RESEARCHERID
THOMSON REUTERS

[FRTSSDS- June 2018] ISSN 2348 – 8034
DOI: 10.5281/zenodo.1296206 Impact Factor- 5.070

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

# COMPARATIVE ANALYSIS OF IDEAL VALUES AND EXPERIMENTAL VALUES OBSERVED FOR RADIATION PATTERN OF QUARTER WAVE MONOPOLE ANTENNA

**Oorja Pandya**
Department of Electronics & Communication SVITS, Indore

## ABSTRACT

The quarter-wave monopole antenna is a single-element antenna fed at one end that behaves as a dipole antenna. It is formed by a conductor in length, fed in the lower end, which is near a conductive surface which works as a reflector (see effect of ground) and is an example of a Marconi antenna. The current in the reflected image has the same direction and phase as the current in the real antenna. The quarter-wave conductor and its image together form a half-wave dipole that radiates only in the upper half of space. In this upper side of space, the emitted field has the same amplitude of the field radiated by a half-wave dipole fed with the same current. Therefore, the total emitted power is half the emitted power of a half-wave dipole fed with the same current. As the current is the same, the radiation resistance (real part of series impedance) will be half of the series impedance of a half-wave dipole. As the reactive part is also divided by 2, the impedance of a quarter-wave antenna is ohms. Since the fields above ground are the same as for the dipole, but only half the power is applied, the gain is twice (3 dB over) that of a half-wave dipole (1.5dB).

***Key words:*** *Monopole antenna, radiation pattern, quarter wave, etc*

## I. INTRODUCTION

The earth can be used as ground plane, but it is a poor conductor. The reflected antenna image is only clear at glancing angles (far from the antenna). At these glancing angles, electromagnetic fields and radiation patterns are the same as for a half-wave dipole. Naturally, the impedance of the earth is far inferior to that of a good conductor ground plane. This can be improved (at cost) by laying a copper mesh.

When the ground is not available (such as in a vehicle) other metallic surfaces can serve as a ground plane (typically the vehicle's roof). Alternatively, radial wires placed at the base of the antenna can form a ground plane. For VHF and UHF bands, the radiating and ground plane Ɵ elements can be constructed from rigid rods or tubes. For a simple 1/4-wave whip, the radials are often sloped at a 45 degree angle to bring the feed point impedance closer to 50 ohms. Since this will introduce RF energy on the shield of the unbalanced feed line which deforms the radiation pattern of the antenna, a choke is often placed near the feed point.

A monopole antenna is a class of radio antenna consisting of a straight rod-shaped conductor, often mounted perpendicularly over some type of conductive surface, called a ground plane. The driving signal from the transmitter is applied, or for receiving antennas the output signal to the receiver is taken, between the lower end of the monopole and the ground plane. One side of the antenna feedline is attached to the lower end of the monopole, and the other side is attached to the ground plane, which is often the Earth. This contrasts with a dipole antenna which consists of two identical rod conductors, with the signal from the transmitter applied between the two halves of the antenna.

The monopole is a resonant antenna; the rod functions as an open resonator for radio waves, oscillating with standing waves of voltage and current along its length. Therefore, the length of the antenna is determined by the wavelength of the radio waves it is used with. The most common form is the quarter-wave monopole, in which the antenna is approximately one quarter of the wavelength of the radio waves. The monopole antenna was invented in 1895 by radio pioneer Guglielmo Marconi; for this reason it is sometimes called the Marconi antenna. Common types of monopole antenna are the whip, rubber ducky, helical, random wire, umbrella, inverted-L and T-antenna, inverted-F, mast radiator, and ground plane antennas.

## II. EXPERIMENTAL

The most basic antenna which allowed the practical use of antennas in the modern field of communication would be wire antenna. Dipole, helical and loop are some of the examples of wire antenna . The wire antenna is easy to realize since its design and mechanism is simple. Owing to its simple mechanical structure, it can easily be used to produce electrical/mechanical down tilt in base stations to reduce channelinterference. Its gain is about 3 dB greater than a half-wave dipole, the highest gain of any dipole of any similar length. Other reasonable lengths of dipole do not offer advantagesand are seldom used.

