COMPUTERIZATION OF THE CALCULATION OF POWER OUTPUT OF AN AMPLITUDE MODULATION TRANSMITTER OF RADIO NIGERIA, KADUNA

By

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FOR THE PARTIAL FULFILMENT OF THE AWARD OF POST-GRADUATE DIPLOMA IN COMPUTER SCIENCE

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MARCH 2000

CERTIFICATION

This project work has been read and certified by the undersigned as meeting the requirements of the department of mathematics/computer Science, Federal University of Technology, Minna.

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Mallam Isa Audu
Project Supervisor

Date

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Dr. S. A. Reju
Head of Department

Date

....

External Examiner

Date

DEDICATION

I wish to dedicate this Project Write-up to my just born baby, NAIMA.

ABSTRACT

Radio Broadcasting is done by sending the signal in air through electronic transmitter. The audio signal is normally originated from the Studios. This signal is called the modulating. The transmitter generate the carrier frequency. The marriage of the two signal is called Modulation.

There are many types of Modulation. But for this write up. Amplitude Modulation was chosen.

The Power out of an Amplitude Modulation is given by:

Ec Cos Wct + 1/2 Ma Cos (Wct + Wmt) + 1/2 Ma Cos (Wet - Wmt)

So the Programme was written in BASIC Language.

The Case Study was Radio Nigeria - Kaduna.

ACKNOWLEDGEMENT

I wish to acknowledge the effort of my Supervisor, Mallam Isa Audu who has been tirelessly attending to me at any time I called on him.

The Co-ordinator of the Programme Mr. Ezokor and all Lecturers of Maths and Computer Science Department is highly acknowledged.

My Colleagues in the office and during the Programme can not be left out.

Back home, my wife Hadiza helped to keep me comfortable and gave me a lot of courage can be over-emphasized.

Mr. Gani Olomi Suleiman of Federal Radio Corporation of Nigeria (Headquarters) who helped to produce the Project Write-up has to be remembered.

Thanks be to Allah (SWA) for the Grace He gave me to go through the Programme.

CHAPTER ONE

GENERAL INTRODUCTION

1.0 INTRODUCTION TO THE PROJECT

Computer which is defined as an electronic device which accepts and processes data by following a set of instructions (PROGRAM) to produce an accurate and efficient result (information), is increasingly becoming indispensable. Many tasks at home and in he office that were hitherto executed manually are being automated at a very fast pace. Thus, it is becoming apparent that in whatever discipline of study or nature of employment, the computer is now an important tool for efficiency improvement and precision of job or task execution. It is in a wake of this that the need for computerization of calculating the power output of the amplitude modulation (AM Transmitter of Radio Nigeria, Kaduna was conceived in the course of writing this project for the fulfilment of the award of Post Graduate Diploma in Computer Science.

The Project was designed to calculate the power output of amplitude modulation transmitters of Radio Nigeria, Kaduna which served as a case study. Though, it could be applied to any transmitter of similar output.

1.1 HISTORICAL BACKGROUND OF THE CASE STUDY

The emergence of Radio Nigeria Television Kaduna or the Broadcasting Company of Northern Nigeria in 1962 was not accidental, the idea to establish the Company was mooted as far back as 1957, when the discussion in Nigeria Independence was going in throughout the length and breath of the country. However, the need had never been so desirable, then when the Independence date could not be agreed upon between the southern and the Northern ~~regime~~ regions. The North had objected to 1957 Independence year for Nigeria and the Southern ~~regime~~ region that was Eastern and Western ~~regime~~ region did not take the objection kindly. Therefore, they mounted vigorous campaigns through the Southern based media against the Northern stand on Independence. Naturally because of their origin and base, the Southern Media did not give fair representations to the Northern view point. That is, to say, the date for Independence to be shifted forward to allow for adequate preparation for self-government. It was at this point the late Premier of then Northern region, Sir Ahmadu Bello, Sardauna of Sokoto and most of his colleagues saw the need for a Northern based medium of information dissemination.

They were convinced that only the existence of such medium could help to make information available to the generality of the people about the Northern ~~Regime~~ region.

Sardauna also believed that if the medium had existed the misunderstanding generated by the Southern Media about the stand of the North on independence could have been avoided.

The Station took the air on the 5th of March, 1962 and subsequently gained the popularity, perhaps never before known in this part of the world. It signal the birth of Radio Television Kaduna also known as the Broadcasting Company of Northern Nigeria, BCCNN. Over the years of its existence, the Station has gone through various changes in ownership, and even name. It began as Radio Television Kaduna or the Broadcasting Company of Northern Nigeria, BCCNN on the 15th of March, 1962 and today, the Station is referred to as Radio Nigeria, Kaduna or Federal Radio Corporation of Nigeria, Kaduna. This change in name and ownership came as a result of previous government policies to take over all the regional government properties. Now, Radio Nigeria, Kaduna is one of five (5) Federal Radio Stations in the Country. They are also referred to as National Stations, namely, Radio Nigeria Lagos located in lagos transmitting in Frequency modulation (FM), Medium Wave 1608KHz and Short Wave (SW) 3326KHz. Radio Nigeria, Ibadan located in Ibadan city, transmitting Short Wave (SW) 6050KHz. Likewise, Radio Nigeria Enugu located in Enugu. That Station like others transmits on FM, Medium Wave and

Short Wave 6025KHz. and Radio Nigeria, Gwagwalada which as of now transmits on only Medium Wave (MW) on 909KHz. To oversee the affairs of the National Stations is the Headquarters which serves as the Central Governing Body to all the National Stations. The Headquarters has her own four air time for news bulletin called Network News Half Hour. These are on air for thirty (30) minutes as the name suggested. To be precise, they come on at seven o'clock in the morning, four o'clock in the afternoon, seven o'clock in the evening and the last comes on at ten o'clock in the night. On Saturdays, eight o'clock in the morning, there is a Network Program called "Radio-Link". The program is a phone-in program. That is, the public will be contributing to a live discussion that may be going on in the Studios.

One can not completely discuss the operation of the Headquarters of Radio Nigeria without mentioning her Network Service to the nation. The earlier mentioned news time and the ~~programs~~ Programmes are all network services. The news are read or generated in case of the ~~program~~ Programme in network studio of the Headquarters which are now located at Garki-Abuja where myself serve as an Engineer. Through an arrangement best known to the Engineers, the Management, and the National Stations mentioned above. In addition to the listed news time and the ~~program~~ Programme, the Headquarters also has a political program called "Platform". This

Program enable the politicians to give their views on a burning issue. Though the program is a recorded one. It comes on air thrice in a week. At the request of the Government, the Headquarters do go for outside broadcasting. Which is also a network services. An instance can be sighted with the just concluded 21st ECOWAS submit that took place here in Abuja from 30th to 31st October, 1998. The occasion was aired live by Radio Nigeria on her Network Service. In this case, the network Engineers will be at scene with arrangement available which need not to be discussed in this project write-up, the signal is sent to all the National Stations who will then transmit in their various frequencies and frequency bands simultaneously as the occasion is in progress.

The transfer of ownership of Radio Nigeria, Kaduna to the Federal Government and based on its location in the Northern part of the country, the Station maintained its status of propagating Federal Government policies and ~~programs~~ Programmes to the Northerners. Serves for passing Federal Government information and directives and other related matters.

1.2 OBJECTIVES OF ESTABLISHING RADIO NIGERIA, KADUNA

The initiator of the Station, Sir Ahmadu Bello, Sardauna of sokoto who was very much concerned about how

level of education in the North, gave the Station adequate priority for educating programmes.

