**Lab 3：Impedance Trans.**

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| **Introduction**  **1. Experimental Objective:**  To understand the impedance matching problem of microwave transmission lines, and to be able to use the Smith chart for impedance matching.  **2. Principle of the Smith Chart**  The Smith chart diagram is a polar coordinate diagram of the reflection coefficient, which is used to do impedance matching between high frequency circuits. It is equivalent to a map, and each point on it, represents an impedance value in complex form, while its center of the circle is called the matching point, which represents the ideal impedance of the real part of 50ohm and the imaginary part of 0ohm. To do impedance matching using Smith chart is to plan a line from the impedance point to the matching point.  **3. Principle of LC Network Impedance Matching:**  The LC network impedance matching is a passive network that is used to match the impedance of a load to the source impedance. It consists of a series inductor (L) and a shunt capacitor ©. The principle is based on the fact that the impedance of an inductor and a capacitor changes with frequency. By appropriately choosing the values of L and C, the LC network can transform the load impedance to the desired value, which matches the source impedance.  The impedance transformation of the LC network can be expressed by the following equations:  Where is the input impedance, is the output impedance, is the angular frequency, and *L* and are the inductance and capacitance values.  **4. Principle of Parallel Coupled-Line Impedance Matching:**  The parallel coupled-line impedance matching is based on the principle of using two parallel transmission lines of different characteristic impedances to transform the input impedance to the desired value. By adjusting the lengths and characteristic impedances of the lines, it is possible to match the input impedance of the load to the source impedance.  The impedance transformation of the parallel coupled-line can be given by the following equations:  Where is the input impedance, is the output impedance, is the characteristic impedance of the lines, is the electrical length, and is the load impedance.  Advantages and Disadvantages of L-Type and π-Type Impedance Matching Networks:  **5. L-Type Impedance Matching Network:**  Advantages:  a. Simple to design and implement.  b. Provides good impedance matching in certain frequency ranges.  Disadvantages:  a. Limited bandwidth of operation.  b. Sensitive to component tolerances and parasitic effects.  **6. π-Type Impedance Matching Network:**  Advantages:  a. Broader bandwidth compared to L-type networks.  b. Provides better matching over a wider frequency range.  Disadvantages:  a. More complex to design and implement.  b. Requires more components and space.  **Lab results & Analysis**：  **1. ADS Circuit Diagram (Two Methods)**      **2. LineCalc tool calculation result chart and Smith chart tool calculation result chart**            **3. S11 parameter diagram, Smith circle diagram, and comparison method to achieve the difference between impedance matching.**          After comparison, the bandwidth of the LC network is greater than the bandwidth of the microstrip line. | |
| **Experience** | |
| **Experience**  I have a deep understanding of the principle of impedance matching in LC networks and the principle of impedance matching of microstrip lines in parallel with two branches. Through the visual comparison of images, I intuitively felt the impact of different simulation modes on the results. At the same time, I learned how to use the smith chart calculation tool to find the right matching inductor capacitors and microstrip lines, and gained a deeper understanding of the principles of smith chart. Through LineCalc, I also gained a deep understanding of the correspondence between MLIN and TLIN. | |
| **Score** | 100 |