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Design and Construction of Audio Amplifier

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Abstract
Audio Amplifier is a circuit that accepts small audio signal as input to produce a bigger output .The Audio input signal is passed through the OP Amp which will produce the required gain and the transistors wired in complementary Darlington configuration produces the drive for the speaker. It is reliable, efficient and cheap with sensitivity of about 1.22MV and an output power of 40wtts at Vcc supply of +15. The pre-amplifier stage is realized from differential mode transistors and the power stage made from the class a transistors.

Keywords:

Introduction

Power amplifier is an electronic circuit that modifies buffers and transmits an alternating power signal (RF or AF) from a source to a sink by the original signal the ability of this circuit attenuating input signal depends on the amplification power of the amplification, which is measure in decibel. Despite the fact that the basic objective of an amplifier is to increase the short comings like distortion due to harmonics, over lap of signal, noise etc were, recorded. This is because only transformers, cathodes diodes etc are the main comportments, of the amplifier used for both radio semi - conductor chips a more reliable and dependable, as well as improved power amplifier systems though with the shortchanges alleviate have been designed.

Recently, amplifiers are made of circuitry of resistors, capacitors and transistors combined in an appreciable ratio to perform some useful function. This amplifier can be designed to perform in different modes, as a Low pass amplifier, High - pass amplifier and Band - pass amplifier, Band reject amplifier and All - pass amplifier. The low - pass amplifier passes all signals below some upper cut off frequency where as High - pass amplifier, amplifiers all signals above the lower cutoff frequency Fl. The Band - pass amplifier is used to tailor the phase, of the signal ratter then its amplifier. And All - pass amplifier, amplifiers signal at any frequencies; the other amplifier circuits designed to amplifier specific ranges of signal frequencies are known as FILTERS.

Considering the recent development of technology in all aspect of life amplifier circuit is the major unit of any circuit that is designed to perform a function. Consider also a situation where modulated wave/ signal is catapulted from Abuja to Enugu, we observe that various power amplifier satiation are built to boost the signal that has already dropped so that the signal reaches the destination without much drop or even amplified as desired. These amplifiers that are designed to boost or amplify such electromagnetic wave are known as power radio frequency amplifiers operating at a frequency range.

Similarly some amplifiers used to modify analog signal in both house and also transmission stations as well as instrumentation (music) amplifier are generally known as Audio amplifier. These amplifiers can be designed to perform linear operation or differential operations to suit the expected output.

Purpose of study

Before any design is uphold, the purpose of the design is the most paramount feature to be considered. Other important feature like the necessary components that can realize the desired purpose of what complexity the designs will be, if it must be the cost of putting this project in place, the type and magnitude of voltages and currents needed for the power supply and also the size/ shape, appearance as well as other physical parameter like the temperature of the environment went where is to used must be considered. Actually, it is best to consider metallic casing of the project but because of high cost and scarcity of metal sheet, wood is used in place of metal. But wooden material is preferred to metallic material in this project because it is an insulator and cannot electrocute when in contact with anybody during surge. If metallic material is used then earthen circuitry will be necessary which could increase cost. Wooden material is also used of its flexibility to work with. .