At the time of inception in 1962, the Station opens at five o'clock in the evening and close at 11 o'clock. The early programmes were Northern based depicting traditions and culture of the people, broadcast news with three times a day in Hausa and English with two main bulletins and one summary in both languages as opposed to nineteen different news broadcast daily in the two languages today. Though some languages have slots of air time. These languages are Fulfulide, Nupe, Kanuri, depending on the situation at hand. To mention few of the English Programs:-

1. Islamic Prayers
2. The Light of Islam
3. Islam and Society
4. Juma'at Talk
5. Christian Prayers
6. Christianity Explained
7. Calling all Christians
8. Christian Songs of Praise
9. Feminine Forum
10. Your Healthy Child
11. Radio Doctor
12. Youth Rendezvores
13. Platform
14. Personality Profile
15. Guest of the Week
16. Music Safari
17. Junior Request
18. Campus Line
19. Brain Trust
20. Young Minds
21. Times to Remember
22. People and Event
23. Green Pasture
24. Science World
25. From our Archives
26. Sporting World

27. Cookery Time
28. Play House
29. Humour Time
30. Forum
31. Topic

While the news are:-

1. Network News Half-Hour
2. News Nationwide; and
3. Newscope

The Hausa service has the following programs:-

1. Adduar Bade Tasha
2. Adduar Kirista
3. Pabiri Sa'ar Kirista
4. Musulienci Ke kira
5. Hasken Musulienci
6. Sallar Juma'a
7. Yara Manyan Gobe
8. Film Umargida
9. Harira Kaciya
10. Maigida Barka da Rana
11. Sinadari
12. Barka da yau
13. Bakun Muna Mako
14. Duniyarmu a yau
15. Jiya ba yau ba
16. Jakar Magori
17. Kiwon Lafiya
18. Labarin Wasanni
19. Jagorar Manona
20. Jigon Manoma
21. Ba Maraya Sai Rago
22. Zabar Safe
23. Zabar Dare
24. Zabar Sonka
25. Lokacin Raha
26. Kunen Kanawa
27. Mu Tattauna
28. Kaciya
29. Kacici Kacici
30. Wasa Kwakaualwa
31. Halittan gida dana deji
32. Mulika Rugage
33. Sharhin Labarae
34. Duniya Budurwar Wawa
35. Samanja Maza Fama

And the news in Hausa comes at the news bulletin called Labarun Duniya.

The Program Schedule was done in quarterly bases, that is for every three (3) months. The ~~Programs~~ Programmes, are designed to serve, entertain and educate the Northerners. Though the Hausa ~~Program~~ Programme extend her services to the neighboring countries like Chad, Niger, Togo, Ghana and Benin Republic whom has a portion of their population speak Hausa.

In the early period of existence of the Station, it was depending on the Ministry of Information for stories about Government activities, its Ministers, Departments and their Chief Executives. at the local level, the Native Authority Information Departments were of great assistance to the Station for ~~Program~~ Programme gathering. later on as records indicated, the Station made use of freelance correspondents and those from Zaira, Jos, Kabba were forthcoming, with the reports on regular bases. In addition, letters were sent to embassies of over sixty countries in Nigeria requesting them to send reports to the Station. From the initial six hour daily broadcast in March, 1962, and adequate experience soon gave way to commitment of purpose and determination to bridge the information gap that had existed in the North. The initial dependence of the Station on Ministerial handout could not continue for too long as its pool of reporters

were out to fish for information themselves. Today, the Station has Correspondent in each State of the Federation where they gather their news and send to the Station at Kaduna via telephone. Some of the experienced Correspondents do relay their news live from the States to the Station.

1.3 ORGANIZATIONAL STRUCTURE

At the time the Station took off air in 1962, it had a total of sixty-three (63) Staff against Five Thousand Two Hundred and Eighteen (5,218) as at August 1998 pay day. The initial Staff Strength of sixty three (63) comprising fifty Nigerians and Thirteen Foreigners. The first Managing Director was Mr. Lesley A. W. Diamond, a Britain who stayed on until 1965. Alhaji Dodo Mustapha was seconded from the defunct Post and Telecommunication and took over as Managing Director that same year. The Station had three departments. Namely: Administration, News Department and Technical Services. Record showed that the News served a dual purpose. That is, it was the Administration as well maintain her status as News. That left the Station with only two Departments. In another era, the Technical Services took over the Management of the Station equally leaving the Station with only two Departments. But today, the Federal Radio Corporation, Kaduna as it is officially known has about seven (7) Departments. The Station is headed by an Executive

Director in person of Engr. Mohammadu Ardo. Each of the Departments is headed by a duty Director while each of the corresponding Department is headed by a Director in the Headquarters. One can not separate the National Stations from the Headquarters while discussing them. As each Department is directly under a corresponding Department in the Headquarters.

The Technical Services as it is called is headed by a Deputy Director. To assist him are two Assistant Directors. The Department is divided into two where we have the Studio Section and the Transmitter Section. The Transmitter's Assistant Director, has a number of transmitters in his charge. There are Frequency Modulation (FM), which transmit in Ninety-Two Point Five Mega Hertz (92.5MHz). The power out of the transmitter is Ten Kilowatts (10kw). The computerization has not affected this transmitter. As its power out put is fixed, being that there is no need to change the frequency of transmission either in the day time or at night. In case of the Medium Wave which has only a transmitter for this service. The computerization service is not extended to this too. Though its mode of modulation fall within amplitude modulation. But there is no need to compute its power output as the frequency of the carrier is fixed right from the start.

The main transmitters of concern are the Short Wave Transmitters. We have Short Wave for Hausa Service as well for English Service. The carrier frequencies are determined by the position of the sum which in turn determine the ionosphere layers. The ionosphere is divided into A-layer, B-layer, C-layer, D-layer and E-layer. The five layers exist in the day time which force Technical Officers to use higher frequencies to enable them achieve good reception. While later in the evening, A and B disappear leaving C, D and E layers. And in the night only D and E exist. at this time, lower frequencies are used for Short Wave transmission. There is no need to derive into the principle of wave propagation in the ionosphere in this Project write-up. so in case of Radio Nigeria, Kaduna, the short Wave Transmitters which are six in number at different power output. As earlier mentioned, Radio Nigeria, Kaduna has been divided into two. Each has three (3) Short Wave Transmitters. These are the Hausa and English Services. On each side, is a Two Hundred and Fifty Kilo-Watts (250kw), One Hundred and Fifty Kilo-Watts (150kw) and One Hundred Kilo-Watts (100kw). The listed transmitters are those due for computerization.

Attached is the organizational Chart of Radio Nigeria, Kaduna:-

radio signal to travel long distance and transmitters up to 500kw (five hundred) Kolo Watts). for Radio Nigeria, Kaduna, there are only three (3) short Wave (SW) Transmitters.

1.5 SCOPE AND LIMITATION OF THE STUDY

Undoubtedly, the power output of an Amplitude Modulated transmitter remained the most important thing to radio broadcasting engineers and the listeners in general. The power output of the transmitter determines the area of coverage of the Station (Radio station). Likewise, the strength of the signal at the listeners' end is determined by the power output. The higher the output of the transmitter, the larger its area of coverage. Reverse is the case when the power output is reduced.

The rate of each transmitter in radio broadcasting is maximum when it is new. But it diminished with age of the transmitter and being that it a thing of concern to the owners of Station and the listeners, the engineers has to know the rate almost every day in order to know whether they are meeting their target which are the listeners at home or not. If the power output is not to maximum, all what is needed to compensate is by changing the angle of firing. The change could be positive or negative depending on the field report on which the Station has been getting from the signal strength taste

that has been carried.

