INDIAN INSTITUTE OF SCIENCE, BANGALORE

NPTEL

NATIONAL PROGRAMME ON TECHNOLOGY ENHANCED LEARNING

Course Title
Electronic Modules for Industrial Applications using Op-Amps

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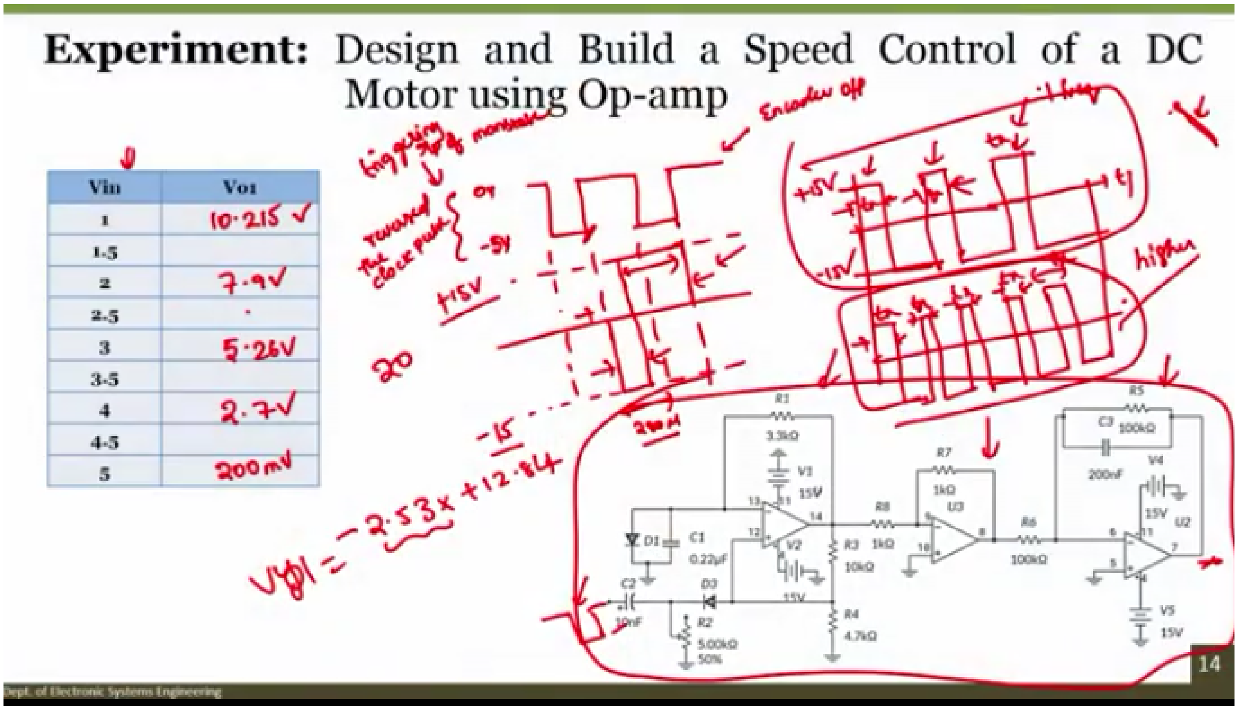
Welcome to the module, so in the last module we have seen the simulation as well as analysis of a signal conditioning circuit that we have designed for, or converting the encoder output signals to output linear voltage.

Today we will see the connections that we made on the breadboard, and we will also see by providing different input voltages to the motor, we will observe the output of the integrator circuit as well as output of the signal conditioning circuit that we have designed after the integrator circuit.

Then we will see, we will look into different controllers interfacing it to our system, then we will see the complete operation of different controllers, so when we looked into the simulation, Refer Slide Time:01:21)



when we looked into our analysis we understood that when we are providing a input voltage of a motor, when we are providing an input voltage of 1 volt to the motor, the integrator output we got somewhere around 10.215 and since the mapping factor of the integrator output is not equivalent to the set point of mapping factor, so that we have designed another signal conditioning circuit to make it equate to the set point mapping factors, so that means when the set point is 1 volt, if the motor is rotating at that particular RPM, the output of the sensor should also give us 1 volt, right, so for that we have realized monostable multivibrator, inverting amplifier, monostable inverting amplifier as well as integrator.

