Integrated Circuits, MOSFETs, OP-Amps and their Applications

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Lecture - 38
Experiment_ Measurement of Active and Passive elements using Multimeter

Welcome. So, last module or series, short lecture, we have seen about the discrete components, and we have seen about the breadboard, right? this particular module we are focusing on measuring the values of different components, right. So, let me introduce the teaching assistant, Sitaram Gupta, he will be showing you how to use the components, and as and when he is using the devices or using the equipment, I will tell you how the equipment works how you can use the devices, all right.

So, we will start with measuring the resistor. So, resistor we have seen in the last class resistor, right. Now, what is the value of the resistor that I am holding in my hand?

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If I can see this is a resistor in my hand, right? Now what is the value of this resistor right. So, for that I will give it to Sitaram, and let him measure the resistance, and you can you focus on this particular multimeter, how he is measuring the resistance, all right.

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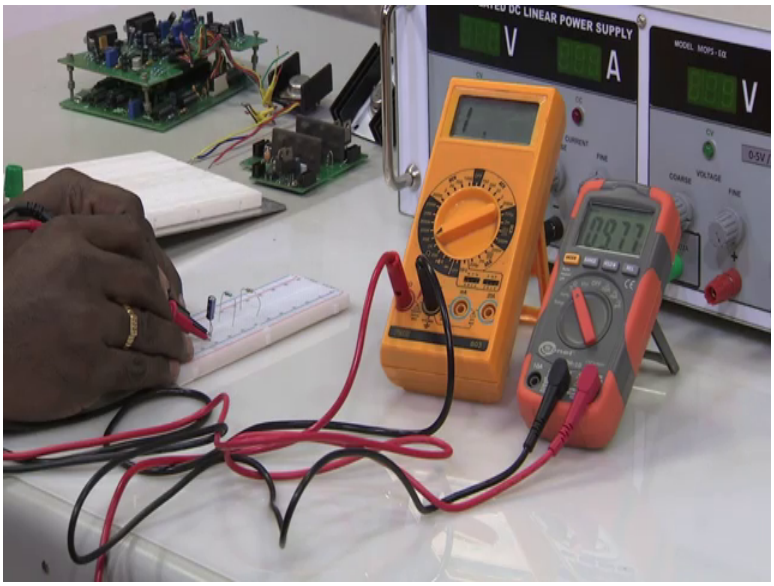

So, you can see the first thing that he is doing is he is using the resistance, right. You see resistance he has kept around 20 kilo ohm. So, you can you can start at any value if you do not know the value. And you can keep on increasing the this probe to higher values. So, the first thing he has tried 20 kilo ok, let us see now.

So, when we see the resistor, the probes are connected you can see here, right. The probes are connected and when you connect the probe, you can take it in hand and you can connect it like this, yes. And when you connect it like this, right. You can see the value can you see the value here can you please focus here.

Yes, so, what is the value you are looking at, you are not looking at any value, right. Is it you know you cannot measure any value. So now, we are increasing the value, right. Initially it was 20 kilo ohm, here you cannot see anything so now, we are increasing it, right. And then we start looking at 40 so, what is 40? 40 it is in 2,000.

So, what is the value of this one? Around 2 and around 33 20 kilo ohms, around 3 110 kilo ohms, right. So, this fluctuating because he is holding with hand, in reality you do not have to hold with hand. You can always use the breadboard, and you can insert the register, insert the resistor, and then you can again measure the resistance.

So, when you insert the resistor like this, and then you measure it, right. You will be able to see the value which is more appropriate here. If you see now is almost constant, right.

It is almost constant, earlier it was like 31, 32 because it he was holding with hand, the connection was were not proper. Now in this case, when you see it is almost constant. What are we using? We are using breadboard, we are using breadboard, all right?

So now let us go to another resistance, right another resistor. So, this is another resistor that I am giving it to him. he is inserting it into the breadboard. Now you again, let me let me reiterate that you may think that this is this. So, easy we know, but even you know it is important to understand, all right.

