

ADS Application Notes

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The Design of Spiral Inductor for Power Amplifier Impedance Matching Application at 5.2GHz using Momentum Package in ADS

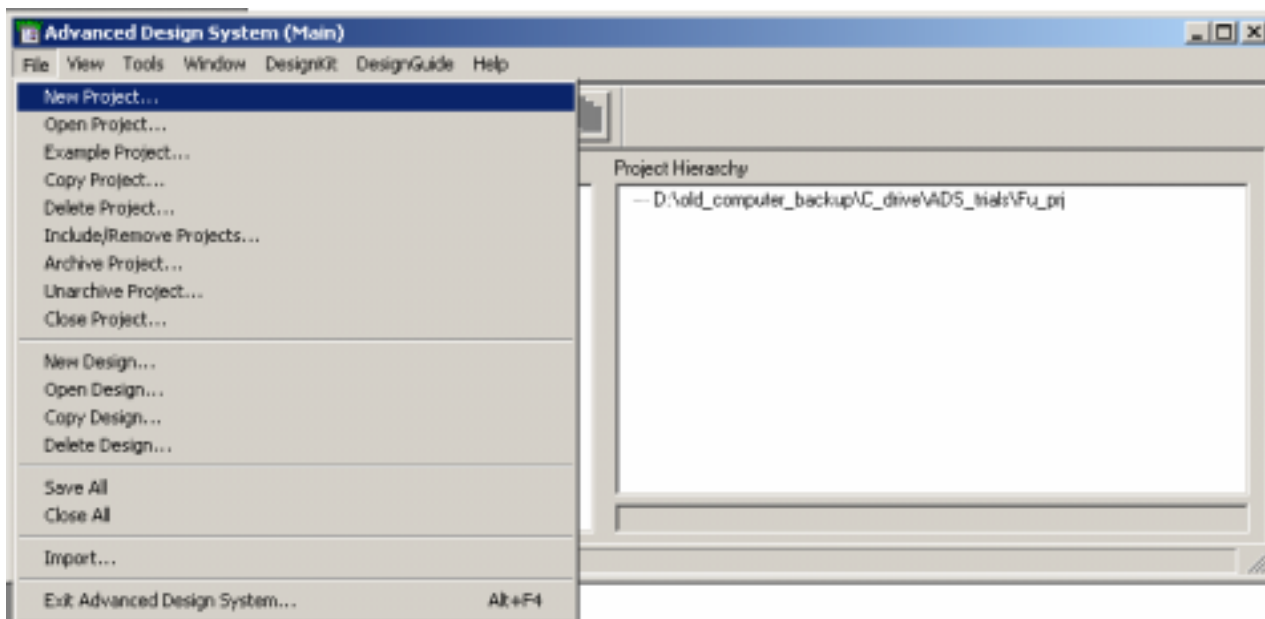
Introduction

This application note describes the design procedure of spiral inductor for Power Amplifier (PA) impedance matching application at 5.2GHz using the Momentum Package in ADS. To improve the power efficiency of PA, impedance matching network is necessary for input and output ports of PA to make better signal transfer. Spiral inductor is an essential element for impedance matching network in integrated circuits.