We have also seen exclusively the working of each and every, the blocks that we have used here, why do we require? How we have done the selection of the resistors, capacitors and everything, along with that we have also seen the role of integrator circuit there, so this completes circuit, the simulation of this complete circuit we have done it in multisim, then we have also verified whether the design circuit is working as per our designed as well as requirement thing.

Now the same circuit we will develop it on breadboard and we will see the working of each and everything. Now when you look into the breadboard, so here this particular block
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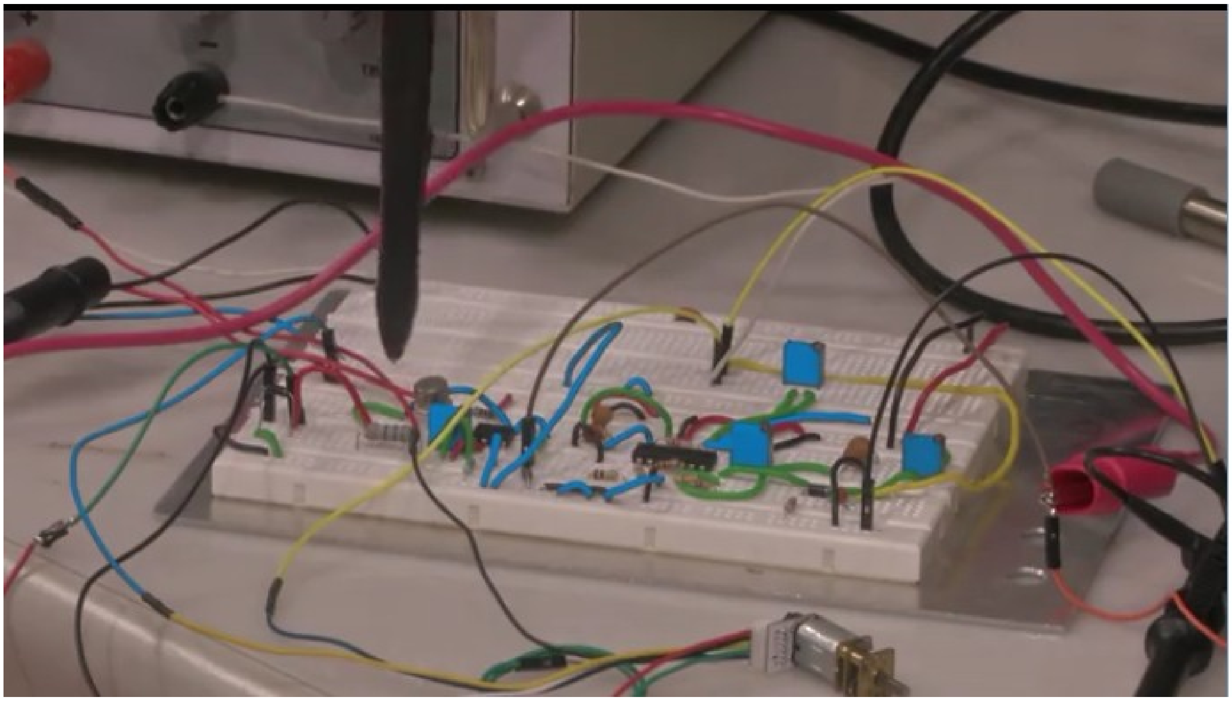

as you have already seen when we are working with a motor, so this is our motor which we have also used in the last sessions when we are discussing about DC motor, when we are looking about the working of encoder that time we've also seen the same motor which is DC gate motor and with encoder connected together.

And this is a part where we have developed a driver circuit and interface to the motor, and last time we have also discussed about the connections that we have done there, then this particular block if you see, this part is completely a monostable multivibrator, monostable multivibrator then integrator, in between these two we also have an inverting amplifier, since this is TL074 which is a quad of amp, all the three op-amps have realized into the system itself.