1.6 PROBLEM DEFINITION

When a problem exists in a particular system and this problem has to be removed, then there is the need to clearly define the motive of the problem. Problem definition allows for re-evaluation of the existing problem in the old system to find out if it is real or imaginary, major or minor and how urgent to alleviate the problem.

Considering the manual system of calculating the power output of an Amplitude Modulation Transmitter by using electronic calculator or logrithem four figure table at Radio Nigeria, Kaduna and other similar Stations. Accurate result is not possible due abbreviation of figures, human errors. Computerization of the calculation has been found most suitable.

The power output which may be directed by

$$\text{Point} = Ec\ \text{Cos}Wct + \frac{Ma}{2}Ec\text{Cos}(Wm+Wc) + \frac{Ma}{2}Ec\text{Cos}(Wc-Wm)t$$

Where Ec is the amplitude of carrier signal, Ma is the depth of Modulation, Wm is the angular frequency of the Modulating signal, Wc is the angular frequency of the carrier signal and t is the time taken.

With these at hand, the computer as we know can not accept the formula unless a program is prepared for it which is the main effort of this project write. And it is

the power output of the transmitter that is of great importance to all Radio broadcasters. It is that final consumers take or receive with their radio sets.

As earlier stated above, the method is found to be highly inefficient. In the cause of defining the problem, computerized calculation was found to be reliable and more valid as it gives result very fast. Unlike the former which takes to two or three days to have a result which may lead to missing the targeted transmission day.

CHAPTER TWO

2.0 RESEARCH METHODOLOGY SYSTEM

GENERAL IMPLEMENTATION AND REQUIREMENT

2.1 ROLE OF COMPUTER IN THE CASE STUDY

What is a Computer? A Computer is a machine that follows instructions in order to process data, solve a specific problem or accomplish a particular task. The instruction that controls a computer when it perform a task is referred to as a program. A collection of programs that are made to work together for a specific purpose is called software.

The role of computer in the study includes the following:-

a) Increased productivity. It is one of the reasons why we use computers in the first place, to get things done faster and better. Unfortunately, sitting down in front of a computer does not automatically make one more productive. One must learn how to use the computer before it can help to improve ones output.

b) Rapid and Accurate calculation - Every one nowadays is aware of the benefit of using an electronic calculator to speed up complex calculations. The computer is even faster and move

efficient at doing lengthy or complex analysis on data in a very short time. Once the procedures are specifically designed, and appropriate data is fed, rapid processing and accurate output is guaranteed.

c) Reliability: Computer systems are particularly perfectly suited to repetitive tasks.

d) Storage of data: Large amounts of information may be stored on a computer (or one disks which can be inserted into the computer like a tape cartridge) in a manageable form.

e) Memory Capability: Computer systems have total and instant recall of data. That is to say computer is no forgetfulness.

f) Data Analysis: Once information has been entered into a Computer, one can ask for summaries and breakdowns of this information expressed in a way one likes. This aspect is particularly necessary when comparing transaction value(s) of 'similar' or identical operations.

g) Transfer of Data: A Computer can provide data for other Computers. For example, the transfer of angle of firing or the power at which transmitter is operating on the given sun sport period in a digital (i.e. Computer - held) format over telephone lines from Radio Nigeria, Kaduna to other national Stations in Enugu, Ibadan and Abuja.

All the above Computer system capabilities are necessary to aid the Computer to give out the best power output of a transmitter at a needed time.

2.2 METHOD OF INVESTIGATION

The fact finding technique employed in this study is the library research in Radio Nigeria, Kaduna, the course handout from the institute for African Communicators in Cairo-Egypt.

The library is the storehouse of knowledge and wisdom which have accumulated since the beginning of time. Radio Nigeria, Kaduna started transmission in 1962.

In a general sense, whatever is ~~with~~ worth knowing is probably recorded in one of the volumes in the library.

The method used in gathering information in this study is record searching. The main purpose of a record search is to establish quantitative information - volumes, frequencies, trends, ratios. It will also help to establish how much reliance can be put on the data source gathered.

2.3 GENERAL IMPLEMENTATION REVIEW

SYSTEM IMPLEMENTATION AND REQUIREMENT

System implementation is the stage of system development when the conceptual requirement of the new system and the overall objectives are to be transferred into physical reality. This stage is very important

because it is the most crucial stage in achieving a successful new system in giving the users confidence that the new system will work and be effective.

However, the system requirement has to do with the hardware configuration needed for the proposed system. a computer configuration is a collection of hardware which forms a complete computer system.

The choice of the computer configuration is done to suite both the current and the future needs of the organization with respect to the volume and types of data to be processed. In summary, a computer system with the following minimum requirement is required.

- Pentuim 166MHz
- 16MB RAM
- 2.1 GB HDD
- 4.44MB FDD
- Microsoft Mouse and PAD
- Un-interrupted power supply (MPS)
- Stabilizer
- Colour Monitor and Printer Epson LQ2070.

2.4 SYSTEM INSTALLATION AND TESTING

System Installation is the process of transferring the designed system into the computer system. To install the software package is as follows:-

i) Insert the External storage Device Floppy disk containing the source program into the desired drive (A).

ii) Change the Default Drive to A by typing:-

C:>A:

It is important to note that there is a batch program written that will copy all the necessary BASIC file and text file into the necessary directory.

Once the installation is completed, the application diskette should be put in safe place for future need.

However, system testing is often seen as a means of establishing that a program is error free and that is does what is required. This is a very dangerous point of view.

It is virtually impossible to test a program so thoroughly that it can be claimed to free of errors. In most cases, fixing one error gives rise to a host of others which in turn have to be corrected and exhaustively tested. It is much more realistic to think of testing a "process of finding errors.

When a stage is reached when the program appears to run perfectly, this does not mean that there are no more errors in the program, it simply means that those errors have not been discovered.

Hence, therefore, the system developed has been fully test run and found to be error free for now.

2.5 SYSTEM CONVERSION/HAND OVER

Once all the planned testing procedures have been completed satisfactorily, the system can be handed over and changeover from the old to the new to the new system put into effect. Though the old as earlier stated was a manual that was by using logarithm table and human brain. So the change over will not be difficult. In alternative, there are several ways of carrying out the change over, the method chosen depends on such factors as the type of system that is being installed with preference to the establishment involved.

The change over, will require careful planning on the part of both the developer and the organization to ensure maximum efficiency and minimum disruption to the normal working of the concerned organization.

The following are the various types of change over that is common:-

a) Direct Change over (CUTOVER)

b) Parallel change over (Parallel Running)

c) Pilot Change over

d) Phased changeover (Staged Change Over)

Given the above four methods of change over, phased change over is chosen for thus system because of the following reasons:-

i) The system is installed gradually so that the concerned organization, that is, Radio Nigeria, Kaduna can be accustomed to one area of the system.

ii) In phased change over, part of the system can be (and often is) installed before the rest of the system has been completed. This gives the opportunity of valuable feed back from the users while the system is being developed. It also takes some of the pressure off the developer since small parts of the system can be delivered when they are ready without waiting for completion of the whole system.

2.6 COST BENEFIT ANALYSIS

This involves the total cost that will be needed to put the whole system in place, that is needed for the computation of power output of an amplitude modulation transmission of Radio Nigeria, Kaduna.

