Electronic Systems for Cancer Diagnosis
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Lecture - 61
Data Acquisition System for Biosensor Applications

Welcome to this module. In previous session, we have seen different varieties of instruments that we have in our clean room facility. We have also seen the demonstration of an LCM meter, how does it works, and how to do the calibration.

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So, now we are going to see another instrument, which is available in our clean room facility that is national instruments virtual bench. If you observe, the purpose of this national instrument virtual bench is to provide the required signal to the fabricated sensor. So, what it does is that, the required signals like voltage generation voltage that is required to apply to your system or the to take to record the data like one whatever the data is being generated from the fabricated sensor, and if you want to capture the signal or to record the signal or to observe it in an oscilloscope that can be everything done by using a single instrument.

It has a multi-purpose different functionalities. It can operate as a function generator; it can also operate as a logic analyzer; it can also operate as an oscilloscope, also as a variable power supply too.

Now, we are going to see, how exactly the single instrument can all can be used to perform all these operations as well as the mode of connection everything. So, if you observe here, it can be communicated to your PC using two different modes; one is either by using USB cable, so other one by using a Wi-Fi connection. So, it has an onboard antenna, once the software has been installed to that or if the Wi-Fi has been connected to this particular software to this particular device, it will automatically show you the software. And using that software, you can control the required functionality using this oscilloscope or using this virtual bench.

Now, I will demonstrate you, both the ways of communicating one by using a USB as well as one by using a Wi-Fi. So, if you see right now, this particular device has been connected to the PC using USB. So, for our case of understanding, I just unplug and plug the USB device. Now, if I see, here I can see the virtual bench right. So, when I click on this, it will automatically open the predefined or pre loaded software which is available in that. So, run or install program, you can see here; so, all the functionalities that we are discussing about.

So, this particular setup is meant for varying the power supply. If I closely observe here, this is where the DC power supply unit is, so whatever the voltage that is required for your system to operate everything can be operated performed using this DC power supplies, so that can be varied using a software. So, one channel can go up to from 0 to 6 volts, other channels can go up to minus 25 to plus 25.

So, in case if we have a systems connected with an operational amplifier, which requires a positive as well as a negative output voltages, everything can be managed with a single source, so that is why, it has about positive 25 values as well as a negative 25. And moreover, here if you see, you have a CH 1, and CH 2 channels which acts as an oscilloscope, what are the signal that you want to acquire and observe the performance of that particular signal can be connected to this using the probes, and can be visualized in your PC.

Then we have a function generator unit. In case if you want to provide a specific frequency of particular output voltage signal like triangular, square, ramp, anything can be generated using this function generator, and can be sent to your device to your actual

device using proper probes. Also this particular unit can also uses digitalize IO pin unit 2 as well as it also acts as a multimeter, we will see one by one.

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Now, when it comes to a software part, so as we have seen, this is a DC power unit, where you can switch on that particular unit, and transmit the signal or send the particular required output voltage using this particular bar. And here if I want to use a functional generator using this national instrument virtue bench that can be completely varied across this particular bar.

So, you can vary, you can provide in DC offset, you can also change you can also provide an amplitude, and the frequency generation, everything you can do with this. And similarly, another functionality is here oscilloscope. So, whatever the signals is being acquired, it can be completely observed using the screen.

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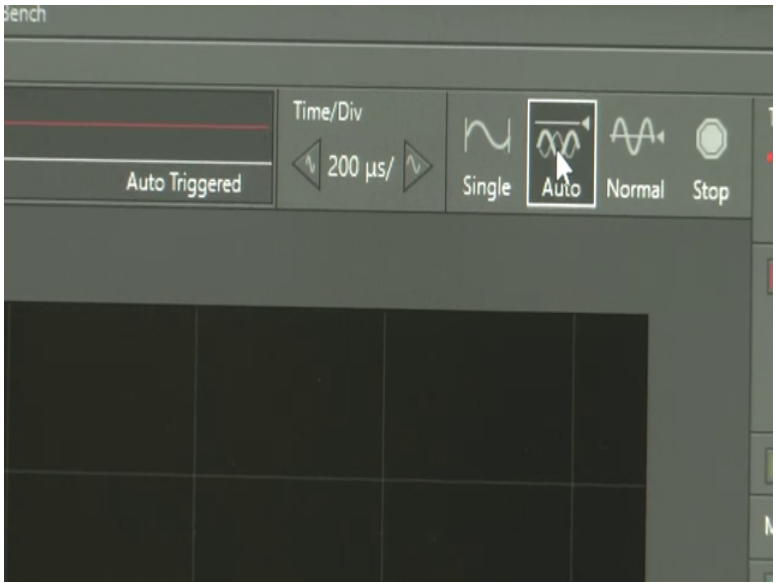