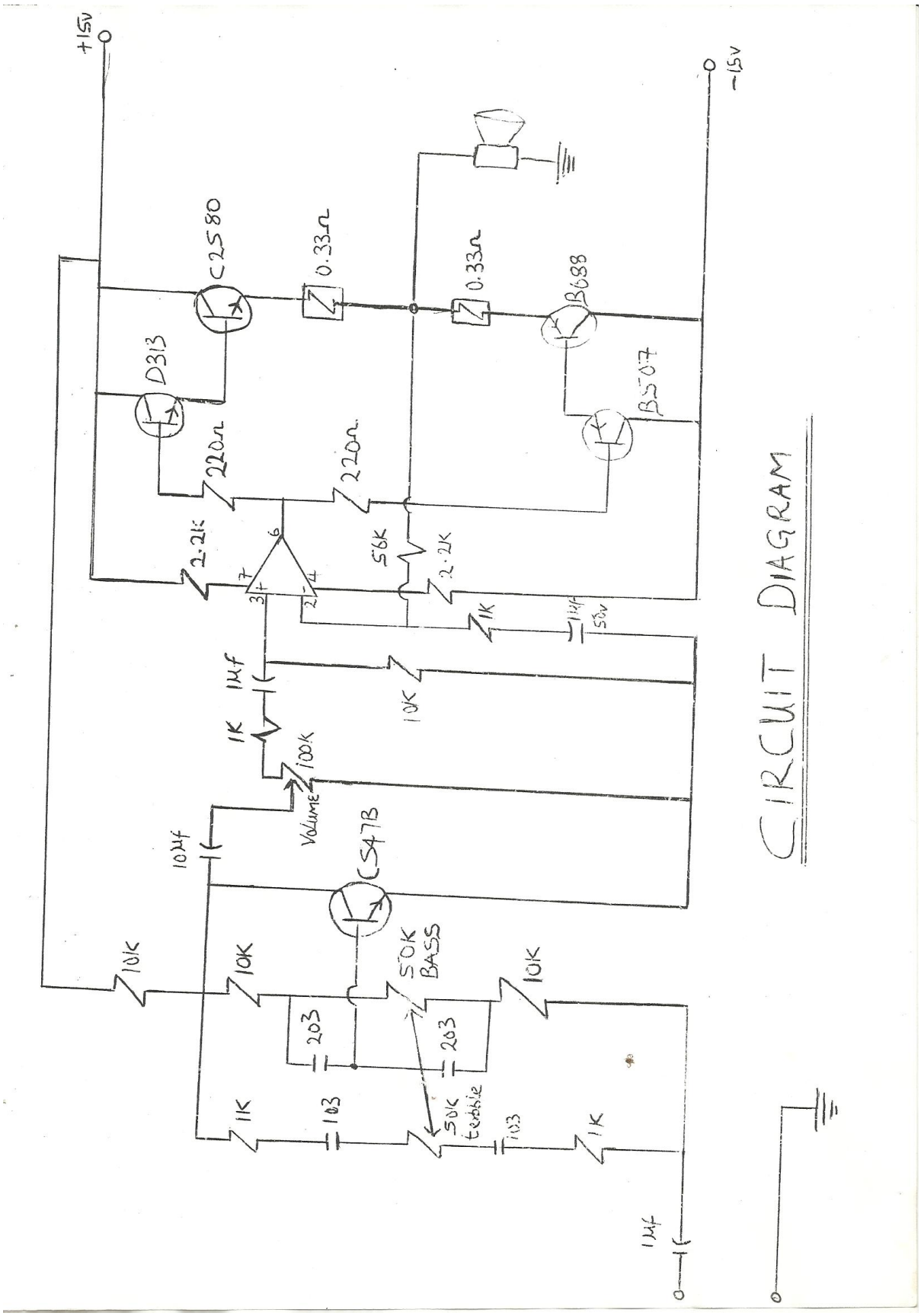
Size of course is determined primarily by the bulk of electronic circuitry and the level of heat dissipation of the transistor coupled with the function it is intended to perform. But in this very design it is not bulky because we used few components except for the weight of the cascaded transformers that supplies power to the amplifier. Consideration is also given to actors such as access to mounted component parts and heats dissipation. Some transistors used are power semi-conductors and so they get hot when powered. Though, it occurs when the supply voltage is higher than the rated voltage. Even though that the required heat sink were provided to checkmate temperature rise of the chips, the supply voltage is limited so as to exceed the rated voltage, A few holes drilled at the sides of the cabinet aids air circulation around the components.

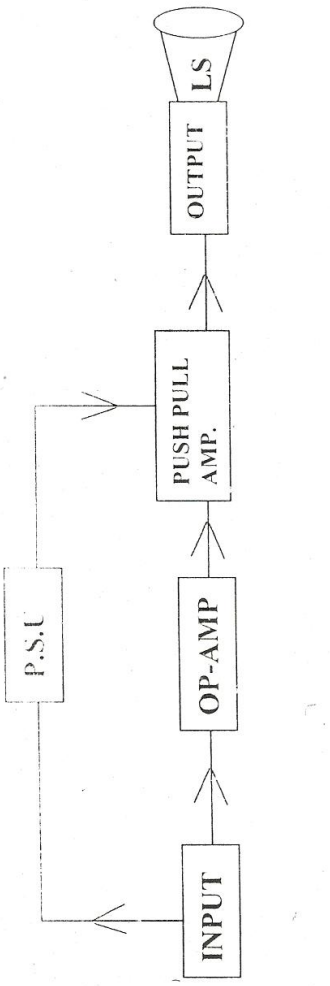
Scope of study

The construction of 40w audio amplifier has immensely contributed a lot by helping me to achieve my goal as a prospecting Electronics Engineer since it is my field of study. It gives me opportunity to go into research and also expose me to some of electronics component like transistors, resistors, capacities and diodes. It also gives me opportunity to improve in soldering of some electronics components smoothly without any fault arisen.

Principle of Operation

This is a Sow cost amplifier circuit using 4 transistors and one op-amp. UA 741, when the input signal is fed into the op-amp which will produce the required gain and the transistors wired in complementary Darlington configuration which is the push pull that produces the drive for the speaker.The input for the Darlington pairs are derived from the power supply as a voltage drop across R4 and R5, The voltage drop across these resistors will be proportional to the input signal because the supply current to the Op. Amp varies according to the input signal. The negative feedback from the junction of Q4 and Q2 stabilizes the amplifier.