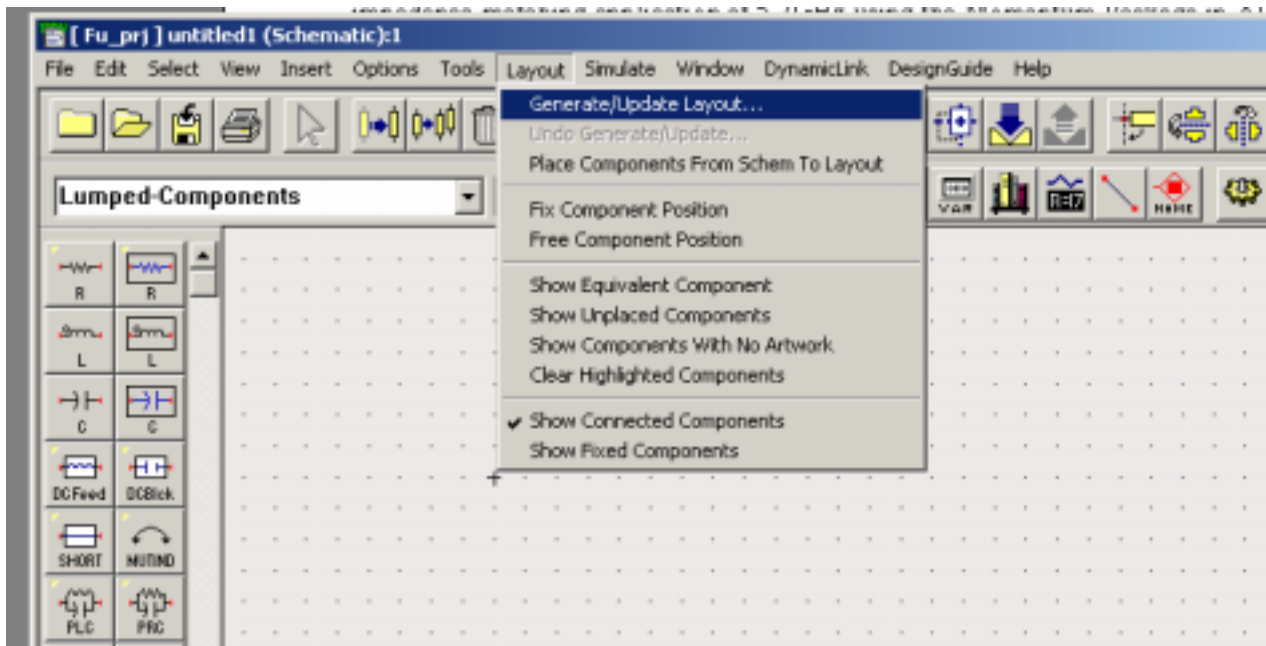
Design procedures

In order to obtain the accurate inductance value and Q-factor value of spiral inductor at designed frequency, EM simulation is needed to conduct by the Momentum Package in ADS. The simulation procedures will be described step by step as follows:

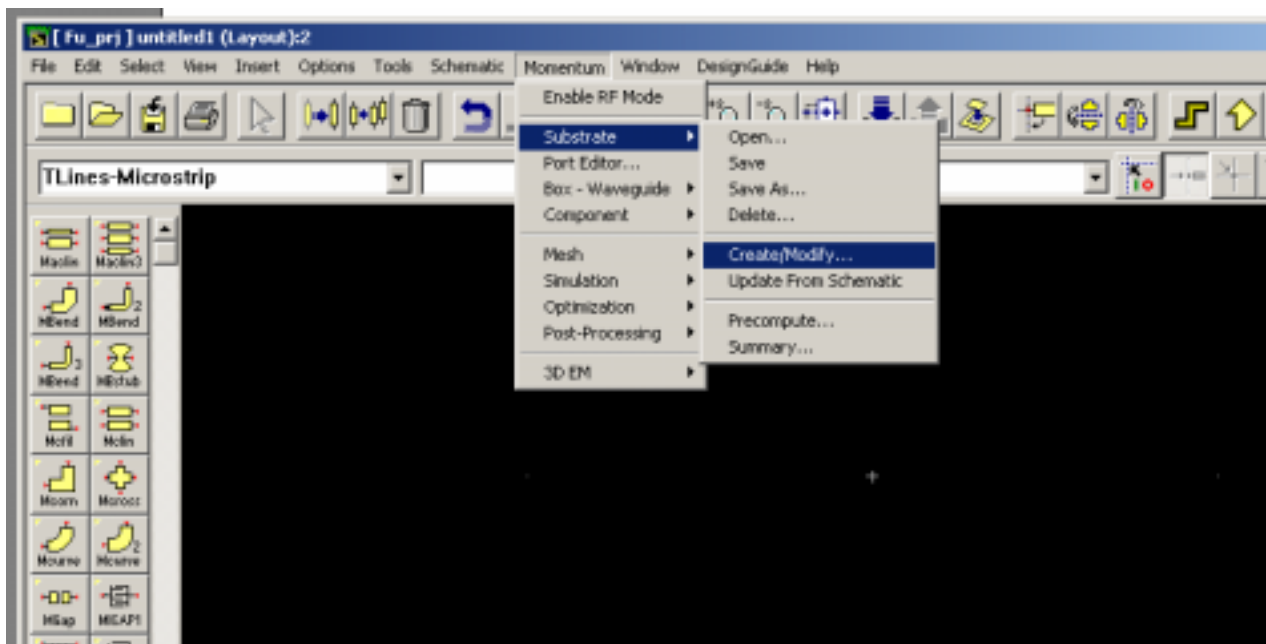
1. Open ADS program. Choose “File → New Project” to open a new project.