APPENDIX I

S/NO	DESCRIPTION OF SYSTEM COMPONENTS	QTY.	UNIT COST(#)	TOTAL COST(#)
1.	A COMPLETE SYSTEM WITH THE FOLLOWING:			
	(a) SPEED - PENTIUM 166 MHz (b) RAM - 16 MB (c) HARD DISK - 2.1GB HDD (d) FLOPPY DISK - 1.4 MB FDD	1	85,000	85,000
2.	EPSON PRINTER LG 2070	1	65,000	65,000
3.	LASER JET PRINTER (HP LASERJET 6C)	1	45,000	45,000
4.	INSTALLATION OF APPLICATION PACKAGES		25,000	25,000

TOTAL AMOUNT = 220,000.00

APPENDIX II

S/NO	DESCRIPTION	AMOUNT(#)
1.	SYSTEM ANALYSIS AND DESIGN OF THE PROPOSED SYSTEM	40,000.00
2.	PROGRAMMING AND IMPLEMENTATION	20,000.00
3.	TRAINING OF AT LEAST, FIVE (5) KEY OFFICERS	50,000.00
		110,000.00
TOTAL COST ON APPENDIX I AND II		330,000.00

To put the proposed system in place, a total of three hundred and thirty thousand naira only is needed as the cost of implementation.

CHAPTER THREE

3.1 INTRODUCTION

It shows us how Modulation can be achieved in different ways, how the wave to be modulated is generated, the different types of waves that can be generated and subsequently how the formula for an amplitude modulation is arrived at.

3.2 CONCEPT OF COMMUNICATION

In the early days of man's life, communication was very crude and the coverage was very limited. With the advancement in technology, electronic communication brought to halt the limitation of communication where the whole world was now turned to a global village.

The purpose of any communication system is to transmit information from one location to the other. The quality of the information received depends on the way the intelligent is transferred.

If we attempt to transmit intelligence say music, speed, picture, or coded signal. Directly at its own frequency spectrum, it may not be possible due to various problems. To start with, only one communication can be transmitted at any one time. The most important argument against transmitting signal frequencies directly; all sound is concentrated within the range from twenty Hertz

(20Hz) to twenty Kilo-Hertz (20KHz), so that all signals from different sources would be hopelessly and inseparably mixed up. In any city, say Minna, the Broadcasting Stations like Niger State Broadcasting Corporation and Nigerian Television Authority, Minna would completely blanket the air and yet they represent a very small proportion of the total number of transmitters in use. Secondly, it is extremely difficult to transmit very low frequency signals. Intelligence signal e.g. Video (Picture) signal may contain frequency components from below hundred Hertz (100Hz) to several Mega Hertzs. Not only would the efficiency of the transmission vary drastically over such a wide range but it is physically impossible to radiate energy at frequencies as low as one hundred (100Hz). In Radio or Television transmission, there must be a receiver for the people to listen or watch at consumption end. So for efficient radiation and reception, the transmitting and receiving antennas would have to have lengths comparable to a quarter-wavelength of the frequency used.

The difficulties are solved by raising the frequency band before transmission. The process by which this is done is call ed Modulation.

3.3 FUNDAMENTALS OF MODULATION

Modulation of a wave is the process by which a characteristic of a so-called "Carrier Wave" of a higher

frequency than any component of the signal is varied in accordance with time variation of the signal.

A simple introduction to the possibilities of different forms of modulation may be given by considering the ways in which radio frequency (RF) signal may be used to transmit information. A general radio frequency (RF) signal may be represented by equation.

$Rc(t) = Ec \cos (Wct + Qc).....(1)$

where Ec is the carrier amplitude, Wc is the carrier angular frequency and Qc is the phase angle of the carrier wave at t = o.

If the three quantities Ec, Wc, Qc, which specify the carrier wave, remained unaltered, then no information is communicated. That is to say modulation has not occurred. In order that some information be transmitted, the amplitude, frequency, or phase of carrier wave must be made to vary in accordance with the intelligence signal. These three possibilities are referred to as Amplitude Modulation (AM), Frequency Modulation (FM) and Phase Modulation (PM) respectively. The last two have many similarities. Both may be regarded as changing the angle (Wct + Qc), they are often taken together and called Angle Modulation.

Other types of Modulation can be developed by starting using different forms of carrier signal in place of the simple continuous wave. One such carrier consist

of a train of rectangular pulses of equal amplitude and durations, and occurring at a constant repetition frequency. Modulation can be applied in a number of ways. For example, by altering the amplitude of the pulse (Pulse amplitude Modulation (PDM), altering the repetition of frequency of the pulse (Pulse Frequency Modulation (Pfm) or altering the time of occurrence of each pulse relative to a mean position (Pulse Position Modulation (PPm). The combination of the train of pulse with a coding technique leads to Pulse Code Modulation (PCM).

3.4 PRINCIPLE OF AMPLITUDE MODULATION

This type of Modulation which is the main concern of this project write-up. It is a process in which amplitude of the carrier signal is made to vary in accordance with the modulating signal. It is the most applied mode of modulation in radio, television and telecommunication transmission.

The Radio Frequency (RF) used as a vehicle for carrying the intelligence is called the carrier. The carriers used frequencies within internationally agreed frequency band.

These are low frequency from One Hundred and Eighty-Five Kilo-Hertz (150KHz) to Two Hundred and Eight-Five Kilo-Hertz (285 KHz), Medium- Frequency Band from Five Hundred and Twenty-Five Kilo-Hertz (525 KHz) to one

Thousand size Hundred and Five Kilo-Hertz (1605 KHz), High-Frequency selected bands in the range from six mega Hertz (6 MHz) to Twenty-Six Mega Hertz (26MHz) and Very-High Frequency (VHF) which is divided into sub-bands namely, Band I, Forty-One Mega Hertz (41 MHz) to Sixty-Eight Mega Hertz (68 MHz), Band II Eighty-Seven Point Five Mega Hertz (87.5 MHz) to One Hundred and Eight Mega (108 MHz). This is the band that suit frequency modulation (FM) and because of the high frequency involved audio signal in television transmission are frequency modulated. The picture part of television fall in the last band that range from One Hundred and Seventy-Four Mega Hertz (174 MHz) to Two Hundred and Sixteen Mega Hertz (216 MHz) Band III. Though satellite transmission has a higher frequency which are measured in Gega Hertz ($X\ 10^9 Hz$).

In an amplitude modulated wave, the amplitude of each cycle of the resultant (the modulated wave) varies in accordance with the intelligence (or modulating wave).

If the intelligence is represented by:

$$e_m = Em \cos Wmt \quad \text{--- (1)}$$

where Wm is the Modulation Angular Frequency and is ordinarily small with respect to Wc, then the amplitude of the Modulated Wave should vary as:

$$A = Ec + Ka\ Em \cos Wmt \quad \text{--- (2)}.$$

The complete amplitude - Modulated Wave is then written as:

$$e = Ec\ (1 + \frac{KaEm}{Ec} \cos Wmt)\ \cos Wct \quad ---(3)$$

Where the constant phase term Qc in equation (1) has been dropped as of no important in this process.

The proportionality constant, Ka, relates the variation of amplitude and the maximum signal Em. Equation (3) can be put in a more convenient form as

$$e = Ec\ (1 + Ma\ Cos\ Wmt)\ Cos\ Wct \quad --- \quad (4)$$

$$\text{where } Ma = \frac{KaEm}{Ec} \quad --- \quad (5)$$

Ma is called Modulation depth or Modulation factor which measures the amount of change in amplitude as compared to the original unmodulated carrier amplitude. When Multiplied by 100 per cent, this becomes the Modulation Percentage.

