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Analysis of Co-Axial Cable Response to 700m Long Digital Data Transmission.

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Abstract: *This project work is based on analysis of coaxial cable when pulse signal (digital signal) is transmitted through it. Transmission of information (Video, Audio or Data) in form of signal through cable suffers degradation such as signal attenuation, signal power loss and signal energy transmitted. An experiment was carried out to analyze the various factors (signal attenuation, signal power loss and signal energy transmitted) that affect signal that are been transmitted through coaxial cable at a distance of 100m. The output voltage of a digital data was measured at an interval of 100m with the effects of frequency variation of the input signal, as well as effect of distance on the transmitted power. It was discovered that the signal attenuation, the signal power loss and the signal energy transmitted increase as the length increases, in line with the established laws.*
Keywords: *Attenuation, co-axial cable, distance, frequency, loading, transmitted power.*

I. Introduction

The transmission medium is what actually carries a signal from point to point in the network. The signal carried by the medium may be voice or data, network control signals or combination of the two. For data to the transferred from place to place, it must have a route of getting there. To achieve this, many difference devices have been developed. In addition, every medium has its own particular advantages and disadvantages. Although modern transmission mediums can be found in many shapes and sizes, they can typically be separated into three categories, wire, radio and fiber optic [1].

Twisted pair cable, coaxial cable and open wire are common transmission medium found not only in the local loop and exchange network but also in the long haul network. Wire is certainly the oldest and most straight forward of all mediums, yet it still remains the foundation of the network [1,2]. Wire has several disadvantages. It is expensive heavy and bulky. The cost of installing and repairing long-haul wire is often prohibitive when compared with other new media. Wires are susceptible to environmental effect such as corrosion, noise and voltage spikes [2,3]. Twisted pair consists of two pair of twisted cable, twisted around each other. Twisted pair can be bundled together so that more than a thousand pair can be placed together. Telephone lines are cheap and fairly fast but they are very sensitive to distance and require repeaters or amplifier every couple of miles to keep the signal strong when received at the other end [3]. The bandwidth of twisted pair is about 1 Mega bit per seconds.

Coaxial cable is a high bandwidth insulated cables. It is the same cable that is used for television cable. It is capable of transmitting 100 Mega bit per seconds. It is a big improvement over twisted pair. Coaxial cable consists of a copper wire core covered by insulation then a braided copper shielding covered by a plastic coating. It is used where a higher bandwidth than twisted pair is necessary [4,5].

Transmission of information as an electromagnetic signal occurs as a traverse electromagnetic wave. With transmission lines, the metallic conductors confine the traverse electromagnetic wave to the vicinity of the dielectric surrounding the conductors. Some aspect of the transmission are best treated in terms of the distributed circuit parameters of the line, while others require the wave properties of the line to be taken into account. In communications and electronic engineering, a transmission line is a specialized cable or other structure designed to carry alternating current of radio frequency that is currents with a frequency high enough that their wave's nature must be taken into account [5].

Transmission lines are used for purposes such as connecting radio transmitters and receivers with their antennas, distributing cable television signals. Energy travels along a transmission line in the form of an electromagnetic wave, the wave set up by the signal source being known as the incident wave. When the load impedance at the receiving end is a reflection less match for the line with all the energy been transferred to the load. If reflection less matching is not achieved, energy will be reflected back along the line in the form of a reflected wave [6,7].

1.1 Coaxial Cable

Coaxial cable consists of two products that share a common axis. The conduction is typically a straight wire, either solid or stranded and the outer conductor is typically a shield that might be brooded or a foil. Coaxial cable is a cable type used to carry radio signals, video signal, measurement signals and data signals. It consists of on insulated center conductor which is covered with a shield [5,7]. The signal is carried between the cable shield and the center conductor. This arrangement give quite good shielding again noise from outside cable and keeps the signal well inside the cables and keeps the cable characteristics stable. Coaxial cables and systems connected to them are not ideal. There is always some signal radiating from coaxial cable. Hence, the outer conductor also functions as a shield to reduce coupling of the signal into adjacent wiring. The more the shield coverage the lesser the energy radiated but, not necessarily mean less signal attenuation [7]. Coaxial cables are typically characterized with the impedance and cable loss. The length has nothing to do with coaxial cable impedance. Characterizes impedance is determined by the size and spacing of the conductors and the type of dielectric used between them. For ordinary coaxial cable that use a reasonable frequency, the characteristic impedance depends on the dimensions of the inner and outer conductors [5,7].

The types of Coaxial Cables available are ;RG-6/$_U$, RG-59B/$_U$, RG-11, RG-11A/$_U$, RG-58$_C$/$_U$, RG-213$_U$, RG-62A/$_U$ [7].