+15v
-15v
C2580
0.33Ω
0.33Ω
B688
D313
BS107
220Ω
220Ω
2.2K
56K
2.2K
1K
1µf
50v
1K
1µf
100K
Volume
10K
10µf
C547B
10K
10K
50K
BASS
203
203
1K
103
50K
treble
103
1K
1µf
CIRCUIT DIAGRAM



Block Diagram of Audio Amplifier

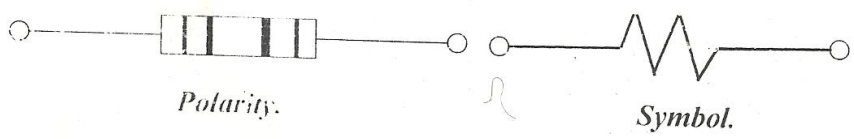
Limitation

In the course of writing this research work, I face some problems. There are insufficient materials to carry out the research work, the most and terrible problem faced was financial problem. I found it difficult to keep up with the financial requirements especially to keep or meet the cost of buying materials for the construction and writing of this project. Handling of electronic components like transistor and soldering which need to be done carefully well.

Literature Review

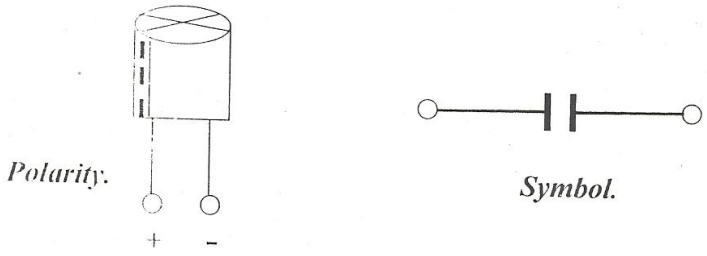
Resistor

Resistor is an electronic component that reduces current in a circuit. It is usually made of carbon, although some are wire wound. These are different sizes of resistance for each resistor is usually found from its colour code. These colour have different number values. In construction, it is used to limit the amount of voltage that get to the relay coil. This is physical device which principal characteristic is resistance. The opposition to an electric current offered by these components is called resistance. The resistor obeys this law at aii times provided the current is not allowed to rise to such a value that will alter the temperature of the resistor to increase appreciably.



Capacitor

Capacitor is a device designed for storing charges. It has the ability to store electric energy. It is an electrical device composed of two conductors separated by dielectric medium. There are different types of capacitors. These include ceramic capacitor, 2-plate capacitor, electrolytic capacitor, variable capacitor etc. they are passive electrical elements. Capacitors are used for wave form generation, filtering and blocking. It is also used in integrator.

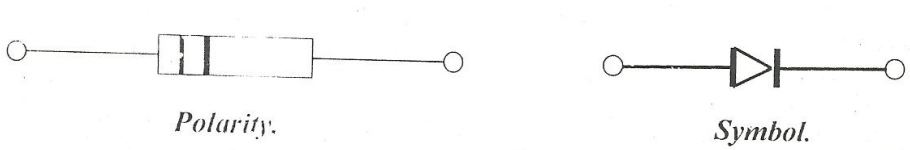


Diode

A diode is a semi-conductor device that permits current flow in one direction when its anode terminal is an made move positive tan its cathode terminal. Diode is a device used to rectify A.C (alternative Current). Diode can also be used as detector (for operating Re and Audio Signals receivers) turning receivers, protector of sensitive instruments.

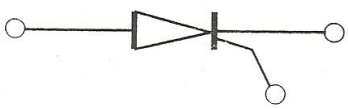
Zener Diode

It is reverse biased heavily doped silicon (or germanium) P-r\i Junction diode which is operated by both external resistance and maximum power dissipation. The major application for Zener Diode is voltage regulation in D.C (direct current) power supplies or for stabilization. Zener diode maintains a nearly constant D.C Voltage under the proper operation conditions. It is rated according to their breakdown voltage.



Silicon Controlled Rectifier

It is a rectifier with a control element. It consist three diodes connected back to back. It is widely used as a switching device in power control application, it can control loads by switching current Off and *On* for variable lengths of time, thereby delivering selected amount of power too the load.



Transistor

Transistor is a semi-conductor device used in construction signal generators, multi-vibrators, buffer, Oscillators, switching circuit, Amplifiers etc.

Transistor has three terminal e.g. base, emitter and collector. It is used for amplification. In the construction the transistor acted as a switch. There are two basic types of transistor:

- Bipolar junction transistor (BJT)
- Field effect transistor (FET)

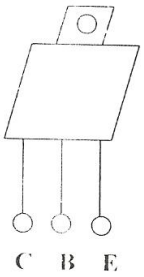
Bipolar Junction Transistor: is used in a linear amplifier to boost an electronic signal and also can be used as a switch. Bipolar junction transistor of back to back P-N junctions manufactured in a single piece of a semiconductor crystal.