The factor Ma, normally ranges in value from zero to one (0 to 1). This, when Ma = o, there is no amplitude modulation present and the expression for a reduces to the cosinusoidal Ec Cos Wct. The condition where Ma = 1 corresponds to hundred per cent (100%) Modulation and is characterized by a periodic reduction of the radio frequency (RF) wave amplitude to zero. When Ma = o.5, the Modulation percentage is fifty percent (50%) and the Minimum amplitude of the carrier wave is equal to half the amplitude of the unmodulated carrier. If the Modulating Voltage is made greater than that for which Ma = 1, a condition described as over modulation exists.

The relations of equation (4) ordinarily no long applies, and the wave is usually characterized by an interval of zero amplitude. This condition result in a distortion of the intelligence being transmitted.

3.5 FREQUENCY COMPONENT IN AM WAVE

In the preceding section an expression for an Amplitude Modulated Wave was written as:

$$e = Ec\ (1 + Ma\ Cos\ Wmt)\ Cos\ Wct$$

By trigonometric identity.

$$Cos\ Wmt\ Cos\ Wct = 1/2\ (Cos\ (Wc + Wm)t + Cos\ (Wc - Wm)t)$$

So that an Amplitude Modulated Wave can be expressed as:

$$e = Ec\ Cos\ Wct + \frac{MaEc}{2}\ Cos\ (Wm+Wc)t + \frac{MaEc}{2}\ Cos\ (Wc-Wm)t \quad ---6$$

Equation (6) shows that a wave that is amplitude - Modulated by a single frequency actually consists of three frequencies. One is the original carrier frequency, Wc, and the other two represent the sum and the difference of the carrier and Modulation Frequencies. The Frequency represented by the sum of carrier and Modulation Frequencies is called the upper side frequency, that resulting from the difference is the lower side frequency.

For Modulation by the complex wave form of speech exist, one pair for each frequency component; these groups of side frequencies are called side bands.

3.6 POWER DISTRIBUTION IN AM WAVE

The total average power dissipated when a complex voltage is impressed a cross a resistance is equal to the sum of the individual average power dissipations produced by the various components of the voltage. The voltage components contained in the wave represented by equation (6) has Root Mean Square (RMS) valve equals to:

$\frac{Ec}{\sqrt{2}}$, $\frac{MaEc}{2\sqrt{2}}$ and $\frac{MaEc}{4\sqrt{2}}$ respectively.

Therefore, if the composite voltages were impressed across a resistance R1 the total average power dissipated would be equal to:

$$Pavg = \frac{Ec}{2R} + \frac{Ma^2Ec^2}{8R} + \frac{Ma^2Ec^2}{8R}$$

$$= \frac{E^2c}{2R}\left(1 + \frac{Ma^2}{2}\right)$$

$$= Pc\left(1 + \frac{Ma^2}{2R}\right) \text{ --- (7)}$$

Where $Pc = \frac{Ec^2}{2R}$ represents the power dissipated by the carrier component alone.

It follows from equation (7) that the average power content of an AM wave exceeds that of the corresponding unmodulated carrier so that the process of modulation

involves an addition of power to the Radio Frequency (RF) Wave. At hundred percent (100%) modulation, the power content of the Modulated wave is fifty percent (50%) greater than that of the carrier wave, so that one third of its total power is contained in the side band.

3.7 HOW TO GENERATE AM WAVES

A class-C amplifier is biased beyond cut-off. At this point, current will flow for less than one half-cycle of the input signal and is cut-off when there is no input signal applied. A Class-C amplifier is not used in audio amplifier as it causes signal distortion, but is commonly used in high frequency, that is Radio Frequency (RF) amplifiers. The clipped signal is restored by the use of tuned circuits.

The purpose of the Modulated stage is to cause the envelope of the Radio Frequency (RF) carrier to vary in accordance with the Modulated Signal; hence for plate Modulation we seek some device whose Radio Frequency (RF) Voltage is directly proportional to its plate voltage. Such a device is the Class - C Radio Frequency (RF) Amplifier.

The sinusoidal (RF) input voltage is supper imposed upon a relatively large plate voltage so that the tube conducts during only a portion of each RF Cycle.

When the Modulating Voltage is applied, the Value of the plate voltage varies above and Ebb in accordance with the modulating signal wave form. The amplitude and width of the plate current pulses vary with e_b. The amplitude of Radio Frequency (RF) current in the tank circuit varies in proportion to e_b and the current wave has the amplitude modulated form.

If the tuned circuit, resonant at the frequency of the RF input voltage, is sufficiently broadband so that it has essentially the same impedance at both the carrier and the side band frequencies, the output voltage established a cross the timed circuit will have the same amplitude modulated wave form. Degree of modulation obtained by this method depends upon the relative values of Ebb and the modulation voltage Em. The modulation factor Ma is given by $Ma = \frac{Em}{Ebb}$ ... (8)

A typical arrangement for plate modulation would have served for better illustration but for the purpose of this Project Write-up, I feel it is not much important. In the circuit, the radio frequency (RF) carrier voltage E_2 is applied to the grid of the modulated stage V_3 and is of such fixed amplitude as to derive the amplifier in the saturation region. Transformer, say T_2, the modulation transformer, serves to couple the audio output

of the modulator tubes (V_1 and V_2 connected in class B push-pull circuit) into the load presented by the class-c amplifier V_3. The audio voltage is thus placed in series with the DC supply voltage Ebb to V_3. The modulation transformer must have the current ratio of primary to secondary turns, so that, with the impedance of the class-c applier as its secondary load, the transformer will present a favorable plate-to-plate load impedance to the modulator tubes/transistors.

The total voltage applied to the modulated amplifier plate is:-

$$Eb = Ebb + Em \cos Wmt \quad \ldots (9)$$

Using equation 18, then

$$Eb = Ebb (1 + Ma \cos Wmt) \quad \ldots (10)$$

Thus radio frequency (RF) energy available at the output terminals of the modulated amplifier is derived from the plate-supply sources. In the absence of a modulating signal, the output contains only a carrier component and its energy is supplied by the high tension (HT) plate supply source.

Power derived from HT source EbbIb ... (11).
Where Ib is the average plate current of the radio frequency (RF) amplifier. When the modulating voltage is applied, the energy content of the output wave is increased. In as much as the efficiency of the circuit remains constant during modulation is furnished by the

modulating source. power derived from modulating source = $\frac{M^2a}{2}$ Ebb Ib ... (12)

The power output pout to the tank circuit as determined by the class-c amplifier efficiency 2_p is Pout = 2_p Ebb Ib (+ $\frac{Ma^2}{2}$) ... (13)

The modulated radio frequency (RF) amplifier serves as the load of the modulating source circuit (the modulator). The valve of the load resistance is determined by Rb = $\frac{Ebb}{Ib}$ ... (14)

The plate modulated class-c amplifier has a number of desirable characteristics. It operates at high efficiency, is relatively simple to adjust, and effect the modulation with little distortion. It has the disadvantage of requiring a large amount of power at the modulating frequency. Consequently, bulky and expensive modulating equipment.

3.8 GRID MODULATED CLASS C AMPLIFIER

In a Grid - Modulated Class C amplifier, both the Radio Frequency (RF) carrier voltage and the modulating voltage are applied to the control grid of the tube in series with the bias.

In the absence of the modulating signal, the RF voltage varies about the fixed bias valve. When the modulating signal is applied, it serves, effectively, to

vary the bias hostage in accordance with the signal wave form. The amplitude of the modulating voltage is normally adjusted so that the minimum instantaneous bias is approximately equal to the cut-off voltage.

