ELECTRICAL CIRCUITS AND ELECTRONIC TOOLS

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Abstract— An electrical circuit is a network consisting of a closed loop, giving a return path for the current. Linear electrical networks, a special type consisting only of sources (voltage or current), linear lumped elements (resistors, capacitors, inductors), and linear distributed elements (transmission lines), have the property that signals are linearly superimposable. They are thus more easily analyzed, using powerful frequency domain methods such as Laplace transforms, to determine DC response, AC response, andtransient response.
A resistive circuit is a circuit containing only resistors and ideal current and voltage sources. Analysis of resistive circuits is less complicated than analysis of circuits containing capacitors and inductors. If the sources are constant (DC) sources, the result is a DC circuit. The part of an electrical circuit that is between the electrons' starting point and the point where they return to the source is called an electrical circuit's "load". The load of an electrical circuit may be as simple as those that power electrical appliances like refrigerators, televisions, or lamps or more complicated, such as the load on the output of a hydroelectric power generating station. Circuits use two forms of electrical power: alternating current (AC) and direct current (DC). AC often powers large appliances and motors and is generated by power stations. DC powers battery operated vehicles and other machines and electronics. Converters can change AC to DC and vice versa. High-voltage direct current transmission uses very big converters. The design and creation of electronic devices and systems requires meticulous attention to detail. Mobile apps for electrical engineers provide a wide range of capabilities that can make life easier for anyone working with electronics. There are apps that provide reference materials, wire-gauging tools, resistance calculators, and visual references for resistors and other components, and generally encyclopedic access to all the information an electrical engineer would need to make important decisions about a project. The apps in this collection cater to users of all skill levels, from pro electrical engineers to amateur household electricians. Many of them are available for both Android and ions, and some even have a desktop or browser based edition. They're listed in no definitive order. Most are free or inexpensive, and they're well worth the price for the wealth of electrical engineering info they put in your pocket. We investigate principles of electronical circuits and tools through this paper.

Keywords— Circuit, Tool, Electrical, Electronic.

I. INTRODUCTION

Electronics folks refer to the assortment of odds-and-ends that go into a circuit, collectively, as components. These are the things that make a circuit work. Although you can make a complete circuit with just a battery, some wire, and a light bulb, most electronics projects use a few more components, such as resistors, capacitors, diodes, transistors, and integrated circuits. You can think of these components as the common building blocks of the typical electronics gizmo. The variety of components, and the way they connect to one another, determines what a circuit does. Wired one way, a collection of a few resistors, capacitors, and transistors can build an electronic siren; wired another way, the circuit can become a flashing crossing sign for a model railroad.
Electrical and electronic circuits can be complicated. Making a drawing of the connections to all the component parts in the circuit's load makes it easier to understand how circuit components are connected. Drawings for electronic circuits are called "circuit diagrams". Drawings for electrical circuits are called "wiring diagrams". Like other diagrams, these diagrams are usually drawn by skilled draftsmen, and then printed. Diagrams may also be created digitally using specialized software. A schematic is a diagram of an electrical circuit. A schematic doesn't look like a life like a circuit, but it does show the essential connections. Schematics use symbols to represent components in the circuit. We use conventions in a schematic, we use them to represent the way electricity flows. The common convention we use is from the positive to the negative terminal. The realistic way electricity is from the negative to the positive terminal. Wiring and circuit diagrams use special symbols recognized by everyone who uses the drawings. The symbols on the drawings show how components like resistors, capacitors, inductors, motors, outlet boxes, lights, switches, and other electrical and electronic components are connected together. The diagrams are a big help when workers try to find out why a circuit does not work correctly.

II. ELECTRICAL TOOLS

As a positive aspect, graphical representation of electronic circuits creates an overview of the components used and how they are connected. Such representation is also a great way to draw attention on details that require changes which would increase the cost of production and the time required to create a physical circuit prototype. The negative side, circuit sensitivity can influence the outcome of the work, for example external noise cannot be fully known or taken into account when creating wiring schematics and this can lead to errors or results not fully predictable in the physical implementation of the

circuit however there are several software tools that do offer pretty accurate simulation features.