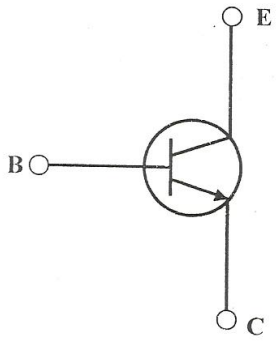
Field Effect Transistor: it is a three terminal unipolar sot-state device in which current is controlled by an electric field as is done in vacuum tubes. The two transistors has three regions:

- Base
- Emitter
- Collector

Base: - It is form at the middle section of the transistor and is very lightly doped.

Emitter: - it is move heavily doped than any of the other regions because its main function is to supply majority charges carries (either electrons or holes) to the base, **Collector:-** its main function is to collect majority charge coming from the emitter and passing through the base. Collect region is made physically large than the emitter region because it has to dissipate much greater power.





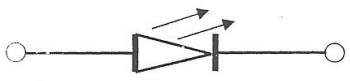
Leg (Light Emitting Diode)

It is a forward-based P-N junction which emits visible light when energized. The colour of the emitted light depends on the types of material used as listed below:

- GAAS - Infared Radiation
- GAP - Red or Green
- GAASP - Red or Yellow Light

Leo's emits reverse direction will quickly destroy them. Led structures are divided into two:

1. **Surface Emitting:** These leds emit light in a direction perpendicular to the P.N junction plane.
2. **Edge Emitting:** These leds emit light in a direction parallel to the P.N junction plane.



Transformer

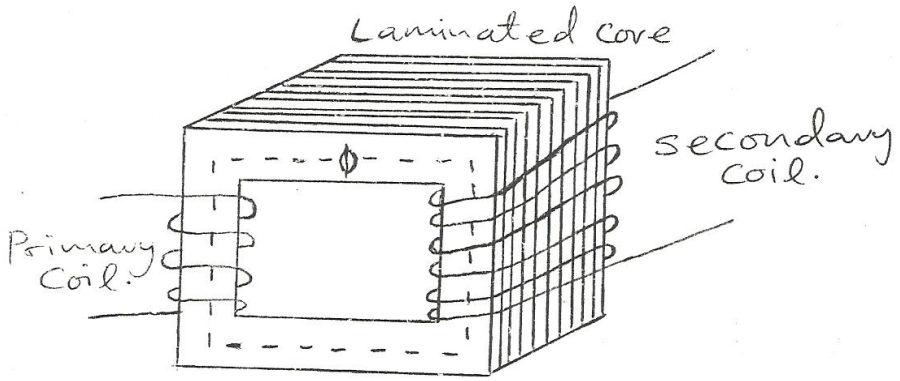
Transformer is a static piece of apparatus by means of which electric power in one circuit is transformed into electric power of the same frequency in another circuit. It can raise or lower the voltage in a circuit but with a corresponding decrease or increase in current. We have two types of transformer.

1. Step Up Transformer

2. Step Down Transformer

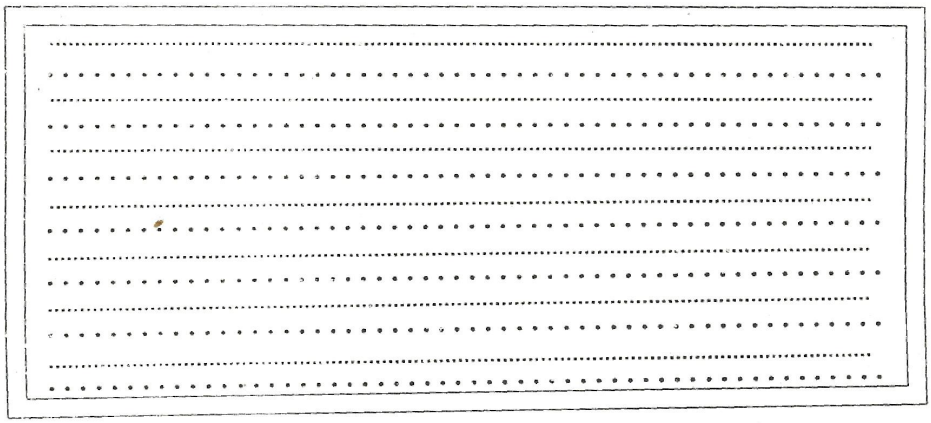
Step Up Transformer: in step transformer thee number of turns in secondary winding is greater than the number of turns in the primary winding.

Step Down Transformer: in step down transformer reverse be the case, number of turns in the primary winding is greater than the number of turns in the secondary winding. Step down transformer is mostly used in construction.