## III. RESULTS AND DISCUSSION

Input current=33µ

*Table 1. Experimental values observed for radiation pattern of quarter wave monopole antenna*

| **Ɵ (in degree)** | **$I_{out}$ (in µA)** | **Gain (in db)** |
|---|---|---|
| 0 | 45 | 1.36 |
| 10 | 40 | 1.21 |
| 20 | 35 | 1.06 |
| 30 | 20 | 0.60 |
| 40 | 10 | 0.30 |
| 50 | 0 | 0 |
| 60 | 0 | 0 |
| 70 | 0 | 0 |
| 80 | 0 | 0 |
| 90 | 0 | 0 |
| 100 | 10 | 0.33 |
| 110 | 24 | 0.72 |
| 120 | 46 | 0.32 |
| 130 | 50 | 1.42 |
| 140 | 47 | 1.75 |
| 150 | 30 | 0.45 |
| 160 | 15 | 0.15 |
| 170 | 5 | 0.15 |
| 180 | 0 | 0 |
| 190 | 0 | 0 |
| 200 | 0 | 0 |
| 210 | 0 | 0 |
| 220 | 0 | 0 |
| 230 | 0 | 0 |
| 240 | 0 | 0 |
| 250 | 0 | 0 |
| 260 | 0 | 0 |
| 270 | 0 | 0 |
| 280 | 0 | 0 |
| 290 | 0 | 0 |
| 300 | 0 | 0 |
| 310 | 0 | 0 |

RESEARCHERID
THOMSON REUTERS
[FRTSSDS- June 2018]
DOI: 10.5281/zenodo.1296206
ISSN 2348 – 8034
Impact Factor- 5.070

| | | |
|---|---|---|
| 320 | 0 | 0 |
| 330 | 5 | 0.15 |
| 340 | 10 | 0.33 |
| 350 | 28 | 0.34 |
| 360 | 5 | 0.15 |

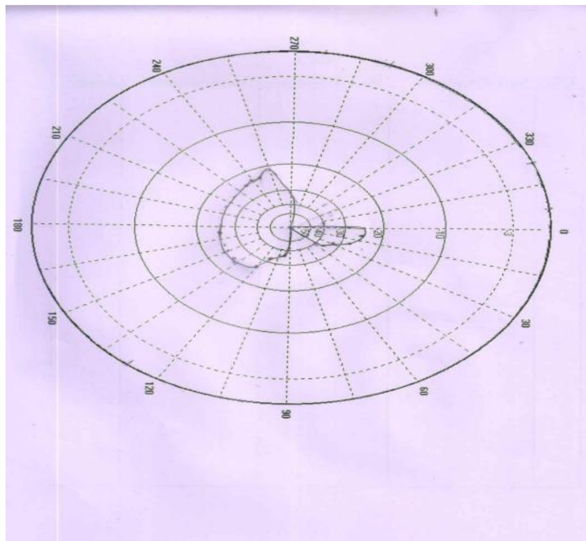

***Fig. 1. Scanned graphical representation of experimental values observed for radiation pattern of quarter wave monopole antenna***

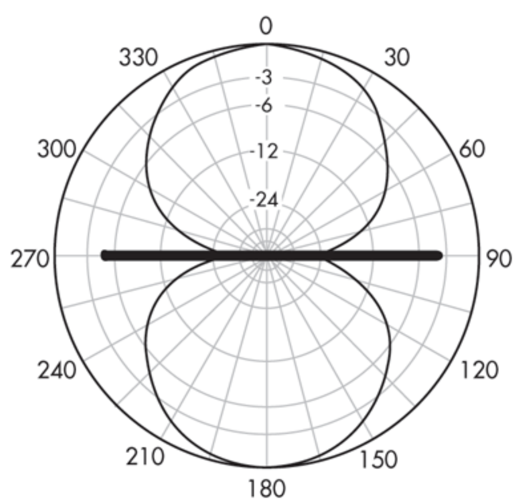


***Fig. 2. Ideal radiation pattern of quarter wave monopole antenna***

When used for radio broadcasting, the radio frequency power from the broadcasting transmitter is fed across the base insulator between the tower and a ground system. The ideal ground system for AM broadcasters comprises at least 120 buried copper or phosphor bronze radial wires at least one-quarter wavelength long and a ground-screen in the immediate vicinity of the tower. All the ground system components are bonded together, usually by welding, brazing or using coin silver solder to help reduce corrosion. Monopole antennas that use guy-wires for support are called masts in some countries. In the United States, the term "mast" is generally used to describe a pipe supporting a smaller antenna, so both self-supporting and guy-wire supported radio antennas are simply called monopoles if

[FRTSSDS- June 2018] ISSN 2348 – 8034
DOI: 10.5281/zenodo.1296206 Impact Factor- 5.070

they stand alone. If multiple monopole antennas are used in order to control the direction of radio frequency (RF) propagation, they are called directional antenna arrays.