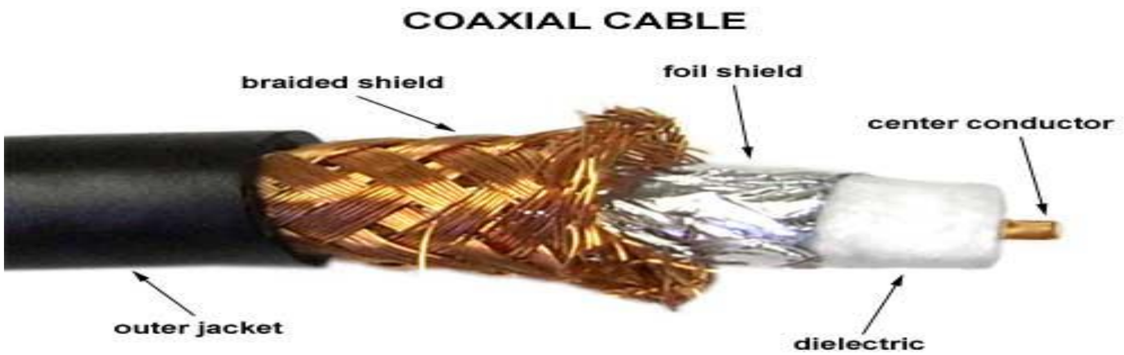

Figure 1: Diagram of a co-axial cable [7]

1.2 Structural Characteristics

The inner or centre conductor is used for the transmission of signal and responsible for ever 80% of the coaxial cables attenuation level. The bigger the section of wire, the bigger the surface and the lesser the attenuation. The dielectric layer of material placed around the inner conductor serve to keep the conduct exactly concentrically with respect to the screen, to perfect the conductor from atmosphere agents; while the outer conductor(screen) function is to protect the antenna's signal running along the conductor from external interference as well as to avoid the radiation from electromagnetic signal outward. The Sheath protects the coaxial cable from the external environment [5,7].

1.3 Electrical Characteristics

It represents the decrease in intensity that the signal undergoes while crossing the cable. It is generally measured in (B/100m).Attenuation is a function of the frequency of the signal and the length and physical structure of the cable itself. Specifically it depends on: The diameter of the inner conductor: as the diameter of the conductor increase attenuation decreases. The composition of the outer conductor: the more effective the screening action, the lower the attenuation. The nature of the dielectric: the lower its dielectric constant, the lower the attenuation. The impedance represents the opposition that a given circuit (thus also a cable) offers to the passage of the alternate electric current. In particular, characteristic impedance is defined as the relationship between the applied tension and the current absorbed in a coaxial cable of infinite length. Examples of standardized values for coaxial cables are 50ohm, 75ohm and 93ohm. Screening effectiveness defines the outer conductor's (screen's) capability to oppose external electromagnetic interferences [5,6,7].

II. Materials and Methods

A practical experiment was conducted on the coaxial cable in order to obtain the cable's response to long distance digital transmission. The following materials were used for conducting the experiment: a coaxial cable of the type RG6/u; with total length of 700m. A cathode Ray Oscilloscope was used for viewing the signal wave formed at both the input and the output cable, and function generator used to generate square wave signal for the transmission through the cable.

A resistor was used for loading the circuit with various resistors values such as 50Ω, 75Ω and 10kΩ. A Digital Multi-meter was used to take the voltage measurement. Other materials used include RF connectors (male and female type and tee type), pliers and measuring tape.
The procedures involved in the experiment are outlined below:

Step 1: Cable Measurement and Cutting

The cable was removed with a measuring tape and cut at every 100m length. Each 100m length of the cable was then terminated using RF connectors. The male type connector was used for terminating the cable at one end while the female connector was used at the other end.

Step 2: Continuity and Bridge Test

The cables were tested for continuity of both the inner and the outer conductors. The presence of a ‘bridge’ i.e. a contact between the inner and outer conductors was also checked for during the test. The faults were corrected where they were noticed.

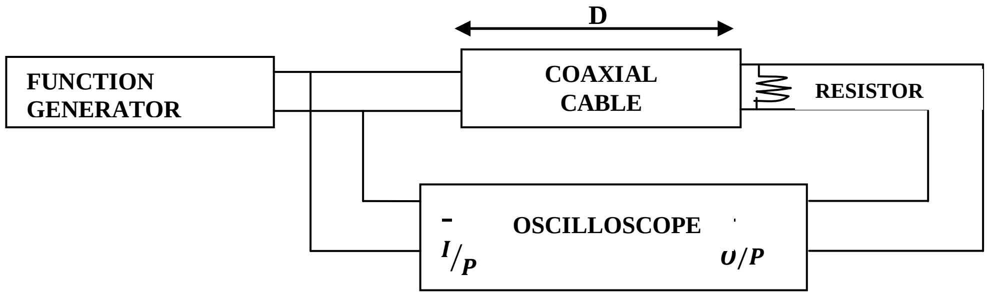

Figure 2: Block Diagram for the Experiment

Step 3: Circuit Connection and Measurement

After the continuity of both the inner and outer conductors as well as the absence of the bridge between the conductors were ascertained, the cable’s input terminals were connected to the function generator’s output terminals and also to the cathode ray oscilloscope input channel’s probes for a given distance D (length of the cable).The Function generator was powered while it was set to generate square wave signals at a given frequency F. The function generator’s output was set to 5V ac. The 5V signal was then connected across the input terminals of the coaxial cable. At the other end of the cable, a resistor was connected across the terminals.