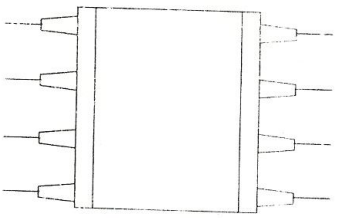
Vero Board

It is on the Vero Board that all the components of this circuit were connected horizontally, it is the circuit board. It is on which all the components are inserted and soldered with soldering iron and soldering lead, there two types of Vero Board: limning and dotted I used dotted fort's project.



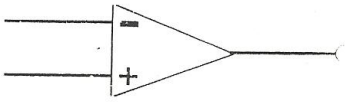
OP-AMP (1C)

OP-Amp is a high-gain operational Amp constructed on a single silicon ship using planar epitaxial process. It is intended for use in DC servo systems, high-impedance analog computers and in low-level instrumentation applications. It is manufactured by semi-conductors limited, pure



Polarity.

S

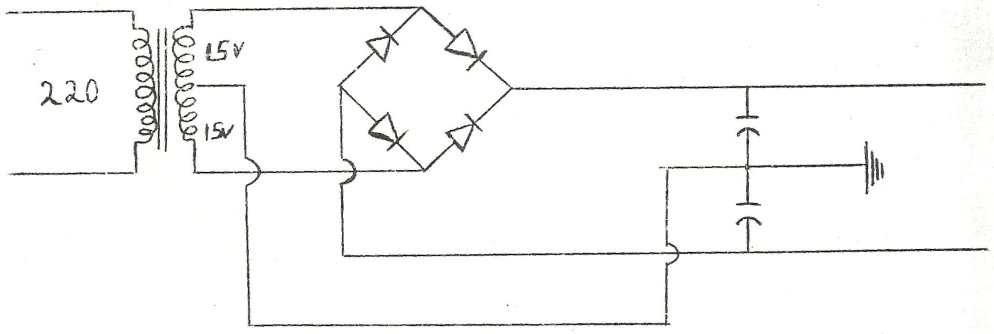


Stages of Construction

Power Supply Unit

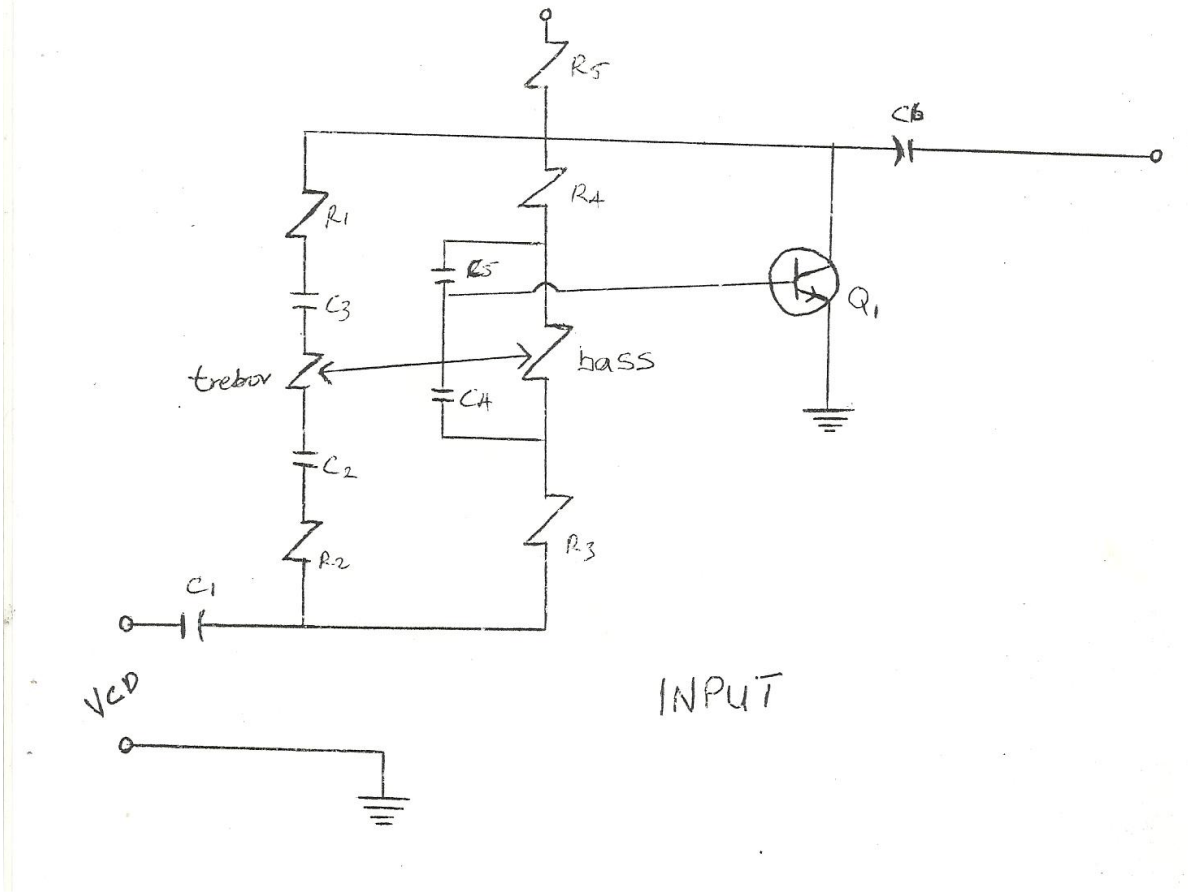
This supply unit is made up of a step down centre-tapped transformers (220v/15v), a bridge rectifier (D_1-D_2) and two capacitors connected as shown in fig below. When an alternating current is applied to the input of the step down transformer, the voltage is stepped down from 220v (mains) to about 15v alternating current converted or rectified by the bridge arrangement (Di and D_4). The transformer output signal is than passed unto bridge rectifier for rectification. When one of the cascaded transformers T, is positive with respect to the ground then the other transformer T_2 will be negative with respect to ground. At forward biased with respect to the positive current while D_3 is forward biased with respect to the negative current so both positive D_c and negative D_c are rectified. When the transformer polarities are released than diode D? is forward biased with respect to the positive and diode D4 is forward biased with respect to the negative current then both positive and negative current are rectified as well.