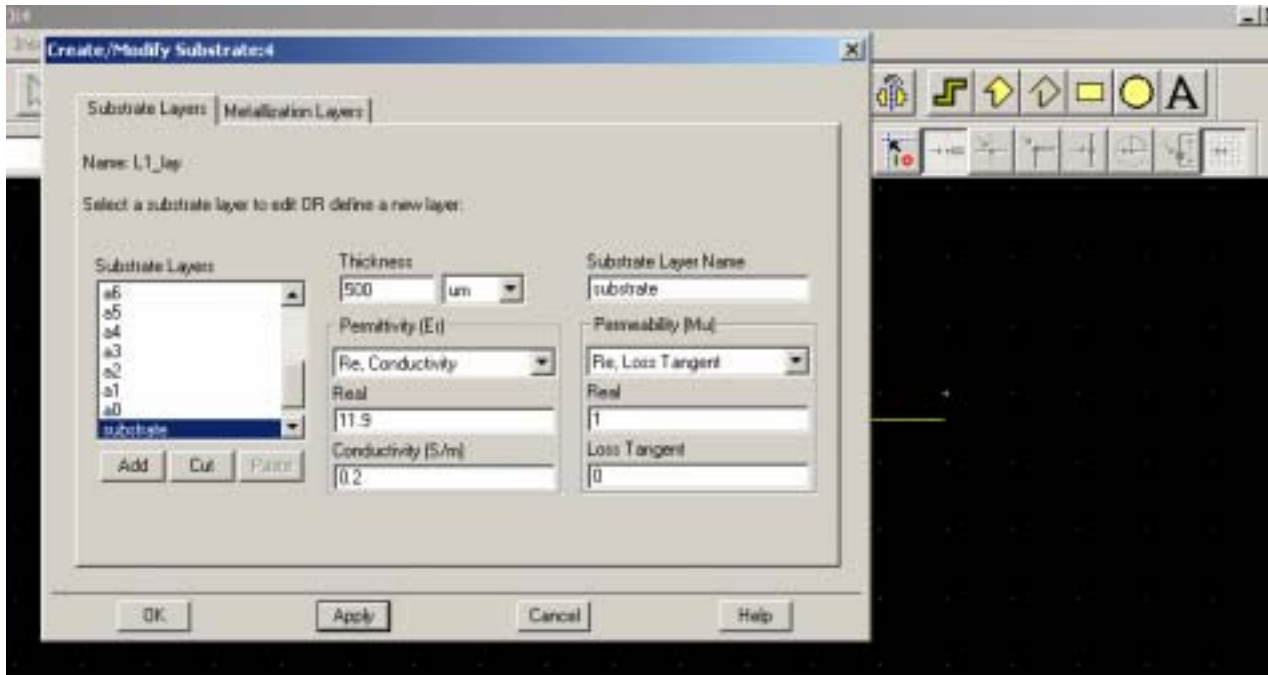
2. In the new schematic of the project, choose “Layout → Generate/Update Layout” to open the Momentum environment to make the EM simulation settings.



3. After opened the Layout window, choose “Momentum → Substrate → Create/Modify” to define the material parameters of the multilayer substrate.



