ASSESSING THE PERFORMANCE OF A DESIGNED CONSTRUCTED CHEAP ROOM LOOP ANTENNA OPERATING AT VHF/UHF BAND

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ABSTRACT

The parameters that influence the performance of loop antennas were computed and analysed. This aids in designing and constructing a cheap room loop antenna operating at the frequency of 288MHz →300MHz. The designed and constructed loop antenna efficiently works within the quoted VHF/UHF Band.

INTRODUCTION

Antennas form the link between guided waves and the free space. They are any structure or device used to intercept or transmit electromagnetic waves. The specification on the type of antenna to be used in a particular application is one of the most important considerations in the set up of a communication system (Green, 1985). Transmitted radio waves spread and propagate as spherical wave fronts and they can be reflected and diffracted by atmospheric geographic and other physical condition. A very strong electrical conductor is used as transmitted sources to radiate electromagnetic waves across great distance. These include low frequency antenna and radio masts high frequency, very high frequency or masts microwave dishes, troposphere scatter and satellite VSAT antennas. Modern antennas design is a mixture of several disciplines and makes considerable use of advance electromagnetic wave theory which helps in solving transmission, propagation and reception problems (Grant and Philips, 1980). However, these days the problems of antennas design and development are solved largely through computer modeling techniques. This modeling define spectrum with which the antenna will work.

Loop antennas are primarily AM broadcasting and long wave antennas. There are two different types of loop antennas, the ferrite bar as in AM radios (Dennis and John 1995) and the wound on air core form. Loop antennas are very directional the pick up pattern is shaped like figure eight, and thus allow signals on opposite sides to be received while nulling off the other sides of the loop signals. The nulling feature allows the removal of local station on a particular frequency and picking up another signal of the same frequency.

The small loop is a versatile antenna and can be used for many different applications such as improving the performance of a poorly designed broad cast receiver, depending on the loop and the type of antenna that is in the receiver. A properly balanced loop can also be used to null down. AC line noises. TV sweep harmonies or other locally generated interface. However, loop can also be attached via transmission line if the set has a wire or screw binding posts for the antenna or it may be inductively coupled for a receiver using a very small loop.

Loop antenna will be more in use because antenna are going toom wards and we need antenna that will operate indoors without much hiss (noise) and unwanted signals (Ahmed, 2001) loop serve these purposes and will be more in use because antenna designers world wide think much about space management especially in big cities. Therefore the issue of long wire antenna is gradually becoming thing of the past. Other points that favour loop antenna usage are their good performance in directional finding and good balance performance. The performance of loop can further be enhanced if the amplifier following a transfer coupled loop is tuned. This provides still better image rejection and channel selectivity (Bates and Dale, 1995).

AIM OF THE STUDY

It is just to highlight the performance of loop antenna as a wide application antenna operating within VHF and UHF and can operate indoor.

JUSTIFICATION

This study is important as it will insure loop antenna usage. Especially these days when antennas are moving to our rooms instead of fighting for spaces outside our rooms. The study not only insures space management but insures also good performance with application.

SCOPE OF STUDY

This scope of this work is limited to loop operating within VHF/UHF, couple with good antenna performance with wider applications in our rooms. Thus widely solve very large space management problem concerning antennas.

ASSESMENT PARAMETER

The parameters considered for assessment are radiation resistance radiation efficiency and number of turns of loop antennas.

RADIATION RESISTANCE

The radiation resistance of any antenna has two component of radiation resistance. Their radiation resistance, which is due to the power that they converts into electromagnetic waves and the resistance due to their actual ohmic losses.

Radiation resistance is most desired in transmitting antenna because it is the maximum conversion of radio frequency current into electromagnetic energy (Krauss, 1988). Radiation resistance therefore, is a desirable power loss by antennas in the form of electromagnetic energy.

The radiation resistance of a small single turn loop antenna, circle or square with uniform current Alfred and Kanodoliar, 1940 is

$$R_{rad} = 31200\left[\frac{\Lambda}{\lambda}\right]^2 \quad \text{Ohms} \text{ -------------------------------------- } 1.0$$

Then the radiation resistance of a small loop consisting of one or more forms is

$R_{rad} = 31200\left[\frac{n\Lambda}{\lambda}\right]^2$ Ohms -- 1.1

The ohmic losses of a loop antenna (smith, 1988) is

$R_1 = c/d\sqrt{\frac{f\mu o}{\pi\delta}}$ Ohms --1.2

Where C = loop length parameter
d = wire or conductor diameter
f = Frequency of the signal inHz
μo = Permeability of the free space HM
δ = Conductivity of the medium

RADIATION EFFICIENCY

The radiation efficiency of antenna is defined as the ratio of the power radiated to the power input of the antenna multiplied by 100% i.e.