For the seek of the lay man who may read this write-up, let us examine the power output capability and efficiency of a grid-modulated amplifier. At the crest of the modulation cycle, the operating conditions are similar to typical class c operation. The plate current pulse amplitude for these two cases are equal. It should be noted, however, that the plate current pulse for a non-modulation condition is only one half the ideal valve. Therefore the carrier power output is limited to only one quarter of the rated power that the same pulse could deliver as a class c amplifier.

At the modulation crest-and only for one hundred percent (100%) - Eb minimum value is low, equal approximately to Ec masse and the high efficiency of a class c amplifier is realized, for any other condition, Eb min rises, the plate dissipation increases, and the plate efficiency falls off. The average efficiency over a modulating cycle is approximately only half the efficiency obtainable as a straight class c amplifier.

Compared to plate modulation, the grid modulated stage has a lower plate efficiency; it produce a lower output to the same tube/transistor. It is more difficult

to adjust if it has power linearity and thereby a higher distortion level. However, it required much lower modulating power. In this respect it should be recalled that when the modulating signal is injected into the plate circuit, an amplitude of Em = Ebb is required for one hundred percent (100%). By injecting the modulating voltage into the grid circuit, the amplification factor of the tube reduces this requirement to:-

$$Em = \frac{Ebb}{2U}$$

In modern amplitude modulation (AM) transmitters, high power transmitters use special purpose vacuum tubes for he final stage. While the rest of the stages are solid states. Class c amplifiers generally used in the medium frequencies and high frequencies bands for higher output power levels. Special cooling systems are required to keep the temperature of the output stage at an acceptable value. Solid state devices are also used in such circuits that are important like communication application, cable transmission systems, frequency division multiplexing. Low power transistor transmitters are good exemplary make up of a solid state.

CLASS C BASE - MODULATION

The basic idea of the base - modulation circuit is to control the collector current magnitude by the modulating voltage applied at the transistor base.

The base and the collector currents will flow only when the applied carrier voltage exceeds $V_{BB} + V_{BE}$. Neglecting V_{BE} compared to V_{BE} and assuming that R_s is much larger than the transistor input impedance. In summary the transistor will conduct if Ec Cos Wct $>$ $(V_{BB} + V_{BE})$ then the collector current can be expressed as:-

$$Ic = BIb$$

$$= B \left(\frac{Ec \text{ Cos } Wct - V_{BB}}{Rs}\right) \quad \ldots (15)$$

Where Ib is the base input current, Ic is the collector current, and B is the common emitter short -circuit current. The peak value of the collector current is Ic

$$\text{Max} = B \frac{Ec - V_{BB}}{Rs} \quad \ldots (16)$$

A modulating signal of value e_m = Em Cos Wmt can be added in series with V_{BB} to modulate the value of Ic max and hence the output signal. The peak collector current becomes

$$\text{Ic max} = \left(\frac{Ec - V_{BB} + Em \text{ Cos } Wmt}{Rs}\right) \quad \ldots (17)$$

If one hundred percent (100%) modulation is desired, the peak collector current must equal zero in the negative crest of the modulating signal. This condition occurs when $Em + V_{BB} = Ec$

From equation (17) the peak value of collector current varies directly with the modulating signal. However, as Ic max varies with e_m, the angle of conduction varies

also. This leads to a variation of the fundamental component of the current with e_m that is not perfectly linear. This linearity of output signal with modulating voltage inproves as V_{BB} is reduced. However, as V_{BB} becomes smaller, the angle of conduction increases and the efficiency decreases. In applications requiring higher output levels it is important to minimize device dissipation by operating with high circuit efficiency. In this case, the value of V_{BB} may be relatively high sacrificing linearity for circuit efficiency.

One practical realization of base modulation, is noted at the RC coupling being used for the modulating signal. However, transformer coupling can be used also. With RC coupling, the resistance value say R1 (and the time constant R1C2) should not get too large. Otherwise excessive reverse bias could be produced by the so-called "grid leak" action. With regard to operation and wave shapes, base modulation is very similar to its vacuum - tab counterpart-grid bias modulation and has the same draw backs.

3.9 COLLECTOR AMPLITUDE MODULATION

The most commonly used amplitude modulation technique is to feed the modulating signal to the collector, in series with the direct current (DC) collector supply voltage. The collector amplitude

modulation generally exhibits more linearity than does the base-modulation stage, especially as high indexes of modulation are produced. One disadvantage of the circuit is the large amount of modulator power required. The base modulated stage requires less modulation power since the active device provides modulated power gain. It is possible, however to transmit a given power level with less device dissipation using the collector modulator. This is important since transistor transmitter applications are often limited by allowable device dissipation.

CHAPTER FOUR

4.1 INTRODUCTION

This Chapter is expected to discuss the type of program to be used to write the program.

Due to the calculations involved in the program, BASIC has been decided to be used for writing the program.

4.2 PROGRAMMING IN BASIC

Basic is the acronym for Beginner All-purpose Symbolic Instruction Code. It was developed at Dart Mouth college in 1963. BASIC is a high level language designed for people who have no prior grogramming experience and is widely used in programming scientific, mathematical and many business problems. so due to the Mathematical orientation of this Project as earlier stated above, BASIC Programming is opted for.

4.3 BASIC TRANSLATORS

One very vital characteristic of BASIC is its availability in all Disk Operating System (DOS). There are BASIC interpreters and BASIC Compilers depending on the version of DOS available.

The versions are:-

1) GWBASIC available on 3.3

2) BASICA and BASIC available on DOS 4.01

3) QBASIC available on DOS 5 and above.

It should be noted that GBASIC, BASIC and BASIC A are interpreters while QBASIC is a compiler. For the rest of this Project, QBASIC will be used. And any situation in the process of the write-up, GWBASIC, BASIC and BASIC A would be collectively regarded as BASIC interpreter while QBASIC would be regarded as compiler.

In BASIC Programming, the following are the most important terms:-

1) Constant

2) Variables

3) Reserve Words

4) Executable and Non-Executable Statements

5) Assignment Statement

6) Arithmetic and Relational Operators

7) system commands

8) Input and output statements.

CONSTANT: A constant is a data written into a program instruction whose value does not change during the excursion of the program. That is, a fixed or invariable value data item. There are two types of constants namely:- String and Numeric constant.

STRING CONSTANT:

This consists of a sequence of characters that may or may be separated by spaces enclosed in apostrophe or double quotation marks. Below are some examples of string constants:

"LAWA", "DAMA" "THIS IS A BOY", "3.145".

NUMERIC CONSTANT:

This is made up of numbers. These include whole numbers (both positive and negative numbers with the plus sign optional), decimal numbers (fixed point numbers) and numbers written in E-notation (floating point numbers). The following are numeric constants: 141, 14.2, 14.2E.

VARIABLES:

Variables, as the name implies are data whose value can change during the execution of a program. The value of a variable may be set to a constant or may undergo changes as a result of calculations in the program. A variable is either numeric or string.

NUMERIC VARIABLE:

These are variables made up of numbers digits which will be used in calculations.

STRING VARIABLES:

These, on the other hand are variable that can not be used in computations. Though, they can be manipulated in several ways, but they can be used for normal arithmetic process.

VARIABLE NAMES:

Because variables take different values at any point in time during the program excursion, it is necessary for names to be assigned to variables which will be used as their reference. Therefore, variable names are temporary storage locations within the memory of the computer to keep variables. They are in the form of addresses which when referenced, make use of their contents at that point in time.