So, similar to your normal oscilloscope, you have different functionalities even here like auto setup, and changing your timescale different time scales, you can change it right. And if I want to have a single signal, you can get a single signal, auto signal, normal, and even digital so everything.

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And another thing is this is the place where, you can make use of the same device as in multimeter.

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You can observe even measure DC voltage, it is a similar to that of your normal multimeter, AC voltage, DC current, AC current, resistance measurement, diode checking, connectivity checking. So, everything can be done with a single unit. Now, we will see, how we are going to use this device, and how do we measure using this particular software.

So, another advantage of this device is that whatever the data you are being acquired can be captured, the screen the screenshot of the system can be taken as well as the data which is being acquired can be exported to a file also. Now, I will take what I do is that, I will connect a multimeter units. So, this is a probe for the multimeter. So, I am connecting it to voltage low, and another multi meter probe high, I just connected it.

Now, we will what we do is it from here, we will generate an output signal output voltage from here, and we will measure, what is the what is the generated output voltage, and what is being measured in your multimeter, we will observe that this is the connector for this. Now, I am switching on the DC power unit here, you can observe here. So, I am enabling it.

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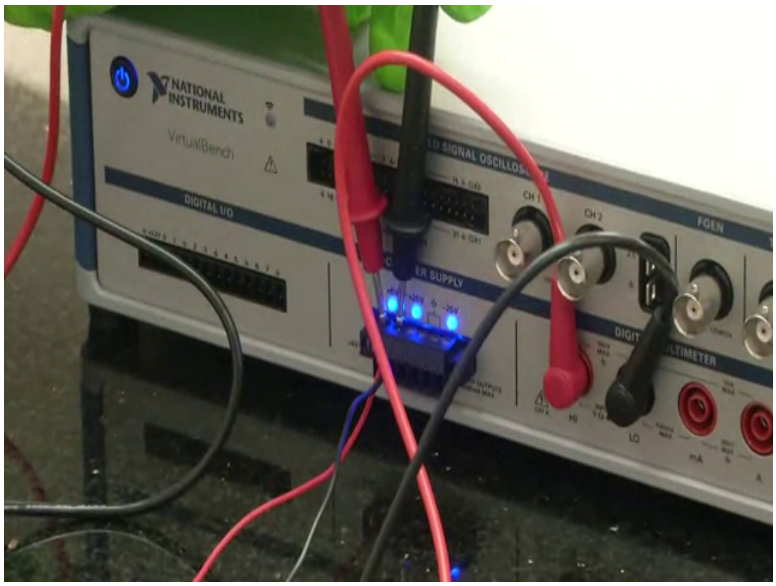

So, since I enabled, here I can observe the switching on off DC power unit the blue colour LEDs. Now, since it is connected in a voltage mode, if I measure across ground and 6 volts, so this is a variable DC power. So, here I have to go to DC voltage, so the applied voltage is 2 volts, the measured is also 2.0004 volts, see the precision of the unit.