So, always understand even you know something what is the value you see value is extremely low. So, if you go down can we go down and can we see still, yes, so, this is around 20 kilo ohms. So, you can see 2.14 kilo ohms around 2.14 kilo ohm is the value of this resistor, right.

Now, if we if you want to measure so, this is about the resistance. So, easy to measure similarly, if we have multimeter which is not the yellowish one, right; which is which has different kind of settings. So, here if you want to use this multimeter, like I have shown you in the last module, we can we can keep it in the resistance mode. So, this is the resistance frequency, capacitance everything can be measured in the same place.

So now, if for this these are the probes, he is in connecting this probe to a resistor you see resistor, right. Again, it is showing some value all right. So, this is in auto mode so, it will automatically measure the resistance of the resistor, all right. If you if you connect to another resistor, you will see an another resistor is connecting and we are getting the value around 2.161 is even more accurate compared to the another one.

But the again, and let me let me tell you this thing that we are not interested in understanding the accuracy, right now not resolution, right now we understanding that how we can use the multimeter for measuring different components, all right. So, this is the how the resistors can be measured all, right excellent.

Let us move to the another part which is the capacitor. Now can you measure the capacitor using the this multimeter? Can you measure capacitor? Can you see there is a capacitance value? No, is it? No, there is no place there you can see the capacitance, but in this there is a place. The same place where we are where we are putting right now which is a resistance which is ohms you can measure capacitance as well, all right.

So, I will give a capacitor to him he will connect it or he will insert it in the breadboard, and then you will see the value of the capacitance on the multimeter. So, let me let me read the value, the value is 10 microfarad. So, let us see so, again let us see how he has inserted the resistors.

You see I told you that you can insert it like this, only when you are not considering the central portion centre portion depth side is one connection in series this side is one connection in series. But so, you can connect resistors like this, you see resistors are like this, all right. Same way capacitor he has connected, but you see another 2 2 different area ok, one pin is here, another pin is here.

Now, let us measure the capacitor. So, you can see you can change the selection, you can bring it or you with this mode button, you can change it, right. And you can bring it to capacitance mode. So now, it is here which is your micro or nano-farad, it is nano-farad. So, let us see, right what we see is around 9.77 microfarad, correct? 9.77 microfarad, and the value on the capacitor is about 10 microfarad. So, it is close it is close all, right 9.77 micro farad.

Now, let us see another capacitor, ceramic capacitor. So, again capacitors are several types again this is not a scope of this particular course, but that can be that can cover under a different course on semiconductor devices, where we can see what is then within the capacitor what are kind of capacitor the kind of diodes. But, right now let us see if the ceramic capacitor is there, which is in my hand and I am giving to again to Sitaram.

So, let us see how we can measure the capacitance of this ceramic capacitor. So, again he is inserting the capacitor in the breadboard, right. He is using the same multimeter, and when he is connecting with the probe, we can see the value of the capacitor which is around 464.1 nano-farad, right; 461, 464.1 nano-farad, you can always convert 2 microfarad if you want it is very easy.

So, the point is this is so easy to use, extremely easy to use, right. How about we have a diode? If we have a diode, can we measure within with both the multimeters? Yes, you see in this multimeter, there is a symbol for diode here. Where my finger is there diode is there. And in this particular multimeter, same again same point we can measure diode all right. So, I am giving him the PN junction diode which we have seen in the last lecture, the PN junction diode. Now he is connecting PN junction diode to the breadboard.

Let us see p, and n p and n. I told you there is a silver ring on the diode that is easy way of identifying it, but we have to measure the diode with the multimeter. So, let us see with multimeter, first we are looking at the multimeter which is 603 from mico this is yellowish one, yellow colour and let us see the which is anode, which is cathode it is easy to identify if we can see some value yes, right.

So, what we are connecting? Right now, is a diode, and if we connect it the positive to the anode and negative there is a ground to cathode, then only we will see this value if we if we change the probe that is, if in change the value that is negative or ground to the anode, and the positive terminal to the cathode then you see, you cannot see anything. Can you see anything in that this one? No right?

So, the is very easy to identify which is anode which is cathode again once again let us see this is the, right. Connection we are connecting ground to cathode and positive to anode, we can immediately see the change. So, this is very easy to identify the diode is anode or diode is cathode.