The Function generator’s output was readjusted to 5Vac after connecting a resistor to the output terminal. The output voltage across the resistor was then taken using a digital multi-meter and recorded. The experiment was first conducted for the length D =100m for the 75Ω resistor at frequencies F=50Hz, 100Hz, 500Hz, 1000Hz and 10000Hz.After the 100m distance, the experience was repeated for distance D=200m, 300m, 400m, 500m, 600m, and 700m at a step of 100m.The entire experiment was also repeated for R=50Ω and 10kΩ starting with D = 200m, 300m incremental at 100m to 700m. The result obtained were recorded and given in the table below.

Table 1: Result of Experiment for R=75Ω at 100m

S/N	Frequency Range (Hz)	75Ω Load Input Voltage V_1 (Volts)	Output Voltage V_2 (Volts)
1	50	5.00	3.50
2	100	5.00	3.50
3	500	5.00	3.50
4	1000	5.00	3.30
5	10000	5.00	2.80

Table 2: Result of Experiment for R=75Ω, 50Ω and 10kΩ at 200m

S/N	Frequency Range (Hz)	75Ω load Input V_1(Volts)	Output V_2(Volts)	50Ω load Input V_1(Volts)	Output V_2 (Volts)	10kΩ load Input V_1 (Volts)	Output V_2 (Volts)
1	50	5.00	2.60	5.00	2.10	5.00	5.00
2	100	5.00	2.60	5.00	2.00	5.00	5.00
3	500	5.00	2.50	5.00	2.00	5.00	5.00
4	1000	5.00	2.40	5.00	1.80	5.00	4.4
5	10000	5.00	2.05	5.00	1.30	5.00	5.15

Table.3: Result of Experiment for R=75Ω, 50Ω and 10kΩ at 300m

S/N	Frequency Range (Hz)	75Ω load Input V_1 (Volts)	Output V_2(Volts)	50Ω load Input V_1 (Volts)	Output V_2 (Volts)	10kΩ load Input V_1 (Volts)	Output V_2 (Volts)
1	50	5.00	2.00	5.00	1.50	5.00	4.80
2	100	5.00	2.10	5.00	1.50	5.00	4.90
3	500	5.00	2.20	5.00	1.60	5.00	4.80
4	1000	5.00	2.00	5.00	1.50	5.00	4.90
5	10000	5.00	1.50	5.00	0.70	5.00	5.20

Table 4: Result of Experiment for R=75Ω, 50Ω and 10kΩ at 400m

S/N	Frequency Range (Hz)	75Ω load Input V_1 (Volts)	Output V_2 (Volts)	50Ω load Input V_1 (Volts)	Output V_2 (Volts)	10kΩ load Input V_1 (Volts)	Output V_2 (Volts)
1	50	5.00	1.70	5.00	1.20	5.00	4.80
2	100	5.00	1.70	5.00	1.35	5.00	4.80
3	500	5.00	1.80	5.00	1.35	5.00	4.80
4	1000	5.00	1.80	5.00	1.05	5.00	4.70
5	10000	5.00	1.20	5.00	0.70	5.00	5.30

Table 5: Result of Experiment for R=75Ω, 50Ω and 10kΩ at 500m

S/N	Frequency Range (Hz)	75Ω load Input V_1(Volts)	Output V_2 (Volts)	50Ω load Input V_1(Volts)	Output V_2 (Volts)	10kΩ load Input V_1(Volts)	Output V_2 (Volts)
1	50	5.00	1.40	5.00	1.00	5.00	4.80
2	100	5.00	1.40	5.00	1.00	5.00	4.80
3	500	5.00	1.50	5.00	1.10	5.00	4.80
4	1000	5.00	1.30	5.00	0.85	5.00	4.90
5	10000	5.00	1.00	5.00	0.60	5.00	4.70

Table 6: Result of Experiment for R=75Ω, 50Ω and 10kΩ at 600m

S/N	Frequency Range (Hz)	75Ω load Input V_1(Volts)	Output V_2 (Volts)	50Ω load Input V_1(Volts)	Output V_2 (Volts)	10kΩ load Input V_1 (Volts)	Output V_2 (Volts)
1	50	5.00	1.30	5.00	0.80	5.00	4.80
2	100	5.00	1.20	5.00	0.80	5.00	4.80
3	500	5.00	1.30	5.00	0.80	5.00	4.80
4	1000	5.00	1.00	5.00	0.60	5.00	4.90
5	10000	5.00	0.80	5.00	0.50	5.00	4.40

Table 7: Result of Experiment for R=75Ω, 50Ω and 10kΩ at 700m

S/N	Frequency Range (Hz)	75Ω load Input V_1(Volts)	Output V_2 (Volts)	50Ω load Input V_1(Volts)	Output V_2 (Volts)	10kΩ load Input V_1(Volts)	Output V_2 (Volts)
1	50	5.00	1.20	5.00	0.80	5.00	4.80
2	100	5.00	1.20	5.00	0.80	5.00	4.90
3	500	5.00	1.20	5.00	0.80	5.00	4.80
4	1000	5.00	1.00	5.00	0.60	5.00	4.90
5	10000	5.00	0.60	5.00	0.40	5.00	4.00

III. Analysis of Result

The analysis involves the following: Calculation of attenuation, power and energy; Graphical variation of the calculated parameters showing: The variation of the calculated parameters with frequency and distance and the Interpretation of the graphs.