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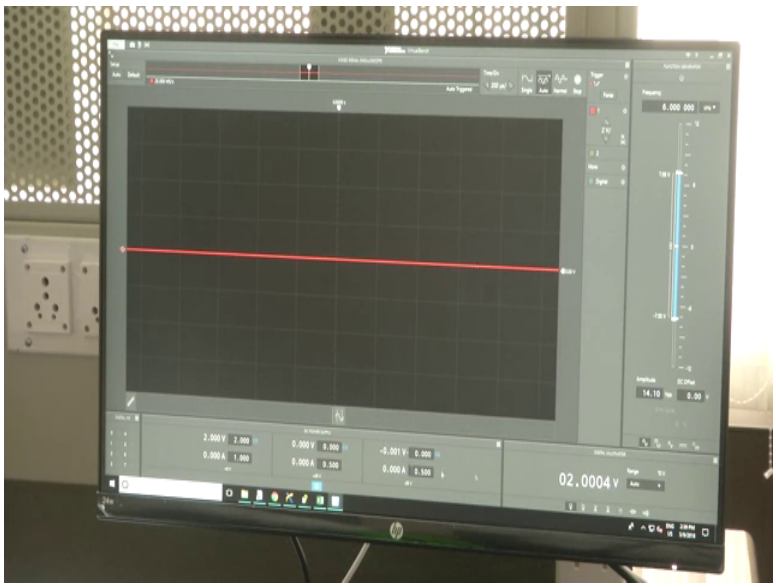

So, what I will do is I will be keep on varying this voltage input voltage, and we can observe even here. So, one step is am generating a voltage signal using power supply, I am varying the power supply in a software level, and using a multimeter which is

available in the same unit. I am measuring what is a voltage being you know measured across the power supply, what is being, what is the voltage being generated across your power supply and even here.

Suppose, if I so this is the current, the rated current is max of 1 amp. So, if you want to limit, you can even limit to using this particular space, so here we can see. Also if I change my terminal from since the rated voltage of these two channels, these two channels are from 0 to 6 volts. If I want to make use of more than higher voltages, I can connect to the next channel from 25 to ground and observe.

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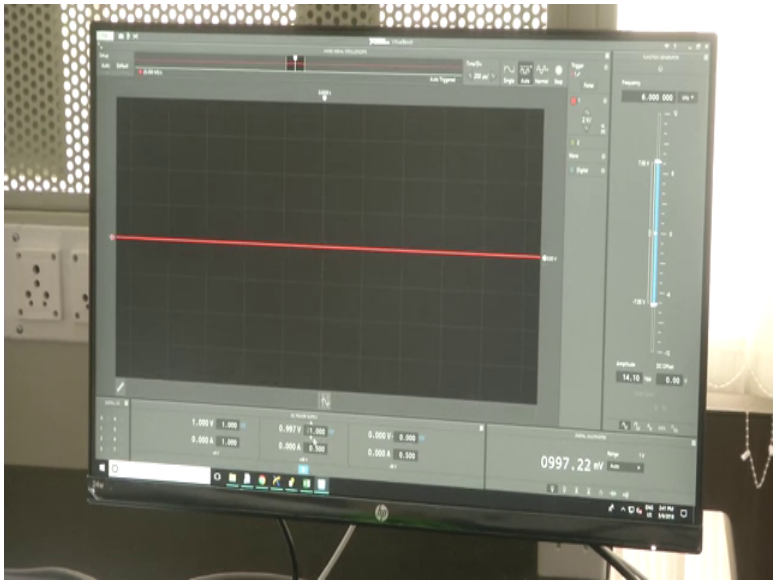

So, here this is plus 25 volts, if I increase it 1 volt 997 millivolts right. So, not only that if I want to make use of the same device to measure a resistance or to measure at to do a connectivity testing, so unfortunately I do not have a speaker connected to this, so I cannot hear it. But, there you can see the Ohms very smaller Ohms, which means that these two are shorted. So, this is the way, where you can use both a single unit as a power supply as well as a digital multimeter too.

Now, I will show you, how to make use of the same device as a function generator as an oscilloscope. So, in order to make use of a function generator unit, what I will do is that, I will take the probes required for the function generator. And externally, I will consider CRO, I will connect this function generator to our CRO and we will see, whatever it is

being generated using this function generator, whether it is being shown at the oscilloscope or not. So, for that I am taking a tektronix oscilloscope.