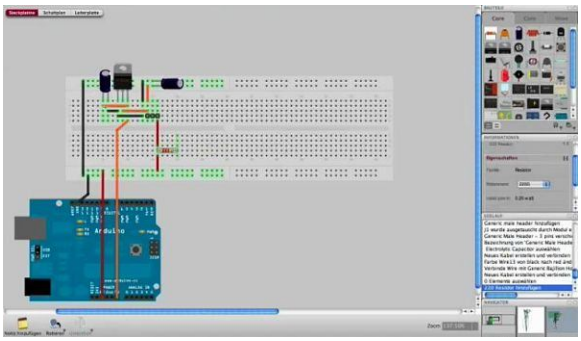


Fig.1 Fritzing

Fritzing is a very user-friendly community driven platform where collaborative design is encouraged. You can also order custom PCBs fabricated based on your very own electronic designs.

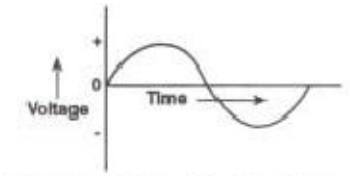
III. CONTROLLING ELECTRICITY

Electrical components, or parts, can control electricity. For example, a switch connects a light bulb to electric current. To disconnect the light bulb and make it go dark, the switch simply makes a break in the circuit. Some other parts that control electricity are resistors, capacitors, diodes, and transistors.

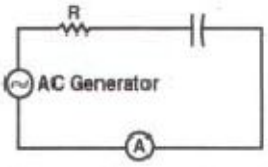
IV. ALTERNATING CURRENT (AC)

With alternating current, the voltage goes from zero to some maximum value, back down to zero, and then in the negative direction before returning to zero once more. Alternating current frequently does look exactly like that shown, which is a sine wave. If it doesn't look like this, engineers find some way to transform their calculations so that they can then use all the mathematics which lie behind the sine wave. What happens when a capacitor is subjected to alternating current?

To the capacitor, it looks just like DC which is flowing in and flowing out again. The capacitor is alternately being charged, discharged, and then recharged in the opposite direction before being discharged again. One fact important to note is that the capacitor can never block the flow of AC but instead permits a steady flow of current. This throws the timing circuit out the window, but it opens up a lot of new possibilities. Consider how much current flows through the circuit. If the generator's sine-wave and the resistance, "R," don't change, current flow depends upon only two things. The first is the size of the capacitor, its capacitance. With a large capacitor, there will be insufficient time for it to be charged more than a small amount before the current direction reverses and it is discharged again. Current flows very easily when the capacitor is near its discharged state, as noted with the timing circuit. If the capacitor is small, it might approach the completely charged state before the current reverses direction and discharges it. The smaller capacitor would thus offer much more hindrance to passage of the current.



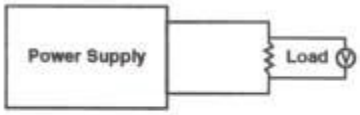
Alternating Current-The Sine Wave



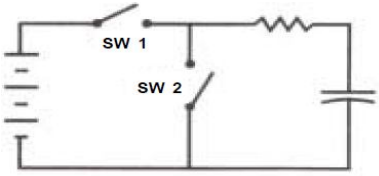
Meter to Measure Current

V. DIRECT CURRENT (DC)

The timing circuit is a good example of a DC application. Note that the capacitor blocks flow of DC once it is charged. Current would flow once more if connected to another switch to discharge the capacitor. If switch No. 1 was opened and switch No. 2 was closed, the stored energy in the capacitor would flow as current through the resistor until the voltage across the capacitor reached zero. The capacitor can thus be compared to a storage battery, although the principles of operation are entirely different. The storage capability of the capacitor is used to good effect in filters. A DC power supply offers a good example. Basic DC power supplies provide an output (that is, the voltage across a load, shown here as a resistor) which is fluctuating. The following figure shows a situation where the voltage drops completely to zero. The goal is a straight line across this graph representing a steady DC voltage.