The attenuation of the signal on transmission is calculated from $A = {V_1}/{V_2}$;

In decibels, $A(db) = 10 \times \log_{10} {V_1}/{V_2}$

The power transmitted is calculated from the formula $= \frac{V_2^2}{R}$; where $V_2 =$ Voltage across the load at the cable's output R = Load Resistor

The energy transmitted is given by the formula $E = P \times T \ldots\ldots\ldots\ldots\ldots\ldots .(i)$

Where P = Power ,T = Time

But $Time\ (T) = \frac{Distance}{Velocity}\frac{D}{V}$ ………………………………..(ii)
The velocity of an electromagnetic wave in a medium is given as $V = \frac{V_c}{\sqrt{K}}$ …………………………. (iii)
Where V_c = Velocity of light in vacuum = 3.0×10^8mls, K = Dielectric constant of the medium

$$T = D/_V \ldots\ldots\ldots\ldots\ldots\ldots (iv)$$

Substitute $V = \frac{V_c}{\sqrt{K}}$ into equation (iv)
$T = D \div \frac{V_c}{\sqrt{K}}$or $T = \frac{D\sqrt{K}}{V_c}$ ……………… (v)
For RG6/U coaxial cable, the dielectric is polyethylene foam with a constant K = 1.64

$$T = \frac{D \times \sqrt{1.64}}{3.0 \times 10^8}$$

$$T = 0.427D \times 10^{-8} \ldots\ldots\ldots\ldots (vi)$$

Substituting for T in equation (i), energy becomes

$$E = P \times 0.427D \times 10^{-8}$$

Table 8: For Frequency F = 50Hz and R = 75Ω

S/N	Distance(m)	Attenuation(dB)	Power(watts)×10^{-3}	Energy(joules)×10^{-9}
1	100	1.549	163.3	69.73
2	200	2.840	90.13	76.97
3	300	3.979	53.30	68.27
4	400	4.685	38.50	65.76
5	500	5.528	26.13	55.79
6	600	5.820	22.53	57.72
7	700	6.198	19.20	57.38

Table 9: For Frequency F = 100Hz and R = 75Ω

S/N	Distance(m)	Attenuation(dB)	Power(watts)×10^{-3}	Energy(joules)×10^{-9}
1	100	1.549	163.30	69.73
2	200	2.840	90.13	76.97
3	300	3.768	58.80	75.32
4	400	4.685	38.50	65.76
5	500	5.528	26.13	55.79
6	600	6.198	19.20	57.72
7	700	6.198	19.20	57.38

Table10: For Frequency F = 500Hz and R = 75Ω

S/N	Distance(m)	Attenuation(dB)	Power(watts)×10^{-3}	Energy(joules)×10^{-9}
1	100	1.549	163.30	69.73
2	200	3.010	83.30	71.14
3	300	3.565	70.50	90.31
4	400	4.437	43.20	73.78
5	500	5.229	30.00	64.05
6	600	5.850	22.50	57.65
7	700	6.198	19.20	57.38

Table 11: For Frequency F = 1,000Hz and R = 75Ω

S/N	Distance(m)	Attenuation(dB)	Power(watts)×10^{-3}	Energy(joules)×10^{-9}
1	100	1.805	145.20	61.92
2	200	3.188	76.80	65.59
3	300	3.979	53.30	68.28
4	400	4.437	43.20	73.78
5	500	5.850	22.50	48.05
6	600	6.990	13.30	34.07
7	700	6.990	13.30	39.75

Table 12: For Frequency F = 10,000Hz and R = 75Ω

S/N	Distance(m)	Attenuation(dB)	Power(watts)×10^{-3}	Energy(joules)×10^{-9}
1	100	2.518	104.53	44.62
2	200	3.872	56.03	47.85
3	300	5.229	30.00	38.43
4	400	6.198	19.20	32.79
5	500	6.990	13.30	28.39
6	600	7.959	8.54	21.85

7	700	9.208	4.80	14.34

Table 13: For Frequency F = 50Hz and R = 50Ω

S/N	Distance(m)	Attenuation(dB)	Power(watts)×10^{-3}	Energy(joules)×10^{-9}
1	200	3.768	88.20	75.32
2	300	5.229	45.00	57.65
3	400	6.198	28.80	49.19
4	500	6.990	20.00	42.70
5	600	7.959	12.82	32.79
6	700	7.959	12.80	38.25

Table 14: For Frequency F = 100Hz and R = 50Ω

S/N	Distance(m)	Attenuation(dB)	Power(watts)×10^{-3}	Energy(joules)×10^{-9}
1	200	3.979	80.00	68.32
2	300	5.229	45.00	57.65
3	400	5.686	36.50	62.34
4	500	6.990	20.00	42.70
5	600	7.959	12.82	32.79
6	700	7.959	12.80	38.25