Since the power amplifier does not need regulated voltage, then the filtered DC voltages were supplied to the common collector Vcc terminals of the power amplifier. The capacitor Cl and C2 must be two large as to store enough electronic charge possible 2200NF $\leq$ C $\geq$1000IMF. Two capacitor Cl are each connected across the capacitor Cl and C2 to enhance discharging whenever power is switched off otherwise the system continues to work for a while even power is off.



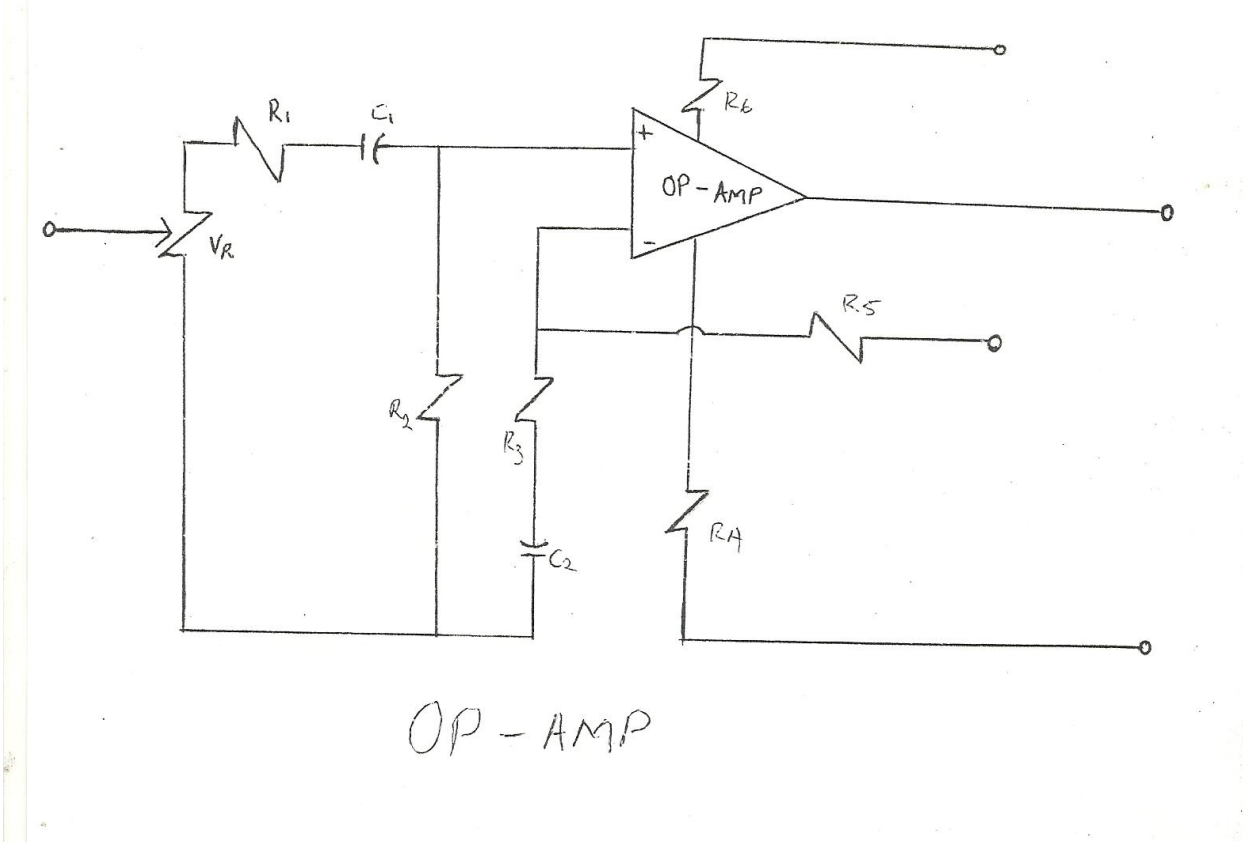
Second Stage (INPUT STAGE)