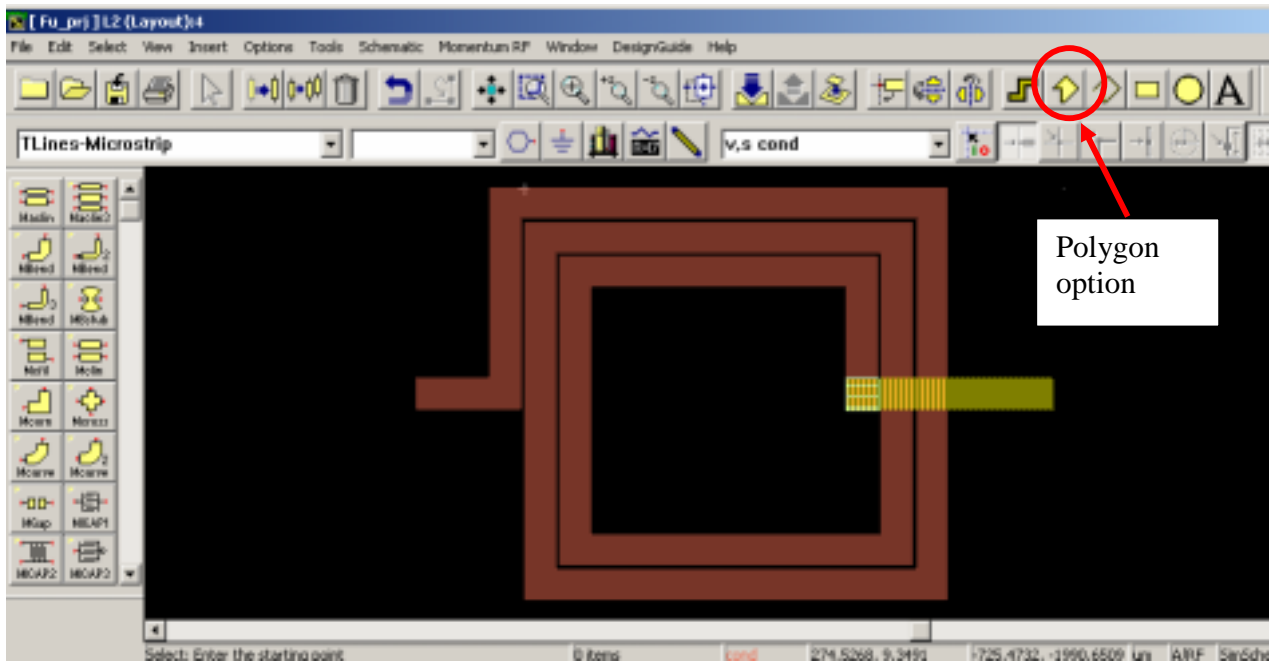
4. Depends on different integrated circuit requirement, spiral inductors will fabricated on different substrate materials. Push “Add” button in the substrate modification window in the tag “Substrate Layers” to add different layer of substrates. While for each substrate layer, input the corresponding layer thickness, Permittivity, Permeability and Loss Tangent to define the characteristics of the substrates.