Table 15: For Frequency F = 500Hz and R = 50Ω

S/N	Distance(m)	Attenuation(dB)	Power(watts)×10^{-3}	Energy(joules)×10^{-9}
1	200	3.010	80.00	68.32
2	300	4.949	51.20	65.59
3	400	5.686	36.50	62.34
4	500	6.576	24.20	51.67
5	600	7.959	12.82	32.79
6	700	7.959	12.80	38.25

Table 16: For Frequency F = 1,000Hz and R = 50Ω

S/N	Distance(m)	Attenuation(dB)	Power(watts)×10^{-3}	Energy(joules)×10^{-9}
1	200	4.437	64.80	55.33
2	300	5.229	45.00	57.65
3	400	6.778	22.05	37.66
4	500	7.696	14.45	30.85
5	600	9.208	7.20	18.44
6	700	9.208	7.20	21.52

Table 17: For Frequency F = 10,000Hz and R = 50Ω

S/N	Distance(m)	Attenuation(dB)	Power(watts)×10^{-3}	Energy(joules)×10^{-9}
1	200	5.850	33.80	28.86
2	300	8.539	9.80	10.25
3	400	8.539	9.80	16.74
4	500	9.208	7.20	15.37
5	600	10.000	5.00	12.81
6	700	10.969	3.20	9.56

Table 18: For Frequency F = 50Hz and R = 10kΩ

S/N	Distance(m)	Attenuation(dB)	Power(watts)×10^{-3}	Energy(joules)×10^{-9}
1	200	0.000	2.50	21.35
2	300	0.177	2.30	29.45
3	400	0.177	2.30	39.28
4	500	0.177	2.30	49.11
5	600	0.177	2.30	58.92
6	700	0.177	2.30	68.75

Table 19: For Frequency F = 100Hz and R = 10kΩ

S/N	Distance(m)	Attenuation(dB)	Power(watts)×10^{-3}	Energy(joules)×10^{-9}
1	200	0.000	2.50	21.35
2	300	0.088	2.40	30.74
3	400	0.177	2.30	39.28
4	500	0.177	2.30	49.11
5	600	0.177	2.30	58.92
6	700	0.177	2.40	68.75

Table 20: For Frequency F = 500Hz and R = 10kΩ

S/N	Distance(m)	Attenuation(dB)	Power(watts)$\times 10^{-3}$	Energy(joules)$\times 10^{-9}$
1	200	0.000	2.50	21.35
2	300	0.177	2.30	29.46
3	400	0.177	2.30	39.28
4	500	0.177	2.30	49.11
5	600	0.177	2.30	58.92
6	700	0.177	2.30	68.75

Table 21: For Frequency F = 1,000Hz and R = 10kΩ

S/N	Distance(m)	Attenuation(dB)	Power(watts)$\times 10^{-3}$	Energy(joules)$\times 10^{-9}$
1	200	0.555	1.94	16.57
2	300	0.088	2.40	30.74
3	400	0.268	2.40	37.58
4	500	0.088	2.40	51.24
5	600	0.088	2.40	61.49
6	700	0.088	2.40	71.74

Table 22: For Frequency F = 10,000Hz and R = 10kΩ

S/N	Distance(m)	Attenuation(dB)	Power(watts)$\times 10^{-3}$	Energy(joules)$\times 10^{-9}$
1	200	-0.128	2.65	22.63
2	300	-0.170	2.70	34.59
3	400	-0.253	2.81	42.87
4	500	0.269	2.21	47.18
5	600	0.555	1.94	49.70
6	700	0.969	1.60	45.43

Table 23: For Distance D = 200m and R = 75Ω

S/N	Frequency (Hz)	Attenuation(dB)	Power(watts)$\times 10^{-3}$	Energy(joules)$\times 10^{-9}$
1	50	2.840	90.13	76.97
2	100	2.840	90.13	76.97
3	500	3.010	83.30	90.31
4	1000	3.188	76.80	65.59
5	10000	3.872	56.03	47.85

Table 24: For Distance D = 700m and R = 75Ω

S/N	Frequency (Hz)	Attenuation(dB)	Power(watts)$\times 10^{-3}$	Energy(joules)$\times 10^{-9}$
1	50	6.198	19.20	57.38
2	100	6.198	19.20	57.38
3	500	6.198	19.20	57.38
4	1000	6.990	13.30	39.75
5	10000	9.208	4.80	14.34

Table 25: For Distance D = 200m and R = 50Ω

S/N	Frequency (Hz)	Attenuation(dB)	Power(watts)$\times 10^{-3}$	Energy(joules)$\times 10^{-9}$
1	50	3.768	88.20	75.32
2	100	3.979	80.00	68.32
3	500	3.010	80.00	68.32
4	1000	4.437	64.80	55.33
5	10000	5.850	33.80	28.80

Table 26: For Distance D = 700m and R = 50Ω

S/N	Frequency (Hz)	Attenuation(dB)	Power(watts)$\times 10^{-3}$	Energy(joules)$\times 10^{-9}$
1	50	7.959	12.80	38.25
2	100	7.959	12.80	38.25
3	500	7.959	12.80	38.25
4	1000	9.208	7.20	21.52
5	10000	10.969	3.20	9.56