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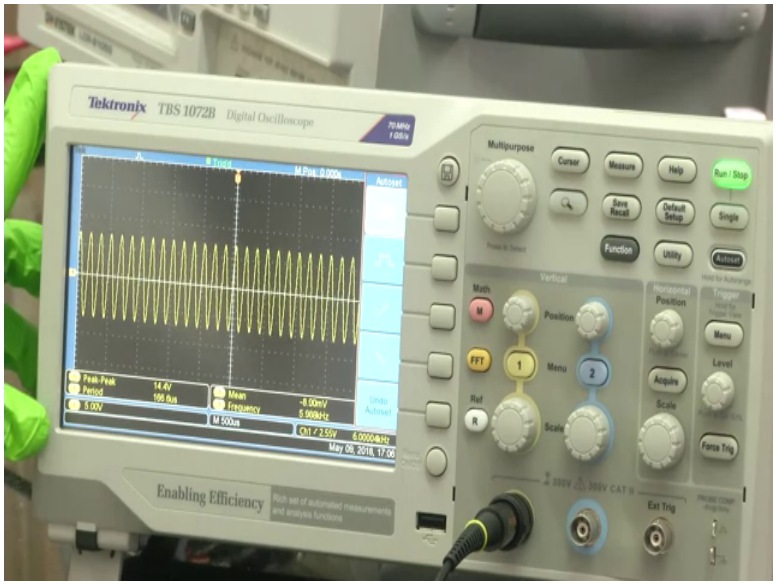

So, now what I did like, I am taking a function generator probe using virtual instrument, whatever being generated using a software or whatever being generated using this virtual instrument, we will be measuring it using the Tektronix oscilloscope. So, now in order to measure that, I will be connecting the positive terminals of both, this supply the CRO first channel input to the function generator positive input, and the both grounds, I shorted.

And here if I see, this is the function generator unit. So, initially, if I want to make use of the function generator, that particular switch has to be switched on, so I am switching it on. Now, the signal being generated is sin wave signal, a frequency is of 6 kilohertz. And this is in DC offset, the amplitude is of 14; 14 peak to peak, and the DC offset is 0, now we will observe. So, if I want to understand, this is what is being generated the peak voltage is of your negative term negative sin wave, and the peak voltage of a positive sin wave is minus 0.75 volts and plus 7.05 volts.

Now, we will observe, whether it is being generated and measured using CRO. So, when we look closely look into the CRO, we can see that the voltage being the peak to peak voltage being generated is of six 14.4, so there we applied 14.10 volts 14.4, and the frequencies of 6 kilohertz, so the applied inputs frequencies also 6. So, if I keep on

varying, if I vary my frequency here, see I am varying the frequency 7, 8, so here we can see very fastly, it is even being varying it right. And if I change from sin wave to square wave, so square of the signals generated, square to triangular wave.

So, whatever it is required for a normal function generation, whatever the signal it is being required for your signal conditioning unit as well as for your fabricated sensor device. So, in order to make use of the data, in order to get the data from the fabricated sensor, it is required to excite some signal, it is required to provide some excitation signal to your sensor. One way to be to be provided by using a single instrument a virtual bench where you can make use of the same DC power supply available here or in case if you require the function generator can also be used to generate a voltage signal.

And in case if it is required to have some signal conditioning unit, so the required signal conditioning unit can be completely powered using the same DC power supply. And it can be even acquired using the same oscilloscope. So, now what I will be showing it to you is, since it is also having an oscilloscope channel available provided the same virtual bench, why do not they connect the input to the same oscilloscope channels, and is it possible to observe it. Now, if you look into the screen right; if you look in this screen, once I connect it, here we can observe the complete signal.