Assigning variable names are as follows:-

i) A variable name may consist of a letter or group of letters of alphabet followed by numbers. This implies that the first character of a variable name must be a letter of alphabet.

ii) A variable name should be no space within the characters that constitute a variable name.

iii) The use of special symbols (like # e) are not allowed in forming a variable name.

iv) A reserve word can not be used as a variable name.

v) A variable name has a maximum number of characters.

In many versions of BASIC, a variable name does not exceed three characters while others are more. For instance, QBASIC allows for up to forty (40) character.

vi) For only string variable names, they must end with a dollar sign ($).

RESERVE WORDS:

These are set of words that are meaningful to the computer or complier. They have predefined meaning within a computer language. They vary from one language to the other. Examples of reserve words in BASIC are read, input, print to mention few.

EXECUTABLE AND NON-EXECUTABLE STATEMENTS:

An executable statement is a Statement that tell BASSIC what operation to perform, eg. PRINT Y which requires BASIC to write the value contained in Y. A non-executable statement does not require any action on the part of the program. REM (Short for Remark) and DATA statements are non-executable statements.

ASSIGNMENT STATEMENT

An assignment statement is used to assign values to a given variable name. The assignment of values to variable names may be proceeded by the word "LET".

For instance, LET A = 3.5

This statement instructs the computer to store the number 3.5 in the memory location named A. However, it should be

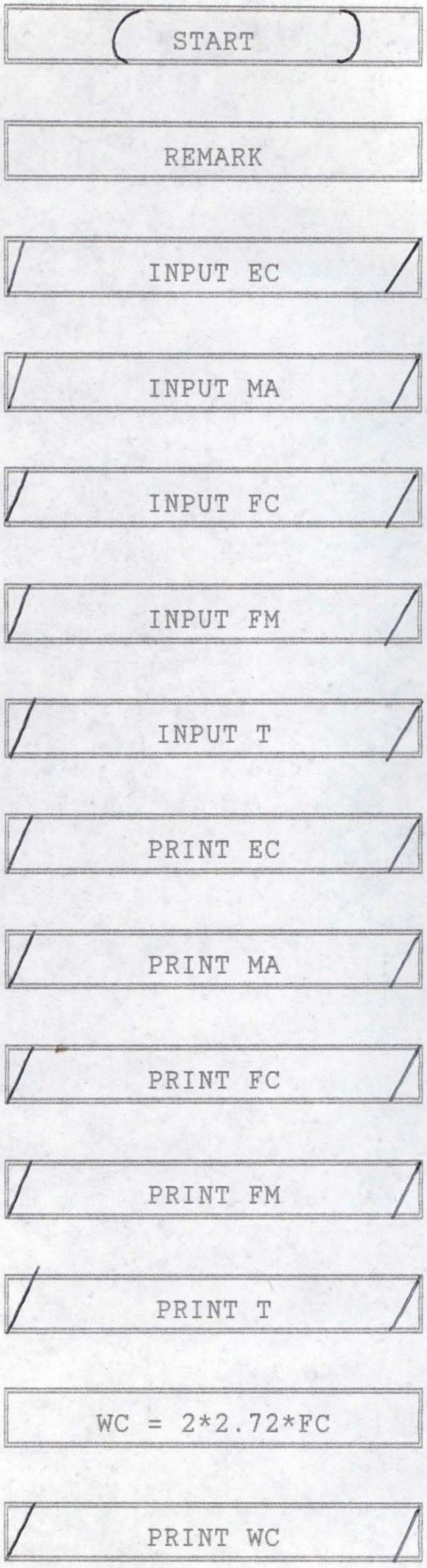
noted that the LET in the statement is optional.

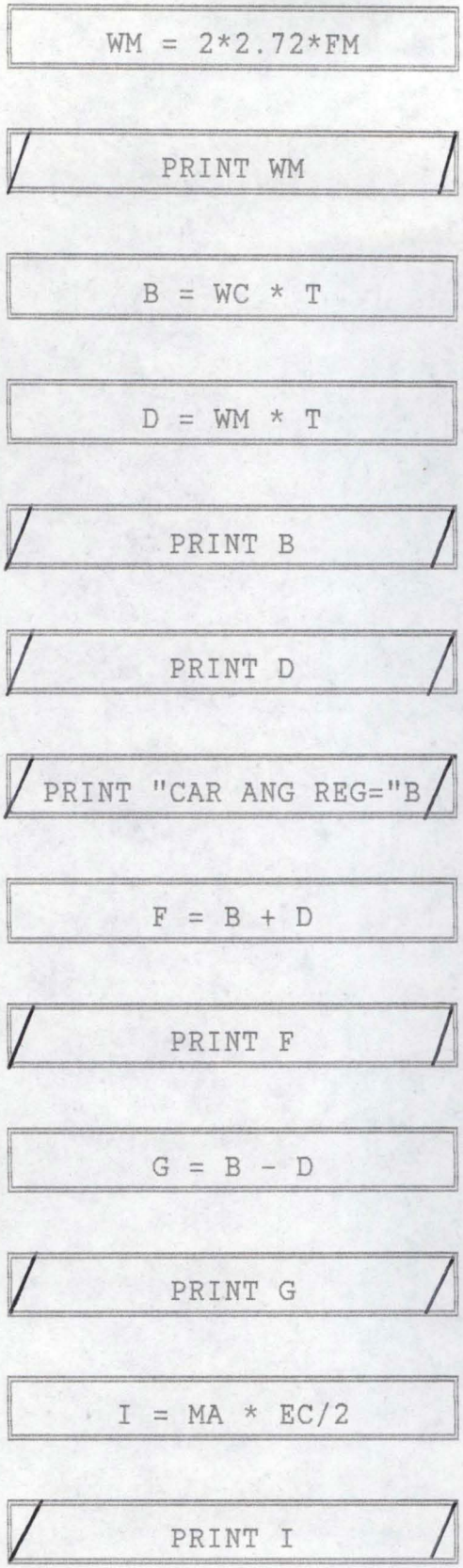
At the end of the derivation the formula for a power output of an amplitude modulation transmitter is given by:-

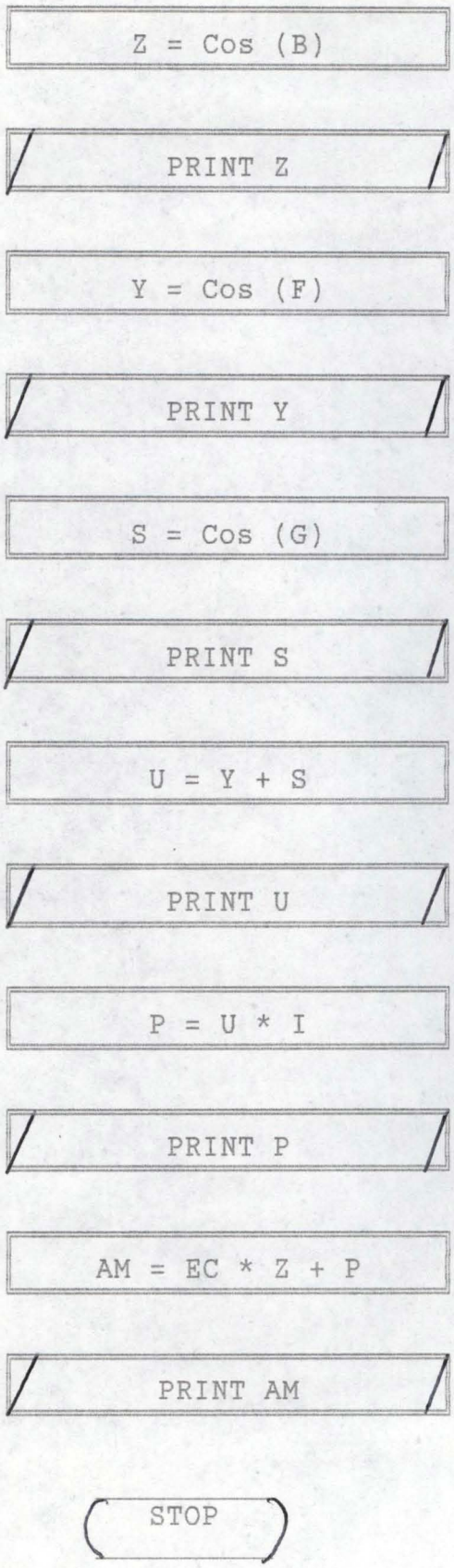
$$e = Ec \cos Wct + \frac{MaEc}{2} \cos (Wc + Wm)t + \frac{MaEc}{2} \cos (Wc - Wm)t$$

The program is to make to accommodate the equation and give the output as required.

