Iridium Patch Integration Application Note

CONTENTS

1. PATCH BASICS

A ceramic patch antenna is preferred over other antenna typologies because it can be made into small format compact applications while maintaining its advantages of high gain towards zenith, a key requirement for satellite based navigation systems. The other key advantage is it can be made to be circularly polarized, and this matches more efficiently with the circularly polarized radiation transmitted from the Iridium satellites.

2. POSITIONING

Theoretically the best position for the Iridium patch antenna is close to the Iridium modem in the centre of the PCB. There are both electrical and physical reasons for this. The electrical reasons are that by placing the antenna close to the Iridium transceiver removes the necessity for a long transmission line on the PCB between the feed point on the antenna and the input to the Iridium modem. The physical reason is that if the antenna is placed in the centre of the PCB then the radiation plots won't be skewed due to the effects of placing it close to the edge of the PCB.

3. GROUND PLANE SIZE

The larger the ground-plane, the higher the antenna gain in general. Also the centre frequency of the antenna will change in proportion to the size of the ground-plane.

4. GAIN

The gain of the antenna is chiefly determined by the directionality of the antenna and the surface area.

The Iridium patch antenna has high gain towards the zenith (highest point in the sky), and gradually decreasing gain towards the horizon.
The typical peak gain for an Iridium patch antenna on a standard ground plane is 2dBi. The gain of the antenna will vary by ground plane size.

A larger ground plane will increase the gain of the antenna

5. ADVANTAGES of the Iridium Patch

- Maximum gain towards sky – critical for high performance applications
- Suitable for high volume mass production
- Economical
- Small form factor
- Can be optimized by tuning to environment

6. MOUNTING

The standard patch is mounted using double sided tape to the cleared area on the device board. The pin goes through to the bottom side of the board where it is soldered to the feed line.

Fig 1. Patch with Pin

7. ENVIRONMENTAL CONSIDERATIONS

Close proximity to components or housing affects the electrical performance of all antennas. The centre frequency will shift, and the radiation pattern will be skewed. We call the process by which we try to realign the centre frequency and impedance “tuning”.

When placed on a non-conductive area of the board, ideally there should be clearance of 4~10mm in all directions from the board/housing for maximum efficiency.

8. TUNING

Iridium Patch antennas should be tuned to their ground-plane that they are mounted on and taking into account the frequency shifts due to the specific device environment the antenna finds itself in. This is done with real-life trial and error testing, which is much faster and more accurate than trying to use simulation tools.

The antenna is physically tuned a number of ways, the shape of the top silver electrode can be changed, or the feed-point can be moved. The antenna can also be tuned via an external PI network placed near the antenna feed terminal.

8.1 IMPEDENCE MATCHING

The antenna will be tuned to get close to a 50 Ohm match on the Smith Chart when in the device. The S11 return loss magnitude is also looked at and the industry standard is <10dB across the bandwidth.

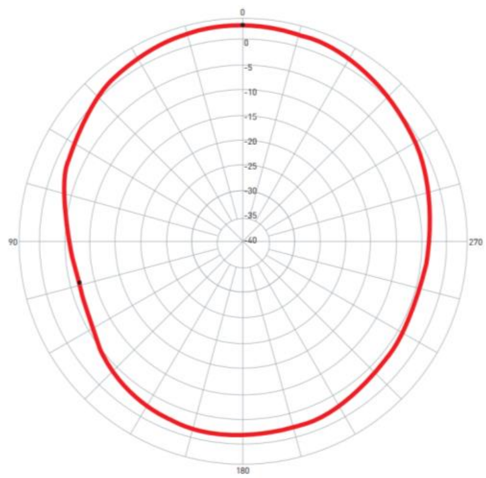
But it can be more important to check the radiation pattern and gain at in-bandwidth frequencies to understand the real performance of the antenna in the device.

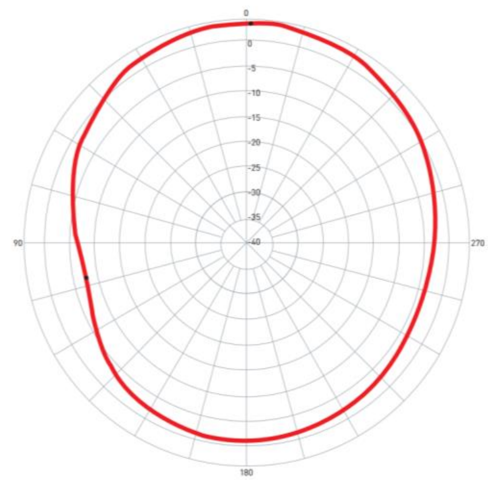
8.2 RADIATION PATTERN AND GAIN TESTING

Radiation patterns of the antennas X-Y and Y-Z planes are taken in the device.

This corresponds to two vertical cuts of an "apple" type pattern which is the typical pattern of an Iridium patch antenna at cross angles to each other. Where they intersect we can then take their point readings at 0deg/180 deg horizontal to have four points of reference for the horizontal radiation pattern and drawing a line through them we can now produce the horizontal radiation pattern of the radiation thereby giving us a 3D view of the radiation pattern.

These radiation patterns tell us the most important information about the real-life antenna performance in the field such as the antenna's ability to receive signals from satellites at low altitudes, or to be able to compare relative performance of one antenna against another. The below patterns are taken from scans of a 25mm*25mm*4mm patch on a 50x50mm ground-plane.





XZ Plane1621 MHz **YZ Plane 1621 MHz**