Measuring Voltage from a Power Supply



Discharge via Switch No. 2

VI. SENSING WITH SENSORS

Certain electrical components generate a current when you expose them to light or sound. You can use the current generated, together with a few of the components listed in the previous sections that

control electricity, to turn on or off electronic devices, such as light bulbs or speakers. Motion detectors, light sensors, microphones, and temperature sensors all generate an electrical signal in response to a stimulus (motion, light, sound, or temperature, respectively). These signals can then be used to turn other things on or off. A high signal level might turn something on and a low signal level turn something off. For example, when a salesperson walks up to your house, a motion detector can turn on a light (or better yet, sound a general alarm).
These signals take different forms, depending on the component supplying them. For example, a microphone supplies an AC signal, and a temperature sensor supplies a DC signal.

VII. TOOLS TO MEASURE THINGS

When building or troubleshooting a circuit, you need to make measurements to check that parts are working the way they should and that you designed and built the circuit correctly. Tools that you can use to measure things include a millimeters, an oscilloscope, and a logic probe. We'll take a moment to briefly tell you what you can use a multicentre for because it's the measuring tool that you buy first and possibly the only one that you ever need. Say you build a circuit, and you've just turned it on. What if the circuit doesn't work? With a multimeter, you can find out which part of the circuit is causing the problem. You can measure voltage, resistance, and current at different points on the circuit. For example, if there are 5 volts at one location on the circuit and further along at another location your voltage suddenly drops to 0 volts for no logical reason you can make a good guess that your problem lies between those two locations. You can then check (after the power is disconnected, please!) for loose wires or damaged parts between those two locations.

VIII. OPERATIONAL AMPLIFIERS

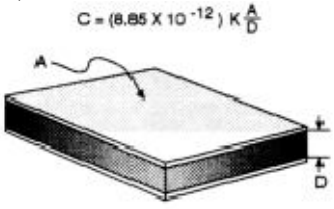
In control systems, feedback consists in comparing the output of the system with the desired output and making a correction accordingly. The "system" can be almost anything: for instance, the process of driving a car down the road, in which the output (the position and velocity of the car) is sensed by the driver, who compares it with expectations and makes corrections to the input (steering wheel, throttle, brake).

IX. CAPACITORS

Capacitors in electronic circuits are normally not subjected to very large AC currents. Upon occasion the power-handling capability of electronic capacitors must be considered. It frequently comes up in filter design where the expression "AC ripple" is used. DC power supplies attempt to make pure direct current by filtering out fluctuations. These fluctuations are like ripples on the surface of a pond and represent AC passing through the capacitor. All would be well except that capacitors which have zero resistance cannot be built. To calculate power, the equation below is used, which requires that the AC voltage across the capacitor be known as well as the AC current flowing through the capacitor. (There might be a DC voltage at the same time, but remember that there cannot be a steady DC current through a capacitor. If there is a pulsating DC, it must be treated like AC.) There is nothing wrong with this expression except its inconvenience.

X. FUNDAMENTALS OF KEMET CAPACITORS

Before proceeding to KEMET capacitors, let's take a minute to review some terms. Here once more is the capacitance equation, where A is the area of opposing electrodes, D is the separation between electrodes and K is the dielectric constant. The value of K depends on the specific dielectric material, and the higher K becomes, the more capacitance we would get if nothing else changes. The constant, 8.85 X 10-12, was derived for units of D in meters, A in square meters, and C in farads (that is, one million microfarads).



The Capacitor Equation

The practical designs of KEMET capacitor types all develop A and D. The value for K comes from selection of materials and not from any geometric arrangement of component parts.

CONCLUSIONS

Most studies of education and learning in relation to electric circuits are done with students studying in primary or secondary school. Few studies deal with learning and understanding of electric circuits at the university level. Although courses for engineering students deals with topics typically not covered in school these studies are relevant for the university level. As will be shown below university students have problems with the same topics and concepts in electric circuits as younger students have. We can see that there are inconcistencies in the majority of the answers to the questions that relate to either potential difference being the cause of current or current being the cause of potential difference. It can be originated from the way the questions were written (in every country the expressions used sometimes change),

from misunderstandings, or because there is not a consensus among the teacher regarding this aspect. Electrical circuits have some aspects such as:

The simple model of matter is that it is made up of atoms which have positively-charged nuclei orbited by negatively-charged electrons. Given sufficient energy, an electron can be dislodged from its atom.

•Think of electricity as the flow of energy carried by the movement of electrons dislodged from atoms.

•An electrical circuit is formed when there is a closed path around which the electrons flow.

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