Matching Circuit Guide of Patch Antenna

1. Introduction

Our patch antenna is not required matching circuit. However, please refer to the following guide line when you design GPS active antenna and only use patch antenna.

2. Frequency Characteristics by patch antenna’s environment

Patch antenna’s center frequency will be shifted due to conditions such as ground size, plastic radom covers patch antenna and double sided sticky tape.

2-1) GROUND PLANE’S AFFECTION

Patch antenna’s best ideal ground shape is square and the performance will be showed very best when patch antenna is located in the center. If ground shape is rectangle and another form, electronic characteristics such as return loss, axial ratio, gain, etc will be changed or not so good compared with given specifications. Below diagram shows frequency shift by square’s size. As square’s size goes small, you can realize that frequency shifts below in the diagram.

If ground shape is not generic, you may need to set up center frequency like below picture as making JIG, same shape with using ground shape.
The reason why ground plane’s size is very essential is that it is critical factor determines patch antenna’s gain value. Below diagram shows gain value’s shift by ground plane’s size for WIT1575PA025T4P3(25mmx25mmx4mm).

![Gain vs Ground Plane Size Graph](image)

You can realize if ground plane’s size goes small, gain value shifts small as well through above diagram.

Additionally, ground plane’s size affects on return loss- 10 dB bandwidth. On the other hand, you can realize if ground size goes small, bandwidth goes narrowly as well. In case of 18 mm patch antenna, it has bandwidth value : 16 MHz at 70x70 mm ground. Likewise, 9 MHz at 40x40 mm ground and 7 MHz at 30x30 mm ground. That is, you can realize that bandwidth goes narrowly.

2-2) RADOM’S AFFECTION

We use the radom to protect patch antenna and LNA. Frequency is shifted to below frequency range by radom’s material and patch antenna’s distance. When keeping the conditions : PC material thickness : 1 mm and distance : 8 mm with patch antenna, frequency shifts approximately 2 MHz below. As distance goes closely, frequency shifts below. That is, 1 ~ 4 MHz would be shifted, mostly.

2-3) DOUBLE SIDED STICKY TAPE’S AFFECTION

Mostly, we use double sided sticky tape to fix on the PCB and depending on attachment strength, 1 ~ 3 MHz would be shifted to low frequency. Therefore, we provide 1580 MHz as assuming given environmental conditions such as on the top side of vehicle like very big ground, radom, double sided sticky tape’s affection. Depending on several environmental conditions, patch antenna’s center frequency comes out 1575.42 MHz due to frequency shift.

Conclusively, it is inevitable to set up center frequency : 1575.42 MHz at given environmental conditions.
3. PRECAUTIONS ON CIRCUIT DESIGN

If ground plane’s size is square, return loss value is 15 dB generally. You can realize this fact through below smith chart for 18mm x 18 mm x 4mm (Ground Plane Size : 50x509MM).

In case of patch antenna, dc block capacitor should locate between antenna and LNA if priority conductor is connected to integrated circuit as composing LNA. And there is possibility to occur damage on the circuit through patch antenna due to ESD. Furthermore, center frequency shift and axial ratio value shift could be occurred. Because patch antenna could be reacted to the things around patch antenna such as metal material, except ground plane.

You have to design so that patch antenna’s top side could be looked at sky. Next page’s picture is pattern measurement method and data(18x18x4mm).
Matching Circuit Guide of Patch Antenna

* RADIATION PATTERN (Horizontal)  

* RADIATION PATTERN (Vertical)