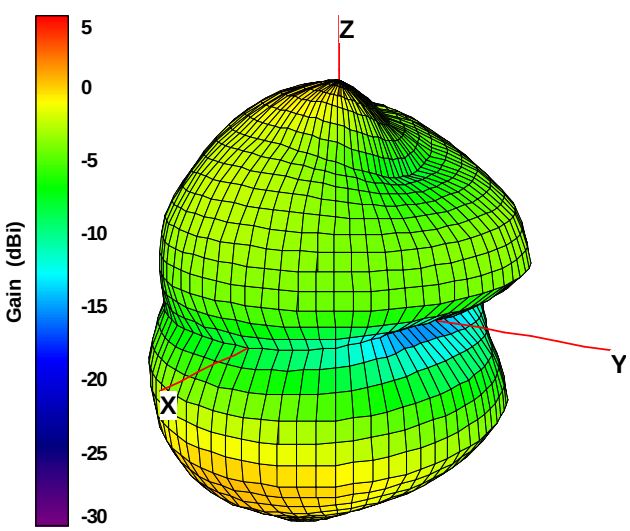
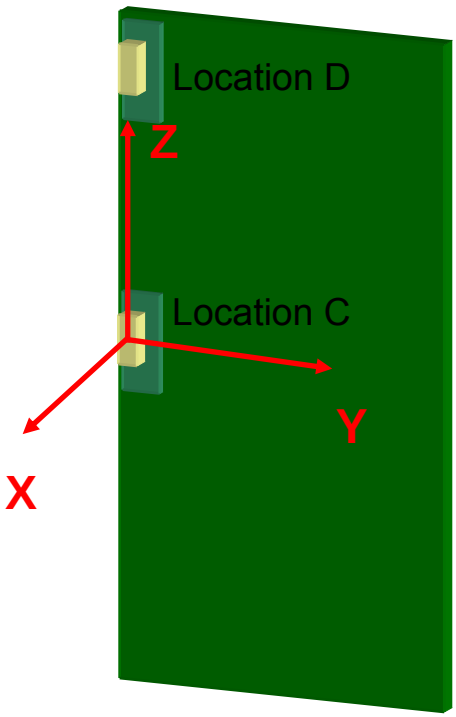
## 3D Gain Pattern on Long Side

| Location C | 2442 MHz |
|---|---|




| Location D | 2442 MHz |
|---|---|



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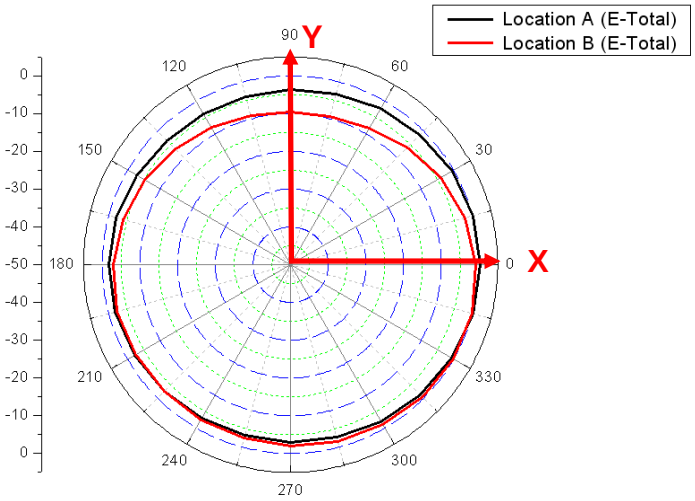
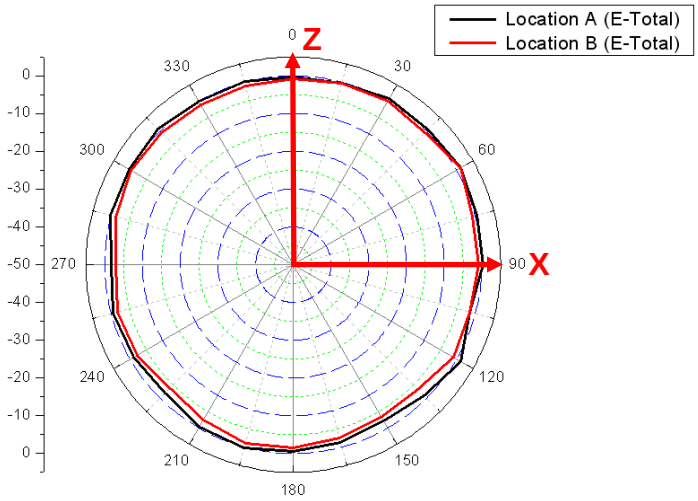
## 2D Gain Pattern on Short Side