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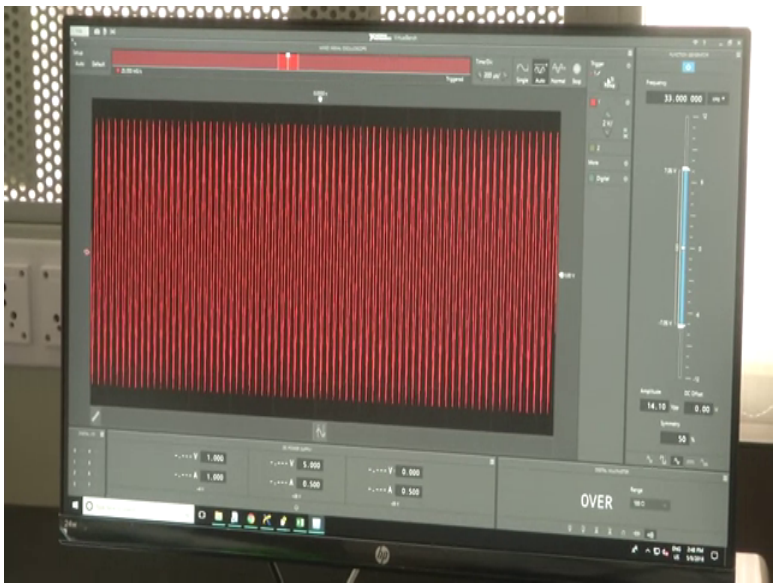

So, the signal being applied is of triangular wave. Suppose, if I make it as a square wave square wave, and here there is a time division. If you want to adjust your time division,

so everything can be adjusted here, whether you need a single or auto scale can be completely done. And you are in the voltage range of your screen can also be adjusted here voltage divisions meaning or you can make it as an auto, which does an automatic you know execution, and it gives you the proper signal to you. So, all the things can be done using a single instrument.

So, now if I want to capture it, I can capture the device, and I can capture the screen, and I can paste it on your desktop. Then if I observe this the screen; photos; so we can see the complete screen. Also we can export the data to CSV files too.

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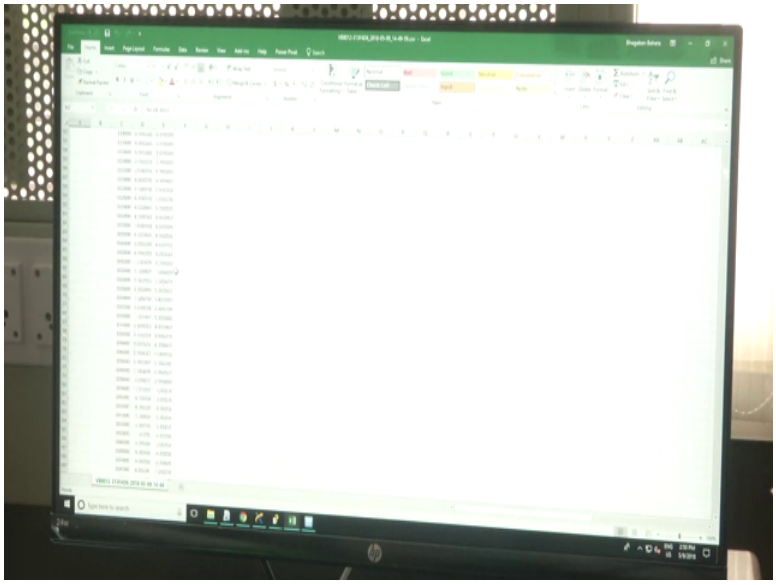

So, right now it is being saved in the desktop, so I will open with excel, see the mixer signal oscilloscope data, so can be seen everything here; the timestamp everything.

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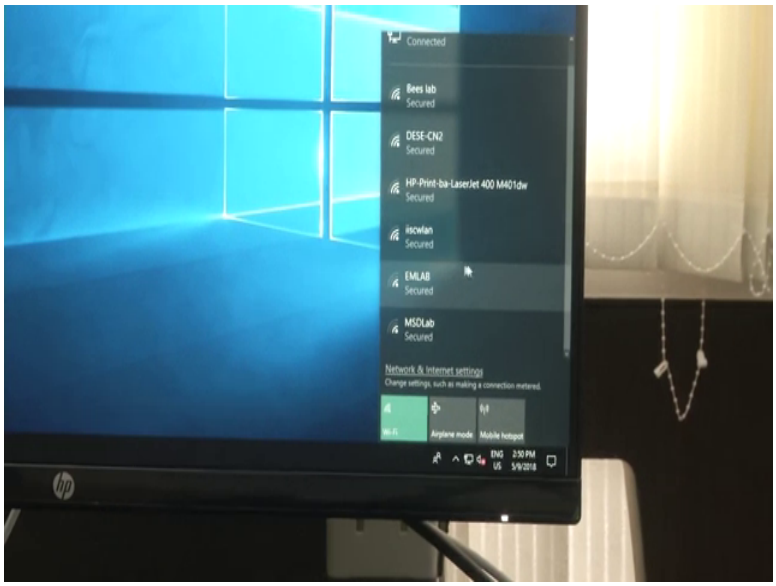

