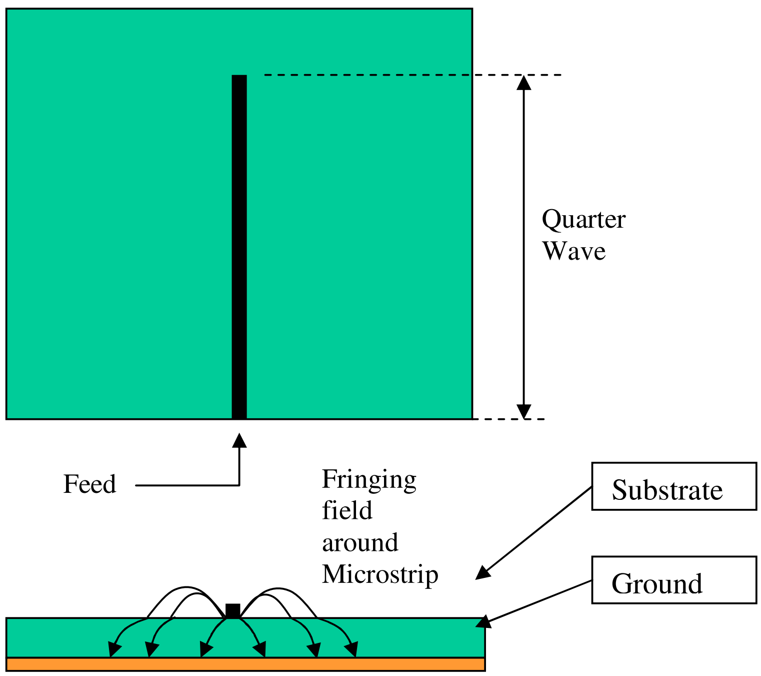
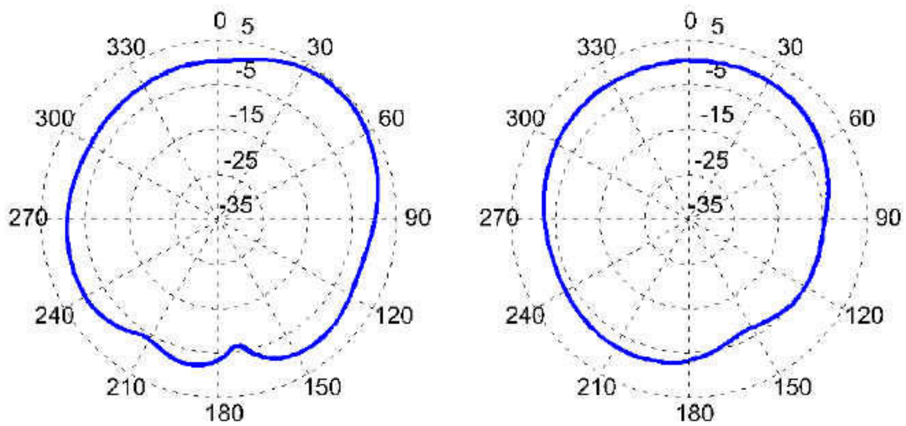
Printed and surface mount antennas have certain common properties. Area around and beneath the radiating element must be kept copper free. Ground plane must be provided on one side of the radiating element. Bandwidth >100MHz with VSWR<2.5 and efficiency >60%.
The antenna will de-tune if any object is placed close to it (in its near field). This has an effect of pulling the frequency, which must be retuned to 2.45GHz

An oscillating or constantly accelerating charge is critical in producing propagating waves, a static or non-accelerating charge will result in a non-propagating electric field. But this is not the only condition for radiation. Consider a printed $\lambda g/4$ element on microstrip;