This is part or a unit of the amplifier through which the audio signal with voltage, to be amplified is supplied. This stage comprises of capacitors as well as fixed resistors, variable resistors and transistor as shown in 'diagram^ below. The capacitor being an electrolytic one acts as a coupler to the input audio signal so that any Ac voltage from the input source will be clipped off or blocked from passing through the circuit. The input resistors helped to improve the base impendence of the master amplifier, the variable resistors is there to separate the signal components to trebor and bass.



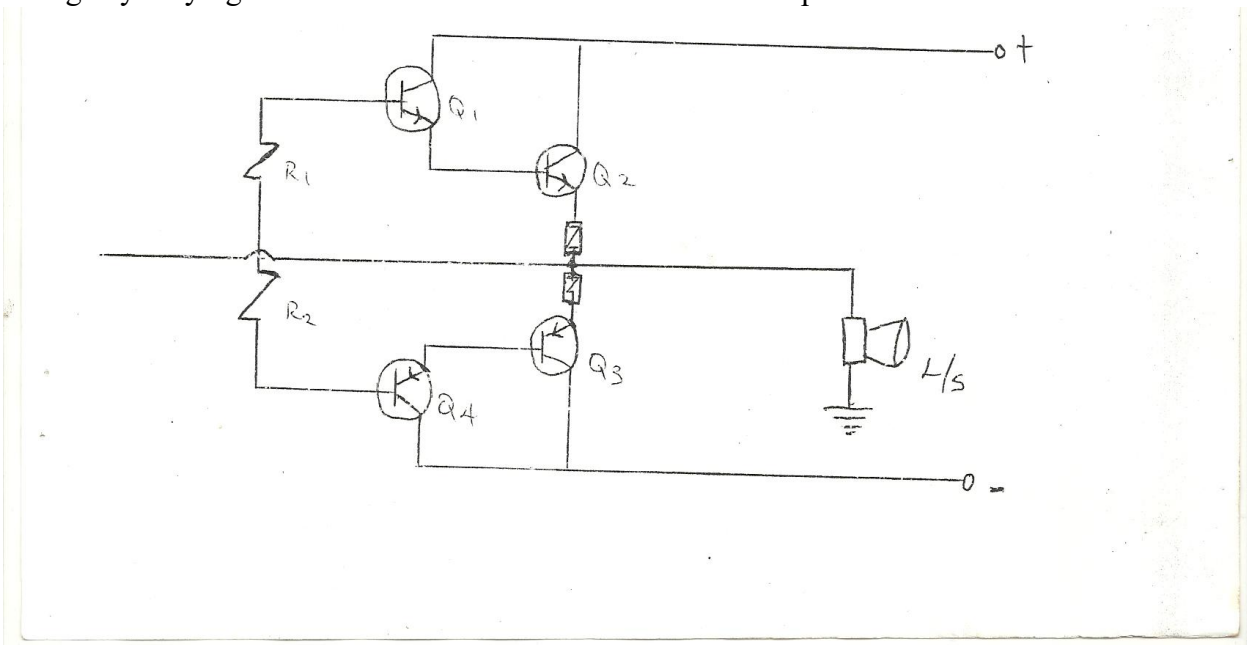
Third Stage (OP AMP)

This is another stage in the construction of this amplifier, tit comprises of one variable resistor, six fixed resistor, two electrolytic capacitors and one operational amplifier.
This stage is where the input signal is amplified to a required stable gain with the help of feedback network. The variable resistor here is used for the volume, to reduce or to increase the volume of the amp.



The Push Pull/OUTPUT STAGE

Push pull, this stage comprises of four transistors connected in Darlington pair. The function of this push pull is to provide the drive for the output transducer, which is speaker the stage derives its input signal from the power supply direct. The output stage comprises of an output transducer called the speaker; the speaker introduces some impendence to the signal flow and the effect generates vibration of this electromagnetic circuit in the speaker. The vibration of this component is in relation to the peak voltage of the signal present and hence the cone fiber that traps air causes the trapped air too vibrate in the same frequency as the audio signal. This step-up fives rise to audio power sound due to responses which is controlled by altering the amplitude of the output voltage by varying the resistance of the feedback resistor or capacitor.