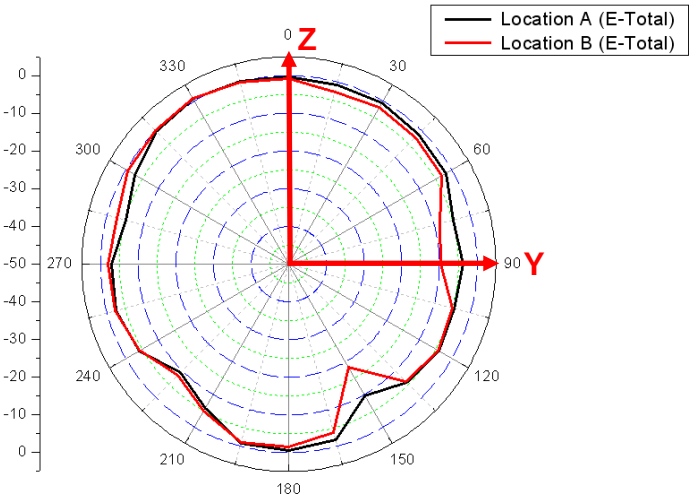
X-Y plane 2442 MHz

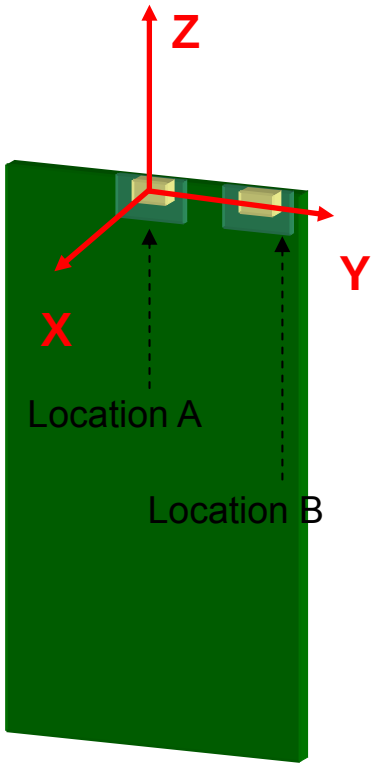



X-Z plane 2442 MHz




Y-Z plane 2442 MHz



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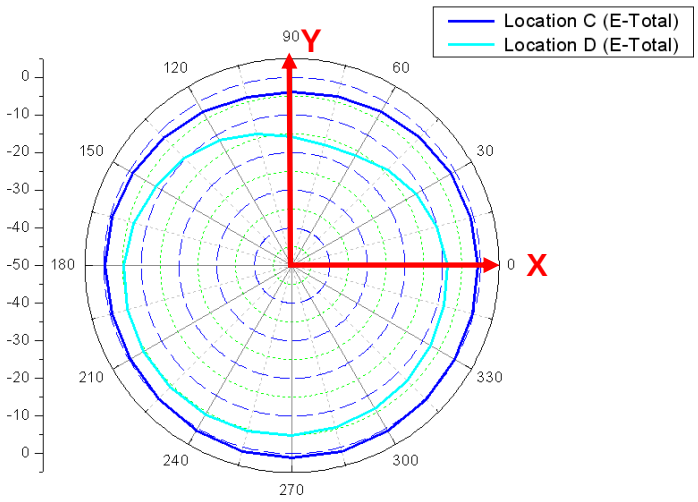
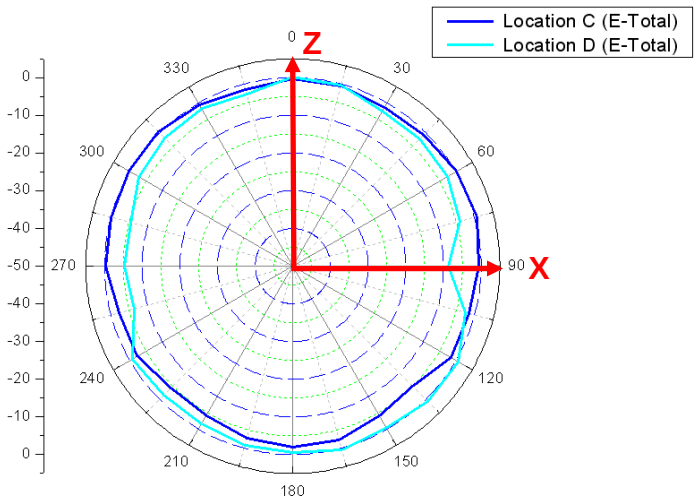
## 2D Gain Pattern on Long Side