Table 27: For Distance D = 200m and R = 10kΩ

S/N	Frequency (Hz)	Attenuation(dB)	Power(watts)$\times 10^{-3}$	Energy(joules)$\times 10^{-9}$
1	50	0.000	2.50	21.35
2	100	0.000	2.50	21.35
3	500	0.000	2.50	21.35
4	1000	0.555	1.94	16.59
5	10000	0.969	1.60	45.43

Table 28: For Distance D = 700m and R = 10kΩ

S/N	Frequency (Hz)	Attenuation(dB)	Power(watts)×10^{-3}	Energy(joules)×10^{-9}
1	50	0.177	2.30	68.75
2	100	0.177	2.40	68.75
3	500	0.177	2.30	68.75
4	1000	0.088	2.40	71.74
5	10000	0.969	1.60	45.43

Tables 8-28 shows the variations of the three properties, i.e. attenuation energy and power with distance and frequency for each load resistor i.e. 75Ω, 50Ω and 10kΩ.For the variation of the properties with distance, two graphs are drawn for each load at F = 100Hz and F = 10,000Hz. For the variation with frequency, two graphs are also drawn for each load at D = 200m and 700m.

The graph of figures 1-6 shows for 50 and 75ohms loading an increase in attenuation with distance which shows that the signal strength is lost as the signal propagates along the line. The transmitted power decreases with distance as seen from the graph. Comparing the two graphs, it shows that the general trend suggests a decrease in power with distance. With the exception of distance 100m and 200m where there is an increase in energy for both 100Hz and 10,000Hz, energy decreases with distance. The trend taken by both graphs shows a decrease in the energy along the line. For 10kΩ loading, the graphs show very low attenuation values compared to the 50Ω and 75Ω resistance. There is no regular trend in the attenuation of the signal with distance. At 10,000Hz, negative values of attenuation are observed which is unrealistic. The power variation with distance as observed from the graphs is not regular and the graphs show an increase in energy with the exception of the 700m for 10,000Hz.

The graph of figures 7-12 shows the variation of the calculated properties i.e. attenuation, power and energy with frequency at 200m and 700 respectively. For 50 and 75Ω loading, there is an increase in attenuation after a constant value between 50Hz and 500Hz. The trend of the graphs shows an increase of attenuation with frequency. With the exception of 700m at frequencies between 50Hz and 500Hz, there is a decrease in power after a constant value in power with increase in frequency, and Energy follows the same pattern as power. The trend of the graphs suggests a decrease in energy with frequency. For 10KΩ loading graphs 12(a) and 12(b) show the variation of the properties with frequency for 10kΩ at 200m and 700m respectively. The two graphs give different trends for the attenuation at high frequencies an indication that the trend for various distances cannot be uniform. The two graphs show that power variation with frequency does not follow the same trend, while the trend the variation takes with frequency can also be seen not be uniform at various distances.

IV. Conclusion

The transmission of signal in terms of transmitted power, energy and attenuation varies with change in distance and frequency. Transmitted power and energy decrease with increase in distance and frequency at a loading of 50Ω and 75Ω resistors. The use of 10kΩ resistor does not follow the trend, it varies randomly. Attenuation increases with increase in distance and frequency at a loading of 50Ω and 75Ω resistors while the use of 10kΩ (very high loading) resistor changes trend and follows a non-uniform trend. The non-uniformity of the various variations (when the 10kΩ was used) might be caused due to a wrong impedance matching which mostly tend to a backward reflection of the generated signal thereby sitting up an interference pattern known as Standing Wave. Thus, in the transmission of signal, it is recommended to use an appropriate impedance matching as this can affects the transmission of signal in terms of the transmitted power, energy and attenuation with changes in distance and frequency.

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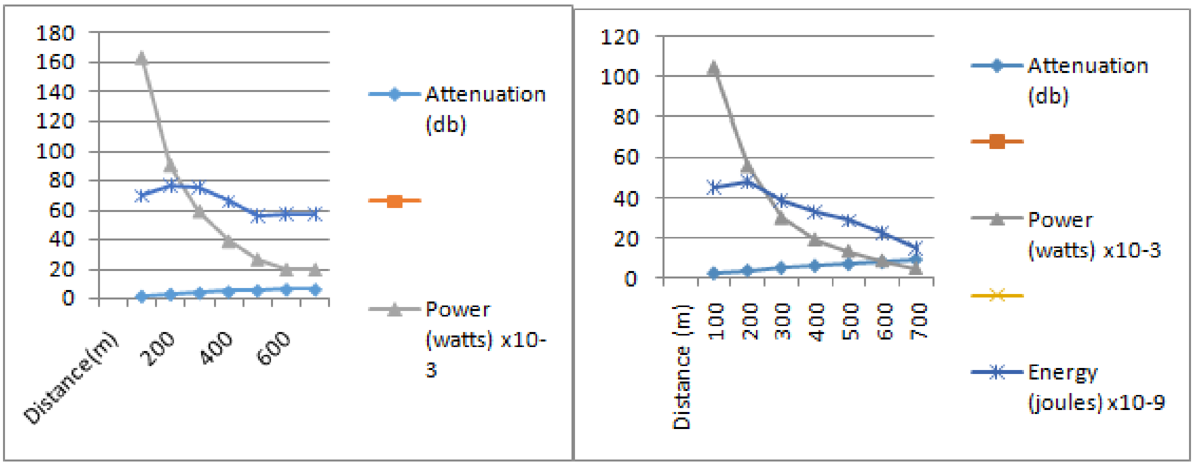

Figure 3: Power, Energy and Attenuation against Distance at a). 100Hz and b). 10 KHz FOR 75 ohms loading.