Testing and Implementation

The construction of audio amplifier has various stages of construction, all these stage were tested as they were constructed before they were incorporate together. After coupling them together, there is need for testing the entire system. I experience failure after incorporating the whole sage together, due to the mismatched if the various stage. In testing of this construction, a digital millimeter was used to test the stages. Also, the project work was tested with DVD player and VCD player equally after the whole was ready.

Problems Encountered

Scarcity of materials needed for this project work, some of the materials needed were scarce within the environment so it posed a lot of stress to me for the construction of this project work. Power problem is one of the problems I experience, due to power failure in this country, the construction of this project work was delayed. This is because the soldering and construction of this project needs steady electricity, but when there is no power supply the construction of the project will be delayed. Packaging problem when I finished constructing my project I decided to package it that's to put to put it in a case, but I don't see any case that ill make it presentable and portable..

Solutions

Due to scarcity of some materials needed, I have to travel out of town in search of the required materials and components and by so doing lucky the materials were found. Finally, packaging problem after construction of this project, I decide to make it portable using of this plywood, I got from the market to pack my work.

Precautions

In the process of constructing this project I took necessary precautions. To avoid accident and damage to the appliance. Some of the precautions undertaken are:

1. I avoid excess heat on the components to avoid damaging them.
2. I avoid rough soldering.
3. I ensured that soldering lead well melt to avoid dry joint.
4. I check the polarity.
5. I never handle instrument with wet hand.
6. I avoid contact with any voltage source.
7. I handle small power transistor that has very fragile leads with care.
8. I check the connection very well before plugging in an DC source.
9. I make sure that I used the right value of the components needed.
10. While packaging, l avoid damaging the component in the circuit.

Tools used

- Multi-meter
- Screw Driver
- Soldering Iron
- Pin Pliers.

Multi-Meter

Multi-meter is an instrument used in measuring voltage, ohm's, current and any other signals in a circuit.

Screw Driver

Screw driver is a tool used in loosen of tighten screw. It is used for coupling of this project to tight the casing of this work.

Soldering Iron

Soldering iron is a tool used in soldering any electronics component. It is used for soldering in the construction of this project work inside it there is an element who's heat is used to melt lead.

Pin Plier

Pin plier is a tools used in holding the components while soldering in the circuit.

Conclusion and Recommendation

The reason for designing it is to help amplifier any audio or video signals input to a bigger output, but mainly for audio signal that is, compact disc, DVD Player. It is clearly designed for amplification of audio signal. Since it can amplifier any audio signal by receiving the small input signal and produce the bigger output signal* however, the construction of this audio amplifier is of more advantages since it is not manually operated in the sense that its' very cheap, more reliable and very economical based on its efficiency. This gadget should be in our homes, public banks, factories, industries and radio station, banks, rectories, of audio signal. Finally the audio amplifier is very essential that any prospective engineer or technician must be perfect on how it is being construction. At this Juncture encourage all electrical/elector students to embark on the advancement of this project, of cause "one" can make a good living out of it.

Recommendation

Regarding to the problem encountered and some of the findings made during the construction of this project work, the recommendation that were made, follow as. Practical seminar/workshops on electronics designing should be regularly held in the school for this will help the students to (earn on how to construct into of these gadgets like Audio Amplifier. The school management should endeavor to make availability of all components needed to equip the school lab and workshop for the student. So that the student can do their project conveniently by making use of the lab. Because the construction of project is not as hard as we think if the students are well exposed to things like that. One should learn the basic things to do in construction of any circuit (cct) like soldering techniques so as to audio damaging the whole circuit or some components in the circuit.

Bill of Engineering Measurement and Evaluation (BEME)

S/N	Items	Quantity	Unit price	Amount
1	Transistor	5	80	400
2	Capacitor	8	20	160
3	Resistor (Fixed)	13	15	195
4	Resistor (Variable)	3	20	60
5	Solder	3 yrds	30	90
6	Connector wire	3 yrds	20	60
7	Vero board	1	100	100
8	Transformer	1	500	500
9	Casing	1	750	500
10	Choke Resistor	2	30	60
11	O.P Amp (IC)	1	80	80
				2,455

References

Edward, H. (2002). *Electrical and Electronics Technology.* London Person Education, LTD.

Francis, T.G. (1971). *Electrical Installation Work.* United Kingdom, Longman

Keivi, M. (1993). *Secret of Electronics*. Enugu, Baru Publishers L.T.D.

Theraja, B. L. & Theraja, A. K. (2003). *Electrical Technology*. New Dehli Ravindra printer