And another feature of this device is that, so it need not be connected using Wi-Fi, it need not to be connected using here USB itself. Even a Wi-Fi unit also does the same thing. So, only thing what I have to do is that, I have to enable my Wi-Fi. So, the system has a Wi-Fi connection here. So, NIVB, it is already connected here. So, I will say reconnect. So, this is the device it is being, so use this device.

So, it is loading the device. Once it is being loaded, it pops up with the software screen, whatever we have seen last time with the wired connection. Now, here we can see, it is running with the Wi-Fi mode. And even if I switch on, so here we can see the Wi-Fi has been enabled right now. So, making use of this device, if I switch on, so we can see the power supply and if I want to make use the same connections which; we have done previously with a wired connection. So, if I switch on my function generator, the signal can be easily visualized, but there will be a little lag.

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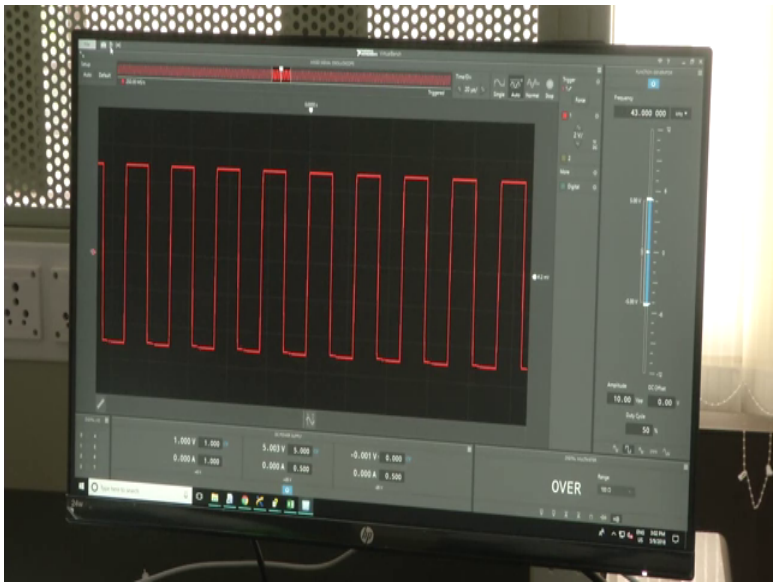

And even exporting of the data, inputting of like that screenshot everything can be done even with the Wi-Fi connection too. So, this is about national virtual bench, but why do we require this device in our laboratory? So, when we fabricated device, and when we fabricate different sensors, which are required for our application. So, one part is we have to provide a signal to the sensor; to the fabricated device, how do we do that, we required to have a power source.

So, one way to generate a power source using the same device. And later on, we require to analyze the data in order to analyze the data, one thing is you have to acquire the data, you required to have a data acquisition unit. One way we have a data acquisition unit is by using the signal oscilloscope that is called digital oscilloscope. So, even the same device can be used as in digital oscilloscope. But, sometimes what are the signal it is being generated from a sensor, may not be enough to acquire very properly, because the signal voltage of any sensor will be really-really small. So, in order to provide a bridge between here the fabricated device as well as to your data acquisition required, we required to have a signal conditioning unit.

So, when we designed the signal conditioning unit operation using an operational amplifier, these operational amplifiers are active devices. So, it requires some external power supplies in order to function. So, those functionalities are those you know excitation voltage signals, it is required for the operational amplifiers can be even

provided using a single source using a single device itself, so that way, this device can be used for as a multipurpose unit; one for generation, one for acquiring, one for voltage generation also as an multimeter too.

Thank you.