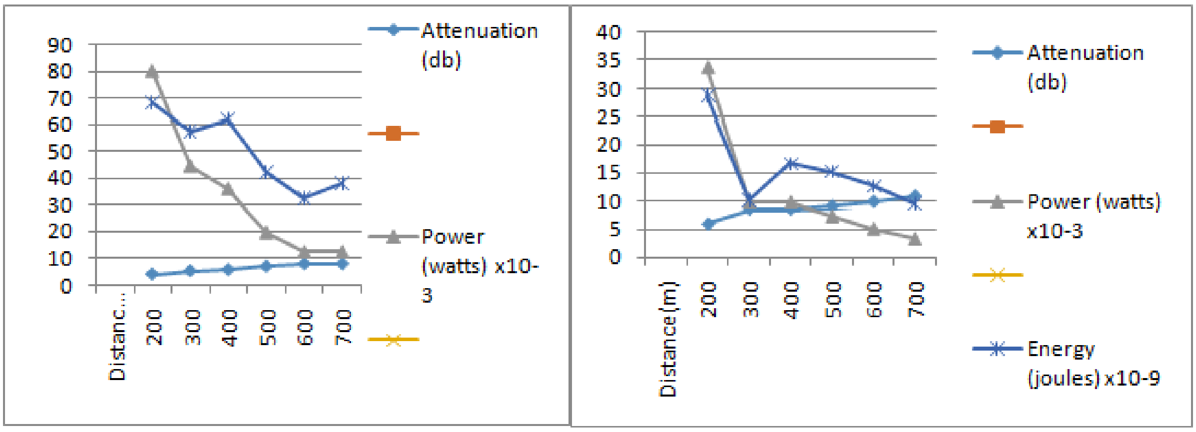

Figure 4: Power, Energy and Attenuation against Distance at a). 100Hz and b). 10 KHz FOR 50 ohms loading.

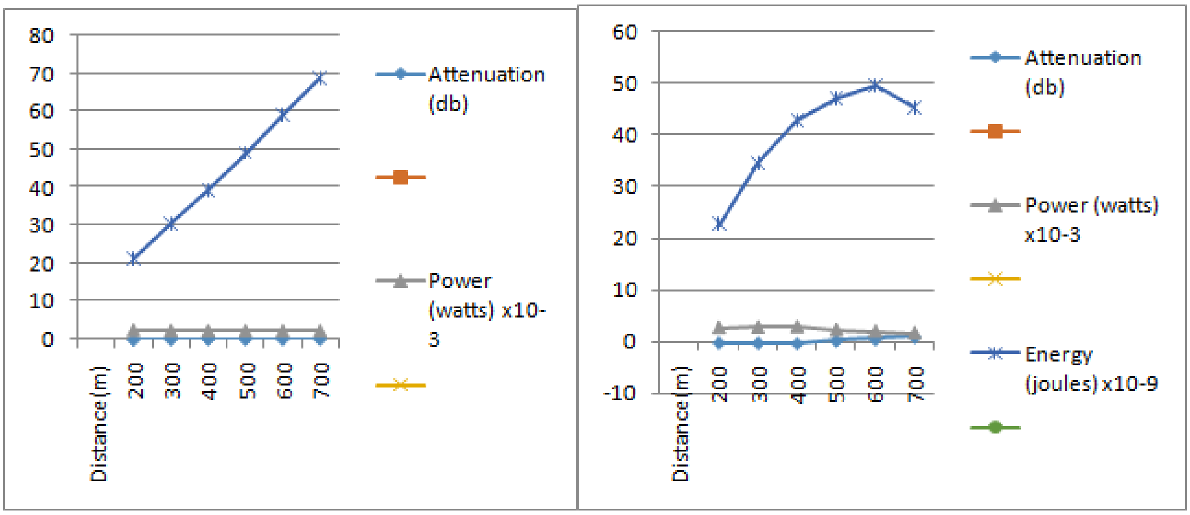

Figure 5: Power, Energy and Attenuation against Distance at a). 100Hz and b). 10 KHz FOR 10kohms loading.