Radiation Efficiency (%) $= \frac{power\ radiated}{power\ fed\ into\ antenna} \times 100$

$$= \frac{l^2 R_r \times 100\%}{l^2 R_1 + l^2 R_r}$$

$$= \frac{l^2 R_r \times 100\%}{l^2 (R_1 + l^2 R_r)}$$

$$= \frac{R_r}{R_1 + R_r} \times 100\% \quad \text{-------------------1.3}$$

Where R_r **=** terminal radiation resistance
R_r **+** R_1 **=** equivalent terminal loss resistance.

THE TURNS

The turns play very important role for turn antenna performance and the gain are always function of the turns while the wave length of the wire determine the turns with which the frequency of the antenna can function and the wavelength is of the form (Carry, 1984)

$\lambda = \frac{V}{f}$ --- 1.4

THEORETICAL COMPUTATIONS

The theoretical computations are obtained from the equation 1.1 and 1.3 because they defined the parameter due for assessment.

The computed values obtained for radiation resistance and number of turns from 1 to 9 are presented in table 1. Table 2 however, present number of the turns with radiation efficiency.

TABLE 1: SHOWING NUMBER OF TURNS AND RADIATION RESISSTANCE

NO OF TURNS	RADIATION RESISTANCE (OHMS)
1	0.95
2	7.60
3	17.3
4	30.8
5.	48.0
6	69.3
7	94.3
8	123
9	132

SOURCE: computer values for number of turns with radiation resistance

TABLE 2: SHOWING NUMBER OF TURNS AND RADIATION EFFICIENCY

NO OF TURNS	RADIATION EFFICIENCY (%)
1	95.0
2	97.0
3	98.4
4	98.8
5.	98.8
6	99.0
7	99.3
8	99.3
9	99.4

SOURCE: computed values for number of turns with radiation efficiency.

THE DESIGN AND SPECIFICATION

The design loop antenna is small multi turn loop of $\lambda/10$ in length, which was based on the value in the table 3. However, a properly designed loop primarily responds to magnetic component of the radio. The general wave equation of (1:4) was use to determine the

wavelength of the loop antenna design. The frequency band of (30-300mHz) and (300mHz-3Ghz) were used in finding the wavelength and the frequency of the loop antennas.
The mid frequency between these two frequencies was considered as an optimum desire in obtaining the frequency of operation, which is 300 MHz

The wavelength thus from 1.4 is

$$\lambda = \frac{V}{f} = \frac{3\times10^{8}MS}{300\times10^{6}HZ} ------------------------1.5$$

The design and construction was carried out based on the calculated design specification of the antenna. The dimensions of the expected loop antenna is however, presented in the table 3.

Table 3*: *Dimension of the loop antenna

QUALITY MEASURE	**FORMULA**	**VALUE IN METER (M)**	**VALUE IN MILIMETER**
Wavelength	V/f	1.000	1000.00
Diameter of conduct	-	0.0034	3.43
Length of the square loop	λ/10	0.1000	100.00
Perimeter of the square loop	$4(\lambda/10)^2$	0.4000	400.00
Area of square loop	$(\lambda/10)^2$	0.0100	10.00
Number of turn	-	-	9turns
Space between turns	-	0.0120	12.00
Length of a conductor	-	7.2000	7200.00
Area of the loop	H × W	$0.0324m^2$	
Area of the base of the loop antenna	L × B	$0.054m^2$	$54.00mm^2$
Height of the loop antenna	-	0.6500	65.00

Source: Data from design calculation and measured values.

MOUNTING AND TESTING OF THE LOOP

There are many ways of mounting the antenna, but mounting system must be stable. For this work it was mounted on a wooden stand, which may be on the floor, hung or kept on an object in the room. The loop can be rotated from one side to the other for better reception.

The testing of this of work is to determine the consonance between theoretical expectation and practical performance of the advice in question. The product resulting from this work was tested using a television set to find out if it could intercept the signals from NTA.

RESULTING AND FINDINGS

The result of the theoretical computation in table 1.0 depicted the variation of radiation resistance with number of turns for loop antenna. The radiation resistance increases with number of turns. But from the turns of 6 upwards the increase is substantial enough for optimum design and construction. Result in table 2.0 shows the variation efficiency of radiation with number of turns and as the number of turns increase the efficiency of radiation also increases while the increase in the efficiency of radiation was not reasonable for number of turns of one to four. Hence the need for more number of turns to achieve optimum performance.

The whole of these assessments were used in designing constructing and influencing the performance of nine turns loop antenna. The antenna however received signals within 224.0Hz to 243.5Hz. Faints signals were also received at 253.2Hz and when a RF amplified was introduced to the device signals were received at 288 to 300MHz with appreciable audio and visual performance.

CONCLUSION

The theoretical assessment leads to the design and construction of the cheap room loop antenna. The antenna was used in receiving signals within the range of mega hertz and kilohertz and these really prove that loop antennas have wide band applications, and they can easily be constructed to work within the band regions of application.

RECOMMENDATION

The antenna is recommended for indoor use to achieve a better reception in a wide hand application in big cities, where population obstruct antenna signal performance and most of land lords complained much about space utilization and management.

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