|  |  |
| --- | --- |
|  | ***Department of Electronics and Telecommunication Engineering***  ***(NBA ACCREDIATED)***  ***Antenna and Radio Wave Propagation Laboratory***  ***Academic Year 2020-2021***  ***Odd Semester*** |

|  |  |
| --- | --- |
| **Course Code** | ECC603 |
| **Subject Professor In-charge** | Prof. Santosh Jagtap |
| **Student Name** | Anuj Shah |
| **Roll Number** | 18104B0024 |
| **Class** | TE EXTC |
| **Division** | B |
| **Date of Performance** | 31-03-2021 |
| **Date of Submission** |  |

**EXPERIMENT NO.3**

**Design dipole antenna and plot Return loss and VSWR**

|  |  |
| --- | --- |
| **Total**  **(10 Marks)** | **Sign** |
|  |  |

**EXPERIMENT No.3**

**Title:** Design dipole antenna and plot return loss and VSWR

**Estimated time to complete this experiment:** 02 hours

**Objective:** Understand network parameters of antenna

**CO to be achieved:**

**Expected Outcome of Experiment:** Performance analysis of dipole antenna at different length by using Network parameters.

**Pre Lab/ Prior Concepts:** Transmission Line, Electromagnetics

**Theory (2 Marks)**

Return loss:

In telecommunications, return loss is a measure in relative terms of the power of the signal reflected by a discontinuity in a transmission line or optical fiber. This discontinuity can be caused by a mismatch between the termination or load connected to the line and the characteristic impedance of the line. It is usually expressed as a ration in decibels (dB):

Where is the return loss in dB, is the incident power and is the reflected power.

Return loss is related to both standing wave ratio (SWR) and reflection coefficient (). Increasing return loss corresponds to lower SWR. Return loss is a measure of how well devices or lines are matched. A match is good if the return loss is high. A high return loss is desirable and results in a lower insertion loss.

VSWR:

In radio engineering and telecommunications, standing wave ratio (SWR) is a measure of impedance matching of loads to the characteristic impedance of a transmission line or waveguide. Impedance mismatches result in standing waves along the transmission line, and SWR is defined as the ratio of the partial standing wave’s amplitude at an antinode (maximum) to the amplitude at a node (minimum) along the line.

The SWR is usually thought of in terms of the maximum and minimum AC voltages along the transmission line, thus called the voltage standing wave ratio (VSWR). For example, the VSWR value 1.2:1 means that an AC voltage, due to standing waves along the transmission line, will have a peak value 1.2 times that of the minimum AC voltage along that line, if the line is at least one half wavelength long. The SWR can also be defined as the ratio of the maximum amplitude to minimum amplitude of the transmission line’s currents, electric field strength, or the magnetic field strength. Neglecting transmission line loss, these ratios are identical.

Scattering Parameters:

**Scattering parameters or S-parameters (the elements of a scattering matrix or S-matrix) describe the electrical behavior of linear electrical networks when undergoing various steady state stimuli by electrical signals.**

**The parameters are useful for several branches of electrical engineering, including electronics, communication systems design, and especially for microwave engineering.**

**Many electrical properties of networks of components (inductors, capacitors, resistors) may be expressed using S-parameters, such as gain, return loss, VSWR, reflection coefficient, and amplifier stability. The term ‘scattering’ is more common to optical engineering than RF engineering, referring to the effect observed when a plane electromagnetic wave is incident on an obstruction or passes across dissimilar dielectric media. In the context of S-parameters, scattering refers to the way in which the travelling currents and voltages in a transmission line are affected when they meet a discontinuity caused by the insertion of a network into the transmission line. This is equivalent to the wave meeting an impedance differing from the line’s characteristic impedance.**

**Simulation Model/ Code (1 Marks)**

|  |
| --- |
| **Dipole Design** |

|  |  |
| --- | --- |
| **Design Specification:**   1. **Frequency (f) :** 750 MHz 2. **Length of Wire (L) :** 0.5λ, 1λ, 3λ/2, 5λ/2,   **Calculation of Dipole Length:**  Velocity factor=0.95     |  | | --- | | **λ =0.95\*c/f** |     Where,  c=Speed of light  L= Length of dipole |

|  |
| --- |
| **MATLAB CODE:**  %Define Specification  n=377;  Io=1;  r=10;  f=80e6;  lambda=0.95\*3e8/f;  k=(2\*pi)/lambda;  L=0.5\*lambda;  %Design Dipole  h=dipole('Length',L,'Width',L/10);  show(h);  theta=0:0.01:2\*pi;  E=j\*n\*Io\*exp(-j\*k\*r)\*(1/(2\*pi\*r))\*((cos(k\*L\*cos(theta)/2)-cos(k\*L/2))./sin(theta));  %Plot VWSR  vswr(h,50e6:1e6:100e6)  figure()  %Plot Return loss  returnLoss(h,50e6:1e6:100e6)  figure()  %Plot S parameters  S = sparameters(h,50e6:1e6:100e6);  rfplot(S) |

|  |  |  |
| --- | --- | --- |
| **Results** | | |
| 1. **VSWR** | | |
| **Dipole Length=0.5λ** | | **Dipole Length=1λ** |
| **Dipole Length=3/2λ** | | **Dipole Length=5/2λ** |
| **Results** | | |
| 1. **S Parameter** | | |
| **Dipole Length=0.5λ** | | **Dipole Length=1λ** |
| **Dipole Length=3/2λ** | | **Dipole Length=5/2λ** |
| **Results** | | |
| 1. **Return Loss** | | |
| **Dipole Length=0.5λ** | **Dipole Length=1λ** | |
| **Dipole Length=3/2λ** | **Dipole Length=5/2λ** | |

**Observations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Antenna Length** | **S11 (Reflection coefficient in terms of S)** | **Return Loss** | **VSWR** |
| 0.5 λ | -14.0411 | 14.0411 | 1.49558 |
| 1 λ | -1.62721 | 1.62721 | 10.707 |
| 1.5 λ | -10.2295 | 10.2295 | 1.8901 |
| 2.5 λ | -8.74884 | 8.74884 | 2.15071 |

**Conclusion:**

1. We want return loss to be as high as possible (or atleast above 10dB). The antenna of length 0.5λ has the highest return loss, while that of length 1λ has the lowest return loss.
2. We want VSWR to be as low as possible (or atleast lower than 1.86). The antenna of length 0.5λ has the lowest VSWR, while that of length 1λ has the highest VSWR.
3. S11 is equal to negative of the return loss.