Quad Band GSM integrated antenna

Insight SiP was asked to design and integrate a GSM antenna on an application PCB board developed for M2M applications.

Insight SiP antenna was meant to replace an existing chip antenna that did not meet the customer performance requirements and added cost to the total solution.

The antenna design constraints were:
- Dual band to cover the 824-960 MHz and 1710-1990 MHz with a return loss better than -6 dB
- Radiated efficiency better than 50%.

Applications:
- M2M

This is a case study on the development of a Quad Band GSM integrated antenna.

We will demonstrate how the antenna in package (AiP) process implemented by the Insight SiP team achieved the customer performance constraints, and decreased the cost of the final solution.

We will show that the SiP with integrated antenna had better performance than the prototype with external antenna when encapsulated in the customer final product.

The flow chart below summarizes the design methodology applied by the design team.

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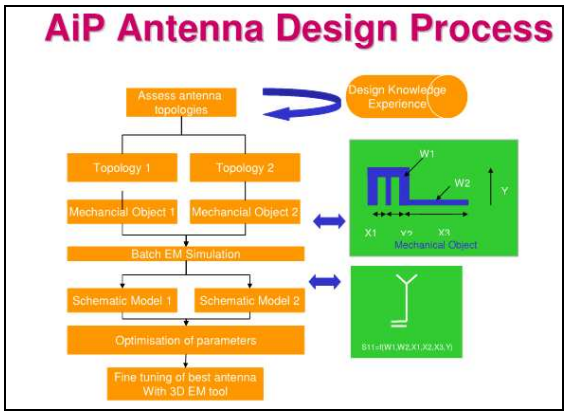

After the design completion using 2,5D and 3D modeling software, a prototype was manufactured and tested.

After the antenna structure optimization, the designer analyzed the effects of the plastic housing and various components like battery and shield on the performance of the antenna. Analysis on the radiation pattern and gain is presented in figures 1 to 3.

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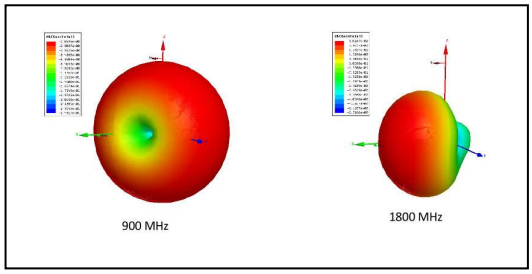

Figure 1: Gain pattern of the antenna basic configuration

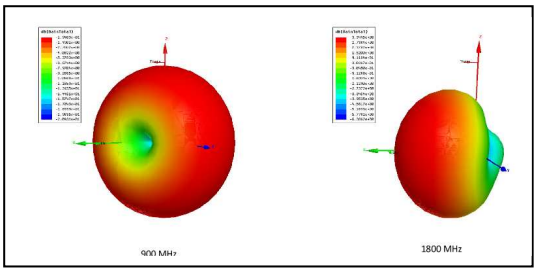

Figure 2: Gain pattern of the antenna placed into plastic housing

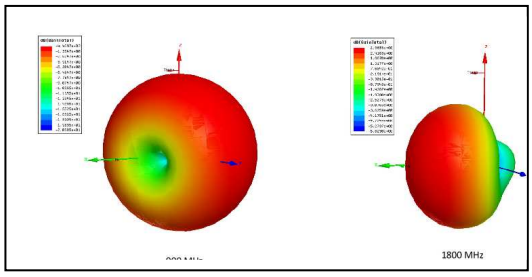

Figure 3: Gain pattern of the antenna with metallic box on the PCB

The conclusion of the simulation shows that neither the plastic housing nor the metallic box on the PCB had a significant effect on the radiation pattern.

At the end of modeling and simulation phases, three prototypes were manufactured.

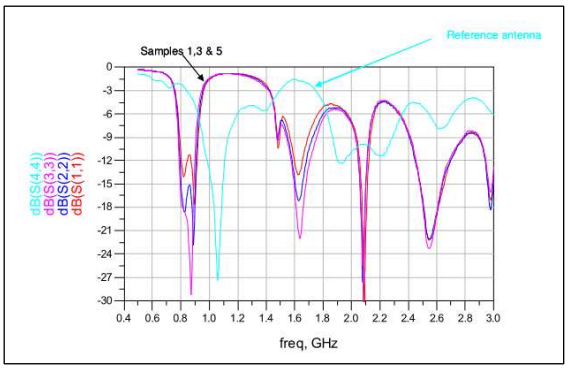

Figure 4: Comparison of the prototypes and external antenna.

The measurement in figure 4 shows that the Insight SiP antenna is better matched at GSM 900 than the external antenna which is shifted.

The plastic housing had a little impact on the matching performance as shown in figure 5.

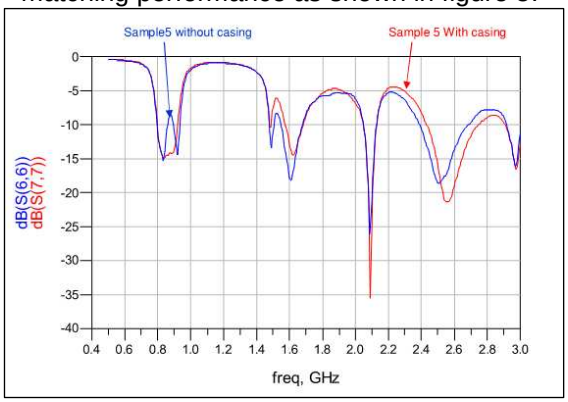

Figure 5: Effect of plastic housing on the antenna return loss

These tests showed the successful result of the antenna development. The last step was to integrate it in the customer final product and test the performance of the antenna.

The prototype measurement of the customer final product prototypes showed a good agreement with simulation behavior, in particular the measurement exhibit a return loss better than -10 dB in the 824-960 MHz band and better than 6 dB in the 1700 -2200 MHz band.

Furthermore a comparison with the external reference antenna confirms that Insight SiP antenna has a better matching in GSM 800/900 band than the reference antenna.

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