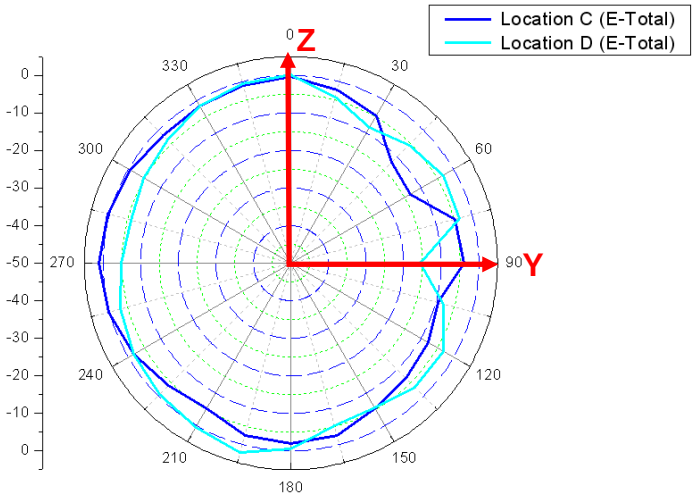
X-Y plane 2442 MHz

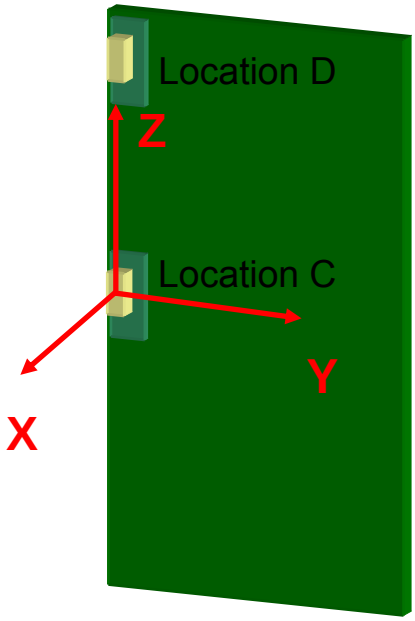



X-Z plane 2442 MHz




Y-Z plane 2442 MHz



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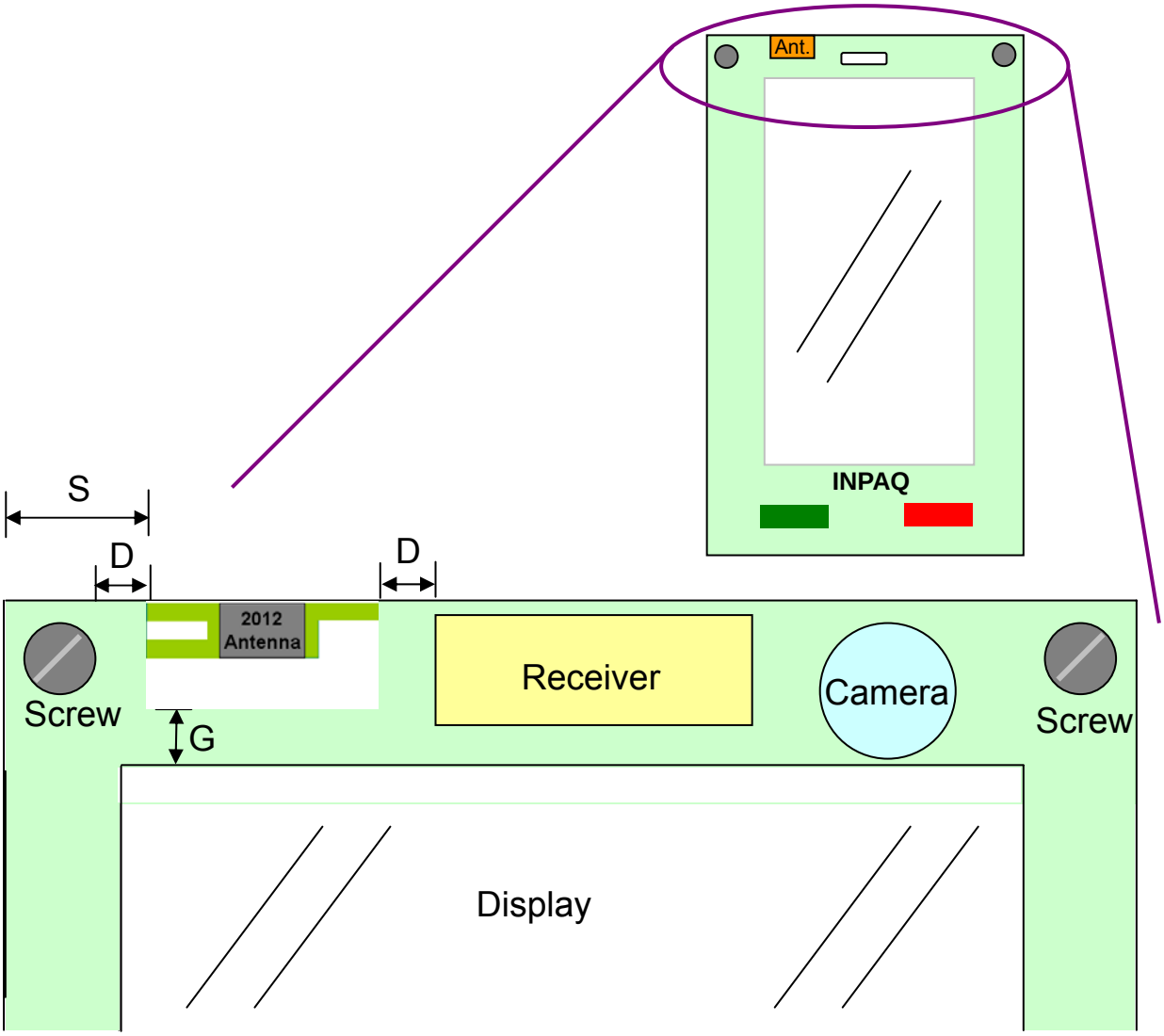
## Mobile Phone Applications

- For the mobile phone applications, the most of the key components are arranged along the long edge of the PCB, so there are no space to place our antenna. We move the antenna to top edge of PCB as showed as follow picture. And the impedance at top edge of PCB is smaller than it in long edge. If antenna is sitting at top of PCB edge, we will get narrower bandwidth and lower performance than in long edge of PCB. Then, we still get arranging antenna and components in a reasonable position.




| Symbol | Suggested Distance | Remark |
|---|---|---|
| S | ≧5mm | The distance between PCB edge and antenna edge |
| D | ≧3mm | The distance between antenna and receiver(or shielding case)edge |
| G | ≧3mm | The edge of display must keep away 3mm from antenna edge. |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## PND Applications

- For the PND applications, Bluetooth antenna usually place at the long edge of PCB. In order to make the device thinner, the PND PCB usually cut a part of PCB to put the battery in it but it will cause the PCB smaller than mobile phone application. In order to increase the performance of Bluetooth antenna, we suggest to keep some part of PCB to make it look as L-shape as Figure E. However, the distance between panel and PCB will affect the antenna performance, we suggest keep the panel away from antenna edge at least 3mm in distance as Figure F.