Same way, if you want to use this particular multimeter, right and we are measuring the diode; So, again using the mode function, we can change it to diode is very, very easy you there is a symbol of diode here also. So, when you press the mode this particular yellow colour button you will see the change here now it is diode.

Let us see the when we are connecting positive to anode ground to cathode we are again looking at the some voltage right. So, is easy we identify that yes this is anode this is cathode, if you do reverse thing we will not be able to see anything correct? Easy?

So, what we have seen here? We have seen diode then we have seen resistor, we have seen resistor we have seen capacitor we have seen bigger capacitor. Now it is kind of it looks very beautiful because if you see from smaller to bigger actually diode is also little bit big in terms of he has placed the components it looks good, all right.

Now, let us see the another one which is the transistor. So, whether the transistor is NPN or whether the transistor is PNP, how we can know? Now you see in this multimeter that you see here, there is no functionality that we can measure the transistor here we can directly place the transistor and know whether it is NPN or PNP by keeping it in this

particular mode which is HFE, I told you last time and there is nothing, but the beta and we can measure whether it is NPN or PNP.

Now, the one that I am holding in my hand, he will insert it and he will and we can see the display, and we can we can identify whether this is NPN or PNP transistor.

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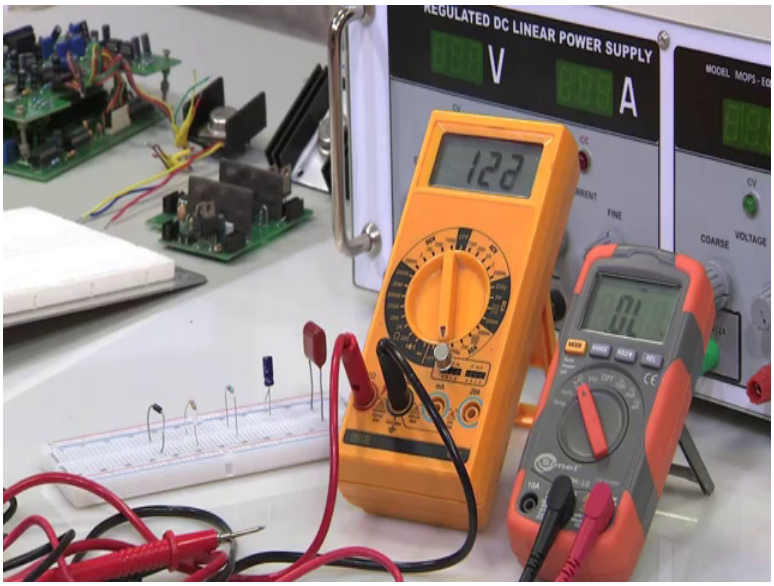

So, he is placing this in NPN to start with, and he can see some value which is around 145, 131, 0, 7 keeps on fluctuating. How about he keeps the same thing in the PNP side?

So, in the in the multimeter itself is NPN, PNP you have to connect it ok. So, when you connect it to PNP, see, no change, you see this is PNP side. He kept this thing, the transistor in PNP, earlier he placed in NPN. When he was placing in NPN, he could see the change in some value. Here when you see PNP HFE there is no change right; that means, that this is not PNP transistor it is not an PNP transistor, and it is an NPN transistor.

Let us see the another transistor, then how about this? Transistor that I am giving it to him and this is another transistor. So, again he is trying to keep it NPN. So, let us try with NPN first one. And as you see, there is no change, can you see any change? There is no change, right. So; that means, that this transistor is not an NPN, is it PNP? Let us see, there is a change; So, easy to identify whether it is NPN or PNP, all right?

So, what we have seen? We have seen the role of multimeter to understand the discrete components to understand the discrete components. But can multimeter be used to measure the AC voltage; can a multimeter, can be used to measure AC voltage? So, yes, it is there, right because we have we have a knob that we can connect it to the this particular value here. So, you can now take it out this transistor, all right.

Now, let us let us keep it to AC, and to understand whether we can use it for AC or not we need to have another equipment called variable variable AC or variac , which is v a r I a c. So, old variac with me now, the way I have placed here.