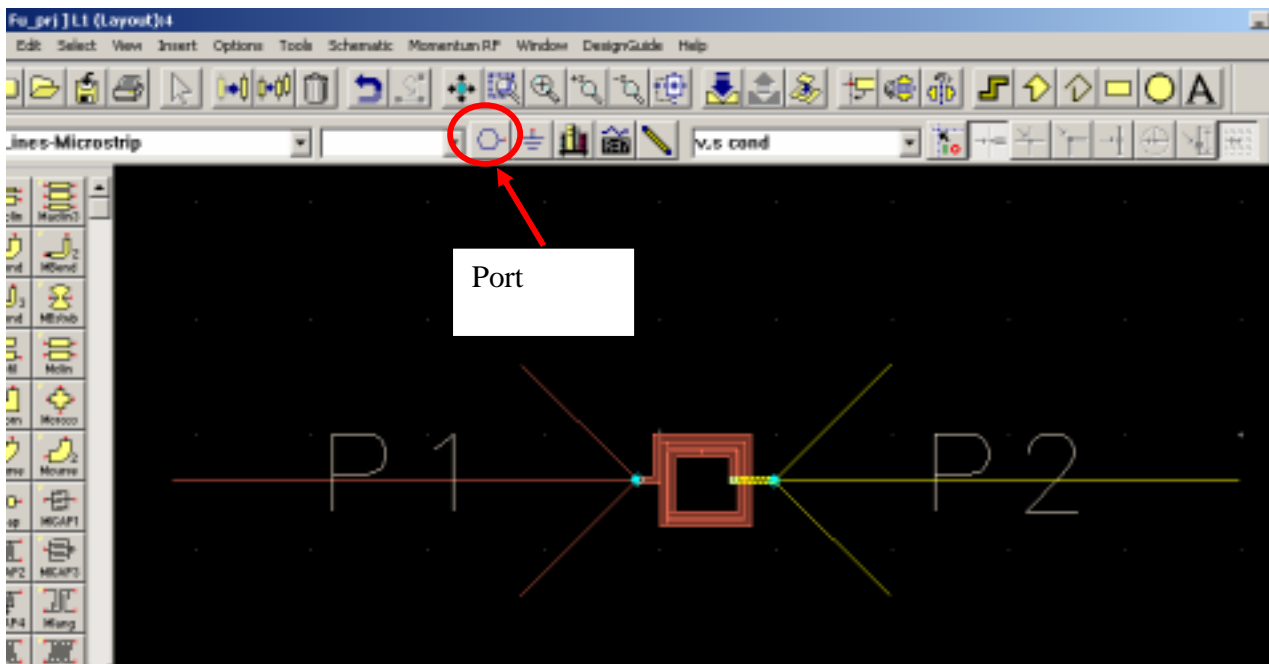
- After defined the substrates layers. Choose the tag “Metallization Layers”. For a typical spiral inductor, there are two metal layers (spiral metal turns and underpass) which are connected by metallic via hole. For each of the metal layer and the metallic via hole, the metal thickness and conductivity needed to input. In the following example, the spiral metal turns are located at 12th layer, the underpass metal located at 9th layer while the via hole metal connected the two metal layers.



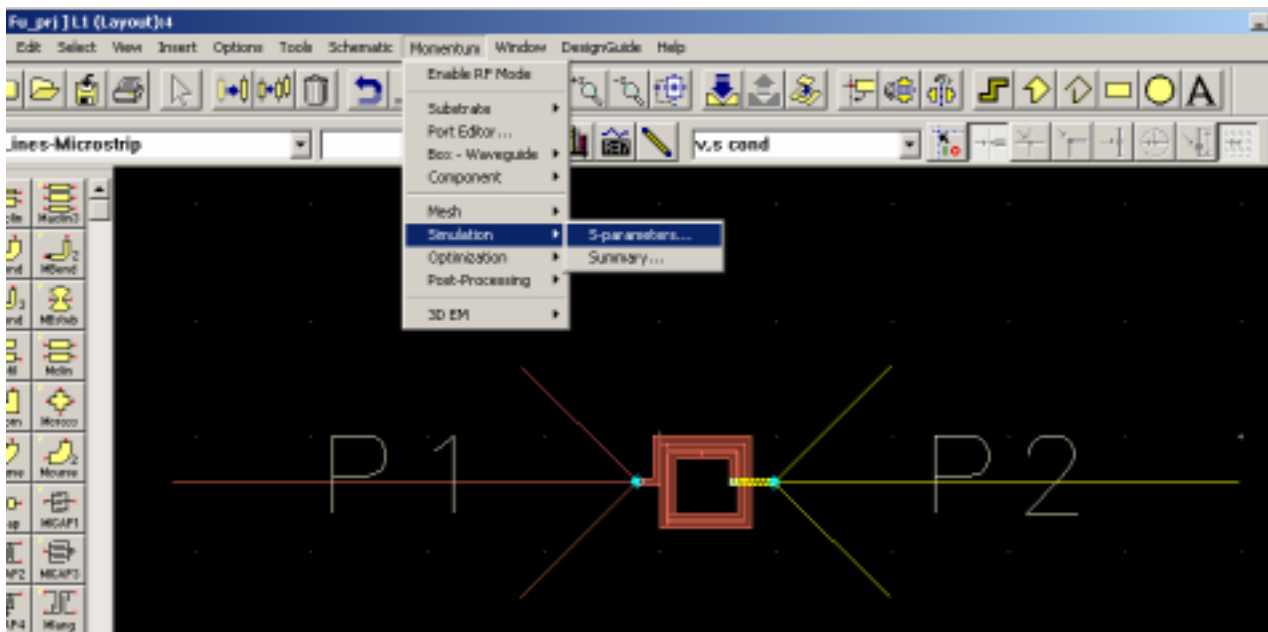
- After defined the substrate and metal layers, the shape of the spiral inductor need to draw by the “polygon” option in the window. While different layer of the metals and metallic via hole need to draw with the correspondingly metal layers defined before. The coordinates of the polygons can be input by choosing “Insert → Coordinate Entry...”.