4.4 FLOW CHART




WM = 2*2.72*FM
PRINT WM
B = WC * T
D = WM * T
PRINT B
PRINT D
PRINT "CAR ANG REG="B
F = B + D
PRINT F
G = B - D
PRINT G
I = MA * EC/2
PRINT I


Z = Cos (B)
PRINT Z
Y = Cos (F)
PRINT Y
S = Cos (G)
PRINT S
U = Y + S
PRINT U
P = U * I
PRINT P
AM = EC * Z + P
PRINT AM
STOP

CHAPTER FIVE

ACHIEVEMENT OF THE SYSTEM

5.1 System Integration into Radio Nigeria, Kaduna and Personnel Reaction.

When choosing a method of changeover, one of the most important factors for the system development and the organization concerned (Radio Nigeria, Kaduna) that is to be considered, is that of personnel reactions to the new system.

However, it is eminent that all personnel will be affected by the system to some degree and will in turn be able to influence the systems success or failure.

On the positive side, many personnel will welcome modernization of the strategic area of the Radio Nigeria, Kaduna. This is because they will enjoy learning new skill and be keen to try out the new system and other facilities that are available on the system like the application Software Package and the Internet. They will also be keen to use it to carry out repetitive and tedious tasks and fully come to appreciate its ability to work rapidly and accurately.

On the other hand, many personnel in Radio Nigeria, Kaduna may feel hostile towards the new system. They may be reluctant to accept change in their pattern of work and be opposed to the idea of retraining.

In some cases, personnel may, see the new system as a threat to their jobs, and may feel valnerable to redundancy, enforced early retirement or transfer.

Even if their job descriptions and salaries remain the same, the personnel are afraid that the most interesting part of their job or work will be taken over by the new system so what will actually be doing is much less skilled than before.

Hence the system integration or introduction into Radio Nigeria, Kaduna and staff reaction will give an avenue for discussion with the two parties involved (that are the program developer and Radio Nigeria, Kaduna personnel) to discuss vital issues regarding the benefits, limitations and the negative aspects. This is because no matter how well developed or well designed and efficient the new system may be, if the staff/officers will not work with it, it will be a failure.

5.2 PERFORMANCE AND ASSESSMENT OF THE SYSTEM

An application that performs well is one that accomplishes its operational objectives within a given time and resource constraint. The two most common used measure of performance and assessment of systems are:-

i) THROUGHPUT

This refers to the capacity of thee system rather than its speed. Throughout can be defined as the amount of work that the system can process in a unit time.

ii) TURNAROUND

This is also referred to as the response of the system. It is the elapse time between the initiation of an activity and the availability of the result. The response time is a function of the volume of information and speed or capacity of the underlying components.

5.3 SUGGESTION AND CONCLUSION

The use of personal computer in the selection of a good and well designed software have received increased attention in recent years. Also, the continuous substitution of the manual for computer based systems has in modern days become a world wide phenomenon.

This is due to its relevance in virtually all aspects of human endeavour. This interest is intensified by the capacity of commuter in a given set procedures with all the necessary accuracy.

It is not subjected to committing errors, and its ability to accomplish any task with high speed and within a reasonable time makes it applicable in recent times.

However, because of the mass production in computers with its relative low demand, this has indeed set the price of computers coming down.

I therefore, suggest and conclude for the implementation of the BASIC PROGRAM which is a computer based program, just like in the other field of mathematical calculations.

5.4 RECOMMENDATION

Going by the computer operations from the application program and customized software perspective, it does substantially appear that no meaningful computerization or computer operation can take place without data being manipulated in one way or the other. That a computer machine is a wonderful system based in its ability to process data fast and accurately. It is because of this fact that a computer BASIC PROGRAM for calculating power output of an amplitude modulation transmitter of Radio Nigeria, Kaduna was picked as my Project tittle and also recommended for other Radio Stations that are operating on shortwave (SW).

However, if this program is implemented, Radio Nigeria, Kaduna will derive the following benefits from the newly designed system:-

a) Efficient Operation of the personnel having gone through the learning of the new system.

b) As a result of familiarization with the new system, it will solve or reduce problems as being experienced with the existing manual method.

c) If the implementation takes effect immediately, personnel will be fully familiar with the new system before the actual implementation of the proceedings of the calculation by the year 2000 ((Y2K) Millennium.

APPENDIX

4.5 PROGRAM

```
10.  REM PROGRAM TO FIND POWER OUTPUT OF AMPLITUDE MODULATION
     TRANSMITTER
20   INPUT "CARIER AMPLITUDE =" EC
30   INPUT "DEPT OF MODULATION =" MA
40   INPUT "CARIER FREQ =" FC
50   INPUT "MODULATION FREQ =" FM
60   INPUT "TIME OF OPERATION =" T
70   PRINT "EC =" EC
80   PRINT "MA =" MA
90   PRINT "FC =" FC
100  PRINT "FM =" FM
110  PRINT "T =" T
120  WC = 2 * 2.72 * FC
130  PRINT "WC =" WC
140  WM = 2 * 2.72 * FM
150  PRINT "WM =" WM
160  B = WC * T
170  D = WM * T
180  PRINT "B =" B
190  PRINT "D =" D
200  PRINT "CARIER ANGULAR FREQ ="
210  PRINT "MODULATION ANGULAR FREQ =" D
220  F = B + D
230  PRINT
240  PRINT "F =" F
```

```
250  G = B - D
260  PRINT "G =" G
270  PRINT
280  I = MA * EC/2
290  PRINT "I =" I
300  PRINT
185  Z = COS (B)
187  PRINT "Z =" Z
225  Y = COS (F)
227  PRINT "Y =" Y
255  S = COS (G)
257  PRINT "S =" S
310  U = Y + S
320  PRINT "U =" U
330  P = U * I
340  PRINT "P =" P
350  AM = EC * Z + P
360  PRINT
370  PRINT "POWER OUTPUT =" AM
     END
```

```
          .1
          477000
          2000
          1
594880
980
 2594880
 9080
ER ANGULAR FREQ =  2594880
ATION ANGULAR FREQ = 9080

93960
 2585800

 3000

 .9910833
 .7877863
 .5971342
 1.384921
 4154.762

R OUTPUT =  63619.76

 any key to continue
```

```
         1
         477000
         2000
         1
94880
80
2594880
9080
R ANGULAR FREQ =  2594880
TION ANGULAR FREQ = 9080

3960
2585800

30000

.9910833
.7877863
.5971342
1.384921
41547.62

 OUTPUT =  101012.6

any key to continue
```

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