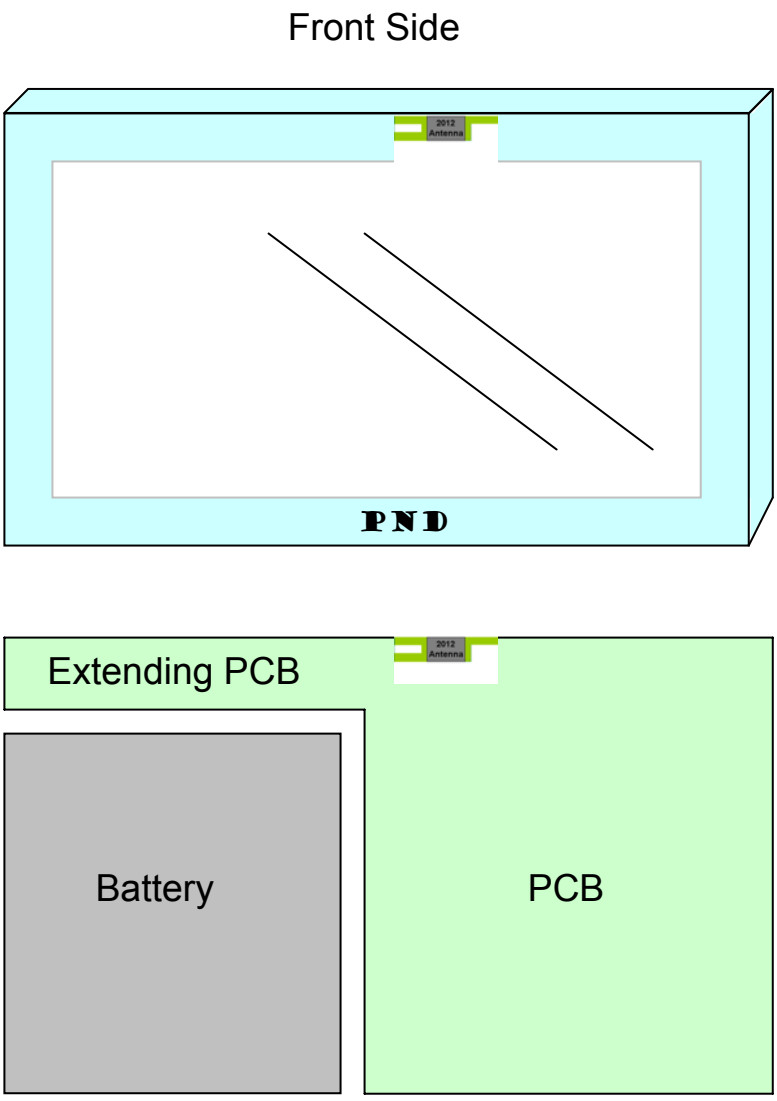


Figure E. Make the extending PCB to get the better performance


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Back Side

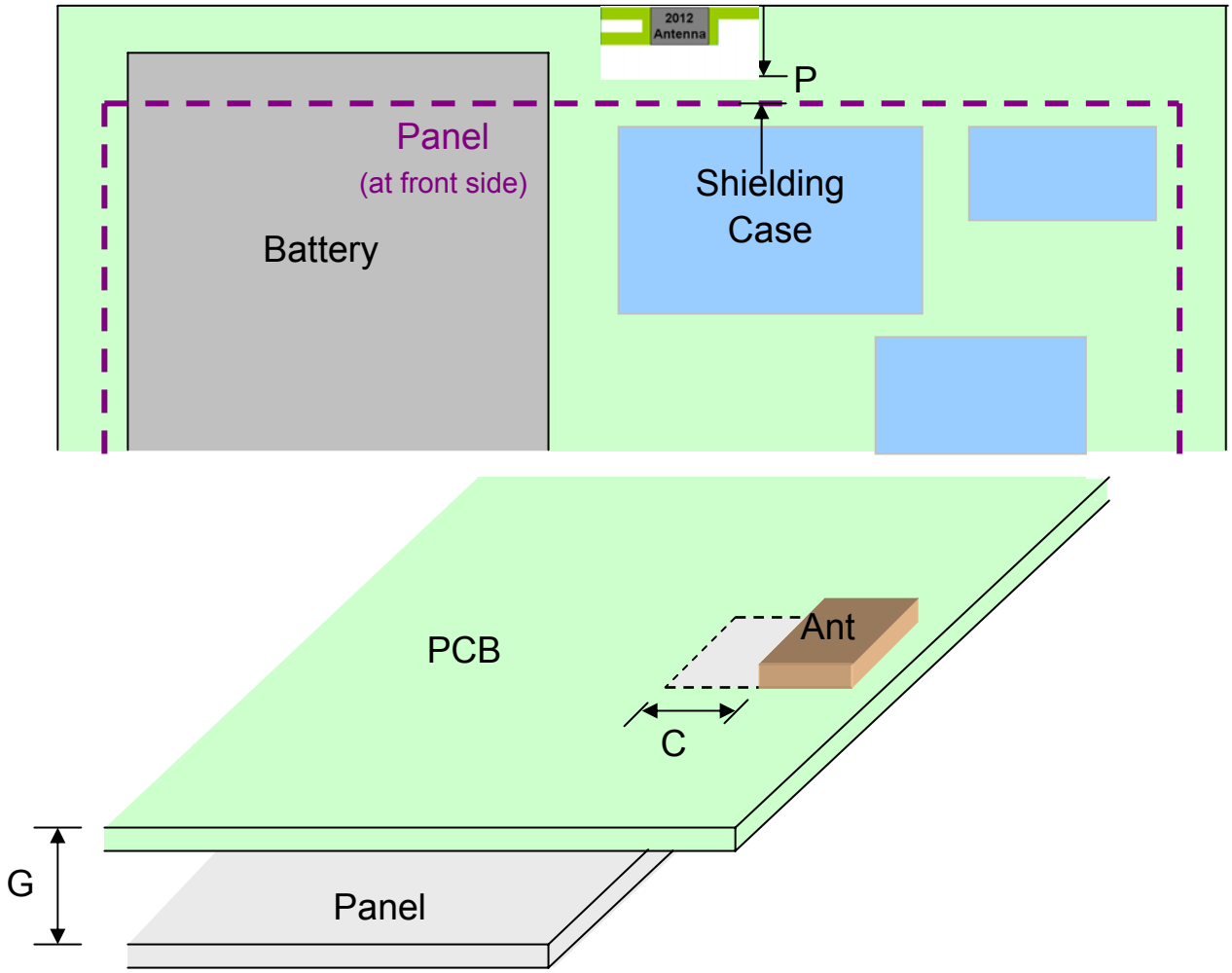


Figure F. Keep the panel away from the PCB more than 3mm.

| Symbol | Suggested Distance | Remark |
|---|---|---|
| P | ≧3mm | The edge of display must keep away 3mm from antenna edge. |
| C | ≧3mm | The width of clearance area needs 3mm from antenna edge. |
| G | ≧3mm | The distance between antenna and panel metal |