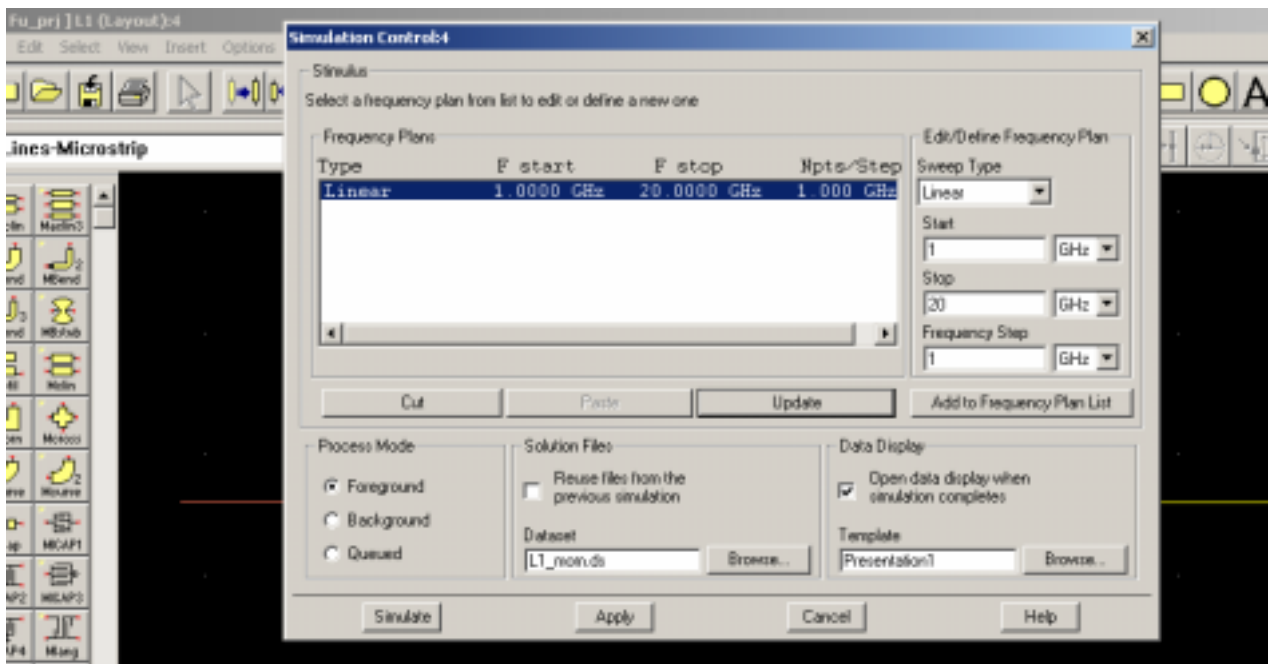
- Before setting the simulation option. It need to add two ports to the spiral inductor as shown below by adding the “port” to the two endings of the spiral inductor.