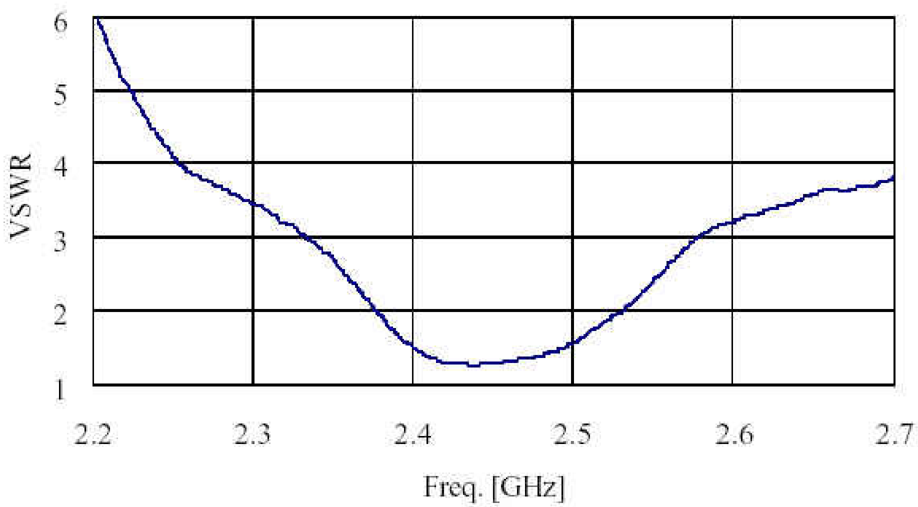
The fringing field around the microstrip due to the ground plane directly underneath the substrate will be confined to a small area. If a network analyzer is connected to the feed point, it would indicate a high VSWR and narrow bandwidth. This means very little radiation is being emitted from the microstrip element.
To increase the radiation emission and achieve a better bandwidth, we have to move the ground plane away from the microstrip element, making the fringing field cover more distance. But it should be noted that if the ground plane is moved too far then the fringing field stops altogether, and there is no radiation. Therefore the position and size of the ground plane is vital in the design of a good radiator.

The antenna could be imagined as an impedance transformer, transforming the impedance of a microstrip line (50Ω) to that of free space (377Ω) allowing the power to be transferred from guided wave to free space wave.



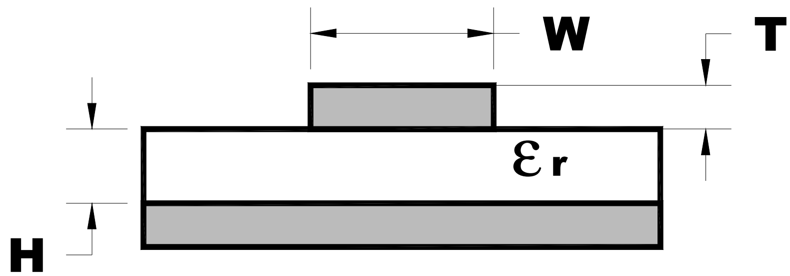
Azimuth Cut   Elevation Cut

The radiation pattern from such antennas where the physical size is much smaller then wavelength (L<<λ) is almost symmetrical in all directions as shown above. Only when L is similar or greater then λ, can the pattern be controlled.



Input return loss when viewed on a network analyzer looks like as shown here with the full band covered with VSWR<2. This gives very good matching into the antenna, however in real conditions when the antenna is detuned due to handling or placement of components close to it, the VSWR of 3 to 4 is normal.

For the MIR device, an SMD ceramic chip was chosen, for reasons of dimensions.
The following microstrip model can be used to calculate the impedance of the trace which carries the signal to the antenna,:



The above diagram shows that the trace must have an impedance of 50 Ω, then the dielectric and also the earthing system.

The impedance must be 50 Ω in order to mantain the ROS "stationary waves" as close as possible to 1. Otherwise, there will be losses as the antenna is not suitable. These losses can then only be eliminated by calculating the length of the trace which must be equal to λ/2.

Dielectric Constant εr	4,6
Dielectric Thickness (mils) H	3,9
Trace Width (mils) W	5,4
Finished Copper Weight (mils) T	1,4
RESULTS	
Impedance Zo (Ohms)	50,03
Inductance/Inch Lo (nH/in)	7,149
Capacitance/Inch Co (pF/in)	2,857
Propogation Delay Tpd (nS/in)	0,1430