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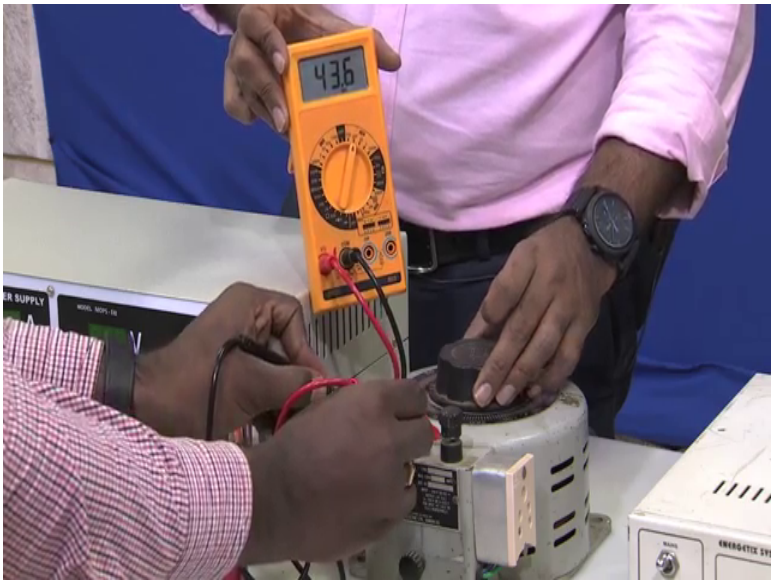

You see lot of time, we do this mistake, you can zoom out, zoom out, this is wrong. You should not place a component over each other, right. This is not a circuit; this is not this thing, that you can place it like this, right. Never place your electronic components one over each other; this is a wrong way of operating the system, wrong way of using in the laboratory, right.

Always remember, when you start the experiment, your table should be clean; when you leave the experiment your table should be clean, right. You should understand how to work in a laboratory, and that is called good laboratory practices how to enter the lab, where to keep the bag, how to use the components, how to place the equipment, that is how it is very important all, right.

So, like I said, we should not place on it we are placing it next to it, all right. This is very heavy, right; because there is a transformer heavy, all right. Now we are connecting this to the power supply, and we have switch on the power supply. So now, if you can focus here, you see, you can change the voltage from 0 from 0 to 230 volts, it is connected to where? This is connected to the power supply, this is connected to the 230 volts AC, all right.

So now, what is the voltage across these two terminal? If I want to measure what is the voltage across these two terminal, I can again use a multimeter, all right any multimeter. So, if you see there is a multimeter here, if you see there is a multimeter here. So, let us see ha whether Sitaram can get any voltage or not, all right let us see.

So, he is connecting the red and black, right. Now this you can connect in any way it is AC, you can connect in any anyway does not matter. You will see the change and I will then tell you, what is that you can you can connect it now, right.

So, what do you see in my hand here, right. Here is about 19.4, I have kept around 20, right. If I keep on increasing, you see? You can see keep on increasing, what is this? Is your AC voltage, AC voltage, we can vary the AC voltage that is why it is called variac, v a r i a c, variac ok?

So, right now what we see is we can change the voltage we I am increasing the voltage and correspondingly I can see the increase in the voltage here on my multimeter. So, easy extremely easy, now you know what is the voltage at the output of this particular variac, correct? We can keep on increasing, you can keep on increasing, same way if I keep on decreasing, it will come down, it will come down, it will still come down, right same way.

Now, what is the frequency? There is another thing right, but what you have seen is you can connect it, connect the probe. And you can see the voltage same way you can do it with another multimeter, which is your, this one can, you can you please connect it. Connect it to here, this one I can hold it. So, again he is connecting this multimeter, right. It is in AC mode, we can we can see the change, right.

We can see the change; I am increasing the voltage, right. And then I am again increasing it 105 and 120, 134, 138, 146. Now I am bringing it down. So, it is coming down, right;

comes back to almost 0, because now there is no voltage. So, around point 0 or 52 millivolts, right 9.095 point 96 right. So, this is how we can measure the voltage, this is what we are measuring AC voltage.