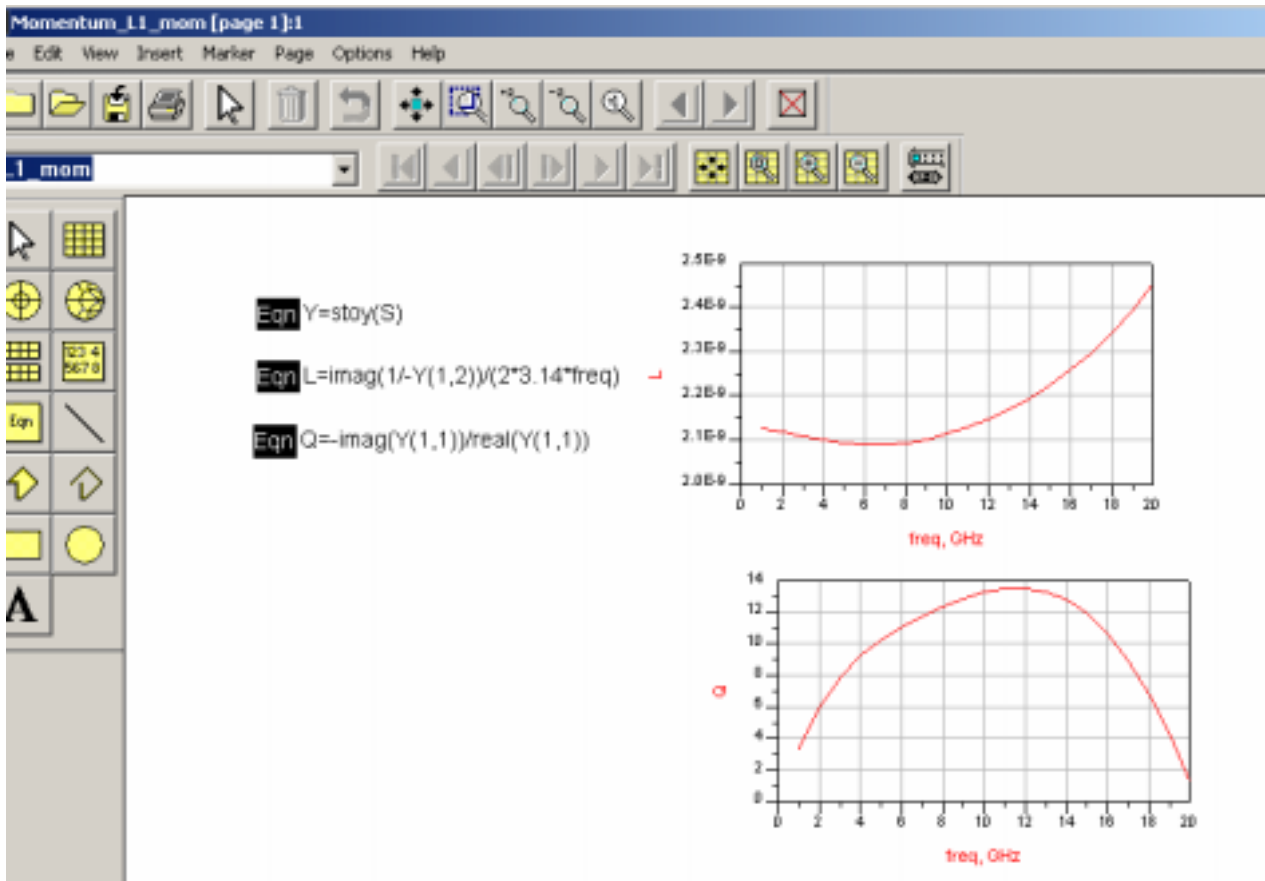
8. Afterward, Choose “Momentum → Simulation → S-parameters...” to do the simulation settings.



9. Now, go to set the frequency range that we are interested in. At initial design, we can set a wider range of frequency to see the performance of spiral inductor.



10. After simulation, in the datasheet, several equations can be added to extract the inductance and Q-factor of the spiral inductor.



11. After the initial simulation, we can see if the inductance value of the designed spiral inductor meets out impedance matching needs. If the inductance value is suitable, we can then go to check the Q-factor value. We may found out that the peak of the Q-factor is located at a higher frequency than that we need (5.2GHz), it means there is a need to modify the physical dimension of the spiral inductor to achieve the optimal performance.

Conclusion

The full steps of designing a spiral inductor used for power amplifier impedance matching application are shown previously. It can be seen that with the powerful simulation tool, Momentum Package in ADS, spiral inductor with any kinds of dimensions, size and metal turns on arbitrary dielectric materials can be precisely simulated within short period of time.