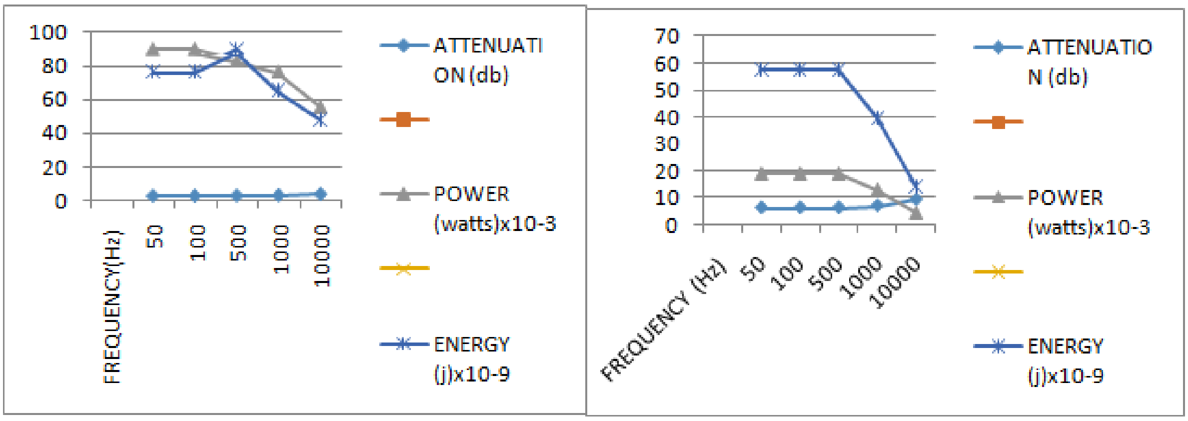

Figure 6: Power, Energy and Attenuation against Frequency at a). 200m and b). 700m for 75 ohms loading.

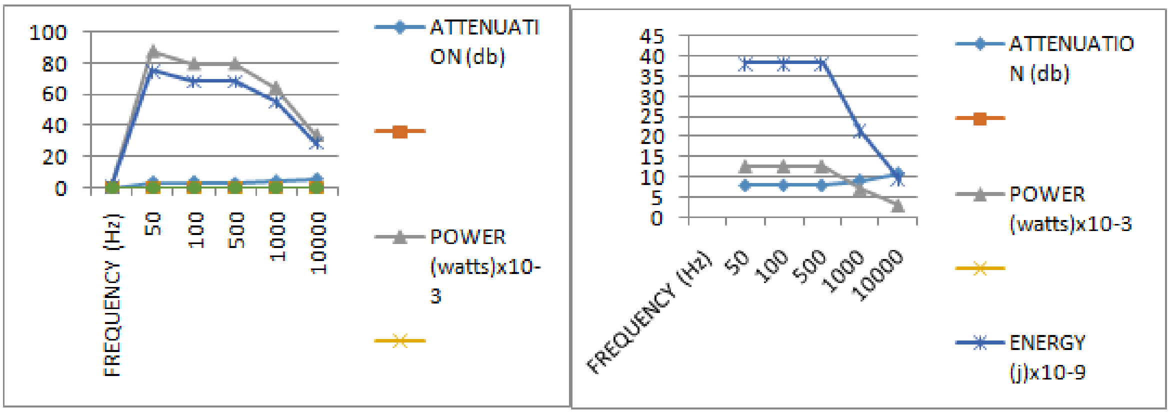

Figure 7: Power, Energy and Attenuation against Frequency at a). 200m and b). 700m for 100 ohms loading.

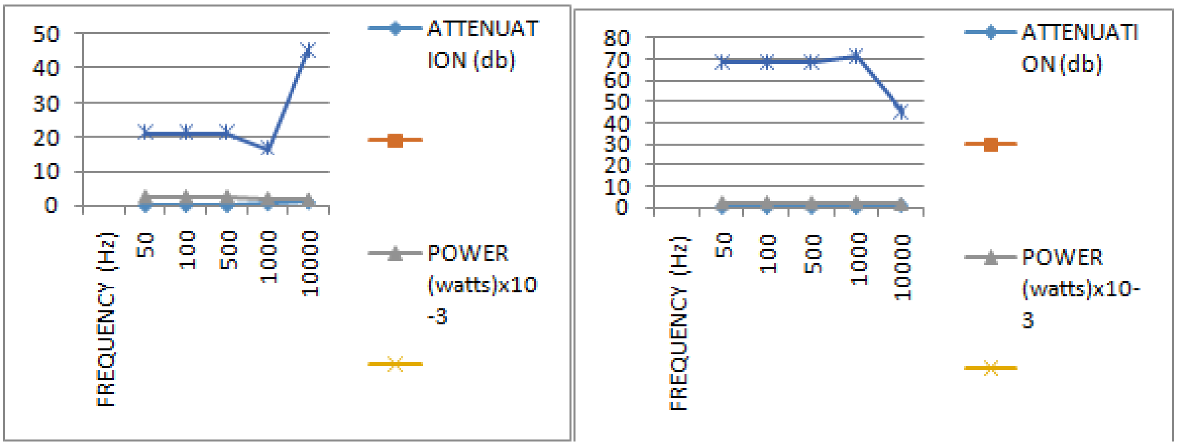

Figure 8: Power, Energy and Attenuation against Frequency at a). 200m and b). 700m for10kohmsloading.