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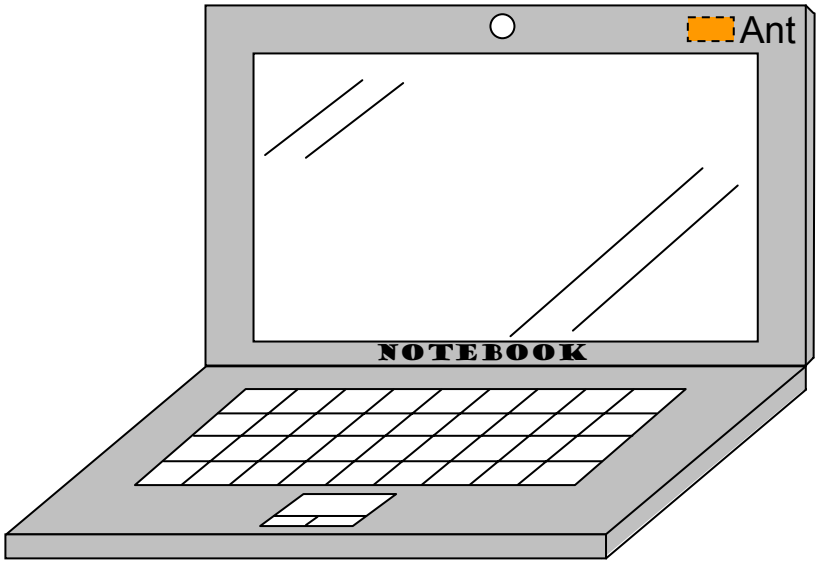
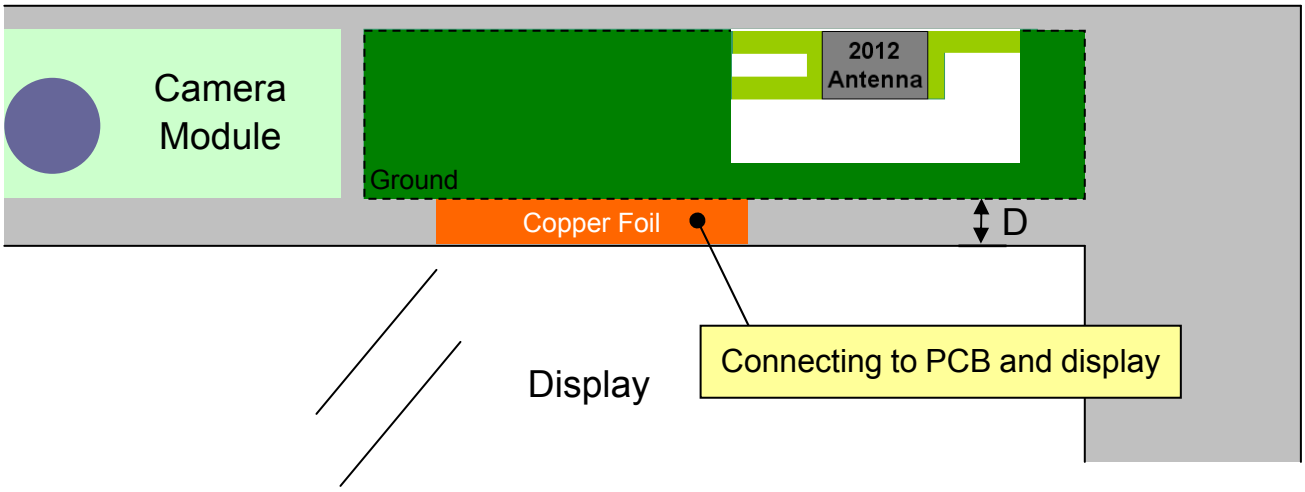
## Notebook Applications

- For the notebook applications, the space is too small to place a larger PCB. As we know, the smaller PCB we have, the worst antenna performance we get. In according to characteristic of this antenna, because the radiation efficiency depends on the size of the metal layer, so we can extend metal layer from PCB to panel by using copper foil. If the radiation plane can be extended to metal of panel, the PCB size will becomes a minor factor of antenna performance. In other word we can use smaller PCB to get the similar performance. By the way, the cable which connects from PCB to main board must fix along the edge of display and shorter cable will get the better performance due to its cable loss.




| Symbol | Suggested Distance | Remark |
|---|---|---|
| D | ≧3mm | The distance between antenna and the edge of panel. |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