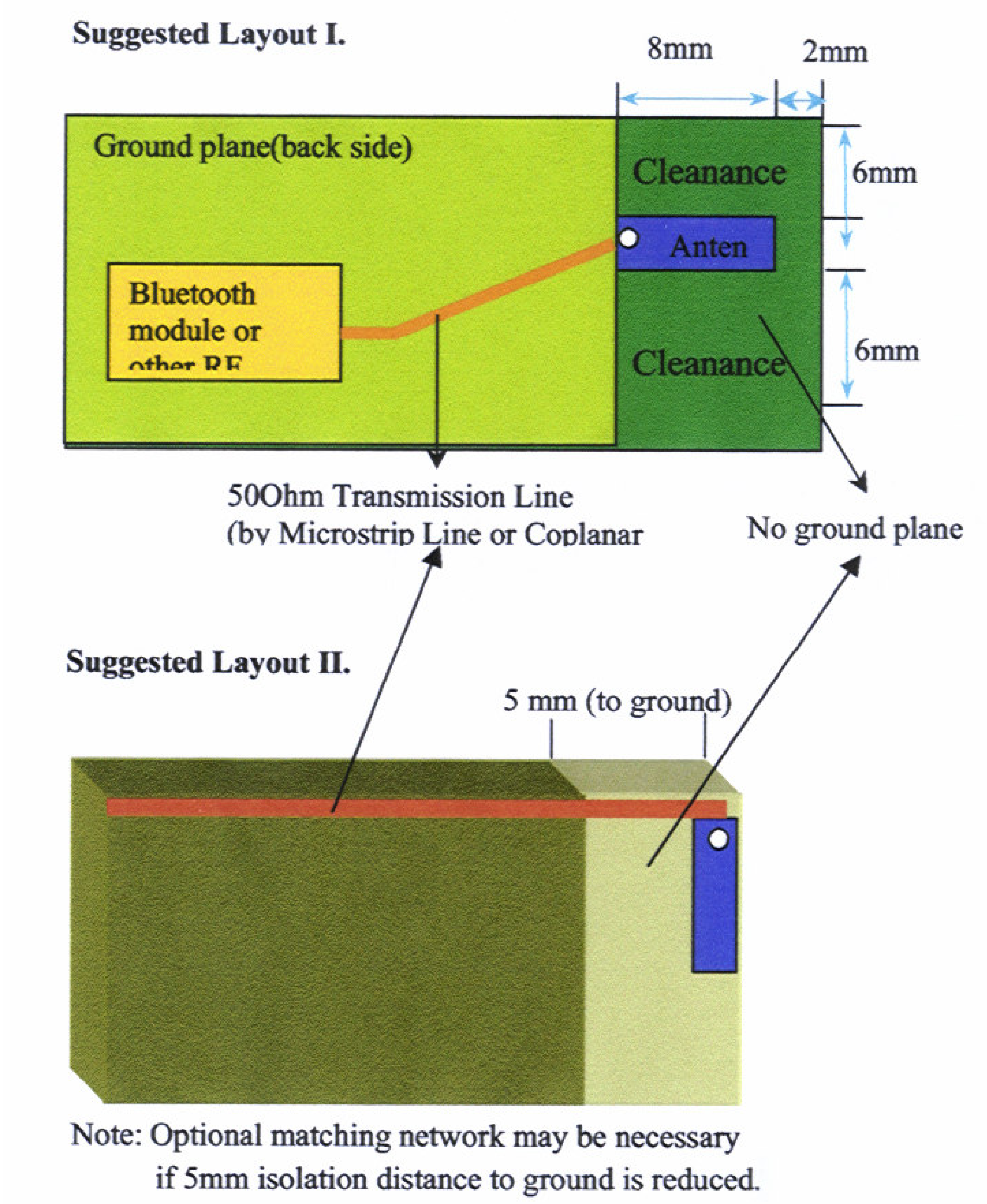
These are the formulas used:

Zo=(87/(SQRT(Er+1.41)))*LN((5.98*H)/(0.8*W+T))

Lo=0.001*(Co*SUMSQ(Zo))
Co=(0.67*(Er+1.41))/LN((5.98*H)/(0.8*W+T))

Tpd=0.0833*(1.016*(SQRT(0.475*Er+0.67)))

In the specific case of our ceramic chip, in order to have the maximum radiation, the antenna mounting specifications are as follows:


Suggested Layout I.
8mm
2mm
Ground plane(back side)
Cleanance
6mm
Anten
Bluetooth
module or
other RF
Cleanance
6mm
50Ohm Transmission Line
(by Microstrip Line or Coplanar
No ground plane
Suggested Layout II.
5 mm (to ground)
Note: Optional matching network may be necessary
if 5mm isolation distance to ground is reduced.