Now after the integrating output as we also required and differential amplifier even that differential amplifier has been realized by using this op-amp TL084 itself, so if you see these are the ports, 3 ports where you can see here, so one particular port, these two ports are meant for the offset and gain values, and this port if you observe this is for our differentiator circuit, so in the input side of our monostable multivibrator we have done a differentiator circuit to convert our DC signal into spike signal, triggering input to the monostable that to tune that value we have used another port, potentiometer and the complete connections has been done as per what we have seen in our simulation as well as in the analysis part.

So now what we do is that, we will connect each and everything, so this particular part as we have already discussed, this particular part is for the driver circuit and this particular part is for our signal conditioning circuit like monostable multivibrator as well as in inverting amplifier, as well as a differential amplifier and integrator, as well as a different amplifier, so as you remember the purpose of this monostable and integrator via multivibrator, monostable multivibrator integrator is to give a linear response, first we will observe by varying a different input voltages whether we are getting the linear output or not, so what we have seen from that? When we provide a voltage of 1 volt to the motor, we are getting somewhere around 10.215, let’s see, so what I will be doing is that, I will connect the output of integrator to the digital oscilloscope, okay.

So now the motor is not running, so I have probable with 0 volts, I’m increasing it to 1 volt, here we could see the motor started rotating, right, when we look into the CRO,
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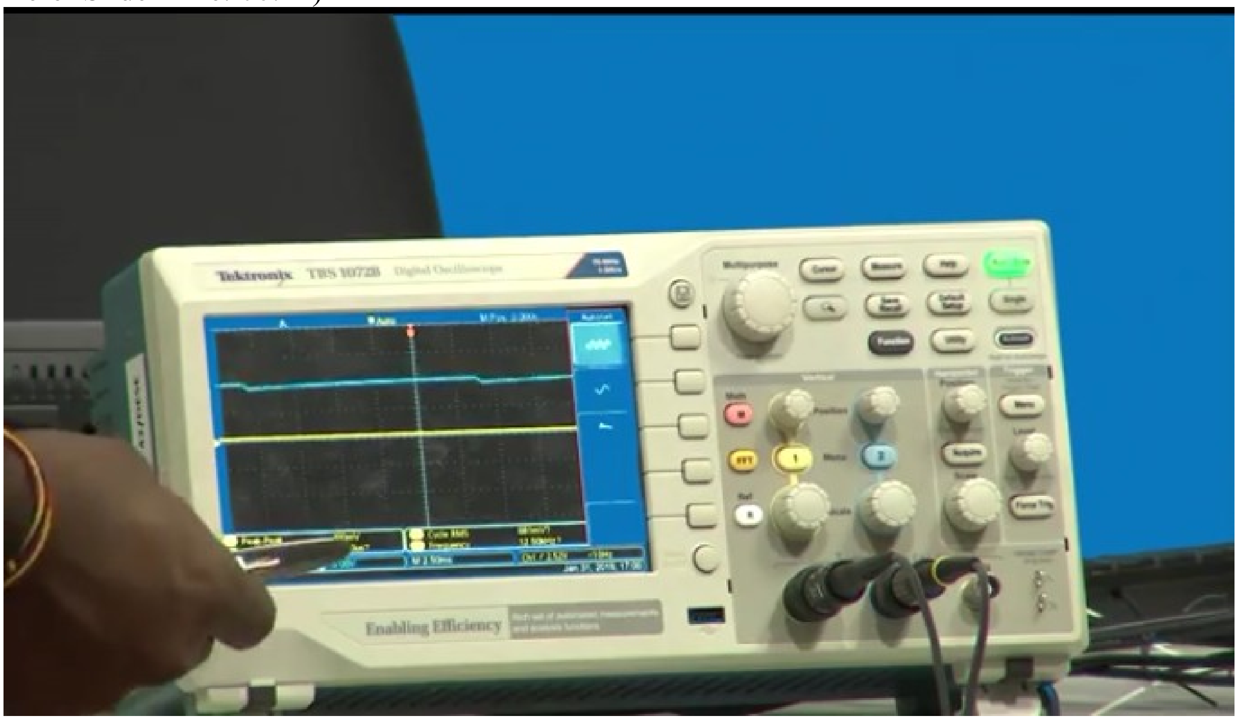

so right now the settings are at 1 block is 5 volts, so I am getting somewhere around let me keep the cursor, measure of channel 2, the mean value, then if I see we are getting the mean value somewhere around 9.9,
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