Now, if I want to measure the frequency, can I measure the frequency, right? So, let us see, what is the frequency here connected to frequency, yes; it is a mode of frequency. Now he will again connect it to the same one, this is 230 volts, all right. And we all know what is the frequency, we will see. Even we know we see, here 49.85, 49.86 close to 50 hertz, right. Close to 50 hertz, all right thank you.

So, what we what we saw, right now, right. In the set of experiment is that we can measure. So, after you use it, right after you use it ok, you should immediately switch off the power. Switch off the power before you start working on other parts, or you note down in your notebook, or you lock down the results in your system, right. First thing that you do is you switch off the power, all right. So, I am switching off the power, I am taking it out all the way, right. Because I do not want to use it right so, I am done with this.

So, this is how you should take it out. Do not just keep it connected. I do not need it I do not use it I just disconnected, always be safe, right. Safety is extremely important all right. So, again a part of your good laboratory practices, cool, all right. So, where were we have seen the multimeter, and the role of multimeter to measure several things, right. Right from different devices discrete devices, right.

Then we have seen we have seen transistors both the transistors transistor PNP NPN transistors, right. Then we have seen the voltage using the variac or vector, and we have also seen the frequency, we have seen the frequency.

Now, why it was close to 49.86 something? Because in India, right if we measure the voltage the voltage would be single-phase 230 volts and the frequency is 50 hertz, 50 hertz right; however, if you go to some countries, you will also see a voltage which is 110 volts, but in that what is the frequency? The frequency is 60 hertz, right; 110-volt 60 hertz, 230 volts 50 hertz right.

So, the point is that that is also another topic that which one is better 110 is better 230 volts is better, but if you if you take a example of a electronic equipment at our home, for

example, juicer or a trimmer, it can operate on both the voltages [vocalized-noise.] If I go to US, I can use it 8, 110-volt 60 hertz if I come to India, I can use it at 230 volts 50 hertz. So, so that is that is a separate issue that what is within it so that it can operate on both the voltages both the frequency.

The point here is that, using the multimeter can you measure voltage can you measure frequency the answer is, yes. Can you measure resistance, yes capacitance yes, right? NPN PNP yes, DC voltage yes, DC current yes, AC voltage yes, AC current yes. So, when you say lot of time yes it looks good, but the point is multimeter cannot solve everything. Can it give you DC power supply? It cannot give, right. How multimeter operates? There is another thing.

So, if I start giving a voltage, right. Some voltage is there constant current is there what is there constant voltage is there constant current is there is a question, right. What is within the multimeter that operates the multimeter. I told you there is a there is a battery, right.

So, if you see in some multimeters 9-volt battery some multimeter it is different the point is, what is the operating what is the with the mechanism how multimeter operates. So, that is that is the same thing that you have to learn, you see, I told you in my first class, that do not rely on instructor to tell you everything, right. Instructor is there to tell you the ingredients, he will show you how to make tea for one time, not every time right. So, every time when you have to do you have to explore, what to add what not to add how to use the components, right?

But the same time, what you learn here is what is safety; right. If you do not know you ask before you use it all right. So, we will stop the this particular module, right; Over here because in next set of modules, we want to see the equipment starting from the DC power supply.

So, you see here in front of me it is a DC power supply, if I remove this, you can see very clearly, what is there is a DC power supply. And here also is a DC power supply. So, in the next like I said module we have to see how the DC power supply operates, and what are the kind of DC power supply is it variable DC or it is a constant.

And then in following modules we will also see different equipment such as function generator, you will see oscilloscope, right. And then we understand that how we can use this all the equipment to solve some electronic circuits or to or to use different experiments to analog experiments, right. You can do measure for example, the inverting amplifier how inverting amplifier operates, right. How non-inverting amplifier operates.

So, if you want to understand this thing, you have to use this equipment. And before we use this equipment we should know about this equipment. So, the next set of modules is to understand the equipment, and then we will move on to actual experiments using this equipment and using the discrete components along with your indicator circuits, all right?

Thank you and I will see you in the next module.