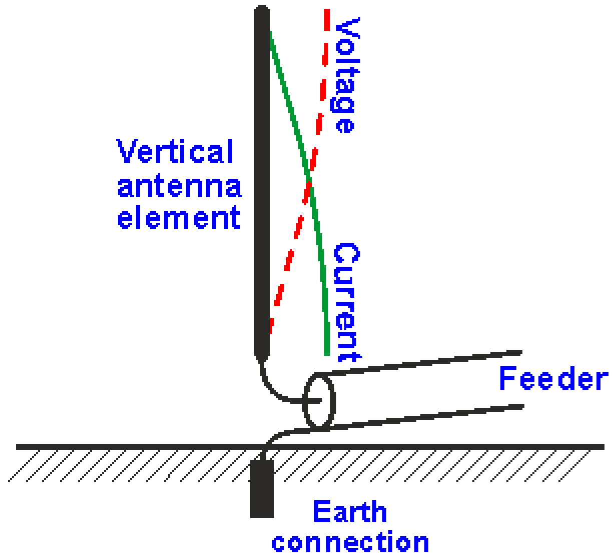


*Fig. 3. A quarter wave vertical RF antenna design*

## IV. CONCLUSION

When the antenna fails to achieve its ideal pattern there are many kinds of propagation errors which interrupt the propagation of the desired signal. The errors are such as-

1) Attenuation : Strength of signal falls off with distance overtransmission medium.
2) Distortion : Signals at higher frequencies attenuate more than that at lower frequencies. Shape of a signal comprising of components in a frequency band is distorted .To recover the original signal shape, attenuation is equalized by amplifying higher frequencies more than lower ones.
3) Dispersion : Electromagnetic energy spreads in space as it propagates .Consequently, bursts sent in rapid succession tend to merge as they propagate .For guided media such as optical fiber, fundamentally limits the product RxL, where R is the rate and L is the usable length of the fiber. Term generally refers to how a signal spreads over space and time.
4) Noise : types of noise
    - Thermal Noise
    - Intermodulation noise
    - Crosstalk
    - Impulse Noise
5) Other effects :
    - Atmospheric absorption : water vapor and oxygen contribute to attenuation.
    - Multipath : obstacles reflect signals so that multiple copies with varying delays are received.
    - Refraction : bending of radio waves as they propagate through the atmosphere

## REFERENCES

*[1] Das, Sisir K. (2016). Antenna and Wave Propagation. Tata McGraw-Hill Education. p. 116. ISBN 1259006328.*
*[2] Wong, K. Daniel (2011). Fundamentals of Wireless Communication Engineering Technologies. John Wiley and Sons. p. 94. ISBN 1118121090.*
*[3] Kishore, Kamal (2009). Antenna and Wave Propagation. IK International Ltd. p. 93. ISBN 9380026064.*

[FRTSSDS- June 2018] ISSN 2348 – 8034
DOI: 10.5281/zenodo.1296206 Impact Factor- 5.070
*[4]* US patent 586193, Guglielmo Marconi Transmitting electrical signals, filed December 7, 1896, granted July 13, 1897

*[5] Macnamara, Thereza (2010). Introduction to Antenna Placement and Installation. USA: John Wiley and Sons. p. 145. ISBN 0-470-01981-6.*

*[6]* Kedar Viswanathan School of Electronics Engineering, VIT University, Vellore, India ,K.S. Harshini School of Electronics Engineering, VIT University, Vellore, India, Priyal Singh School of Electronics Engineering, VIT University, Vellore, India, **Date Added to IEEE Xplore:** 30 October, 2017, **ISBN Information: INSPEC Accession Number:** 17316134, **DOI:** 10.1109/ICSTM.2017.8089177, **Publisher:** IEEE

*[7]* http://www.ccs.neu.edu/home/rraj/Courses/6710/S10/Lectures/AntennasPropagation Antenna and wave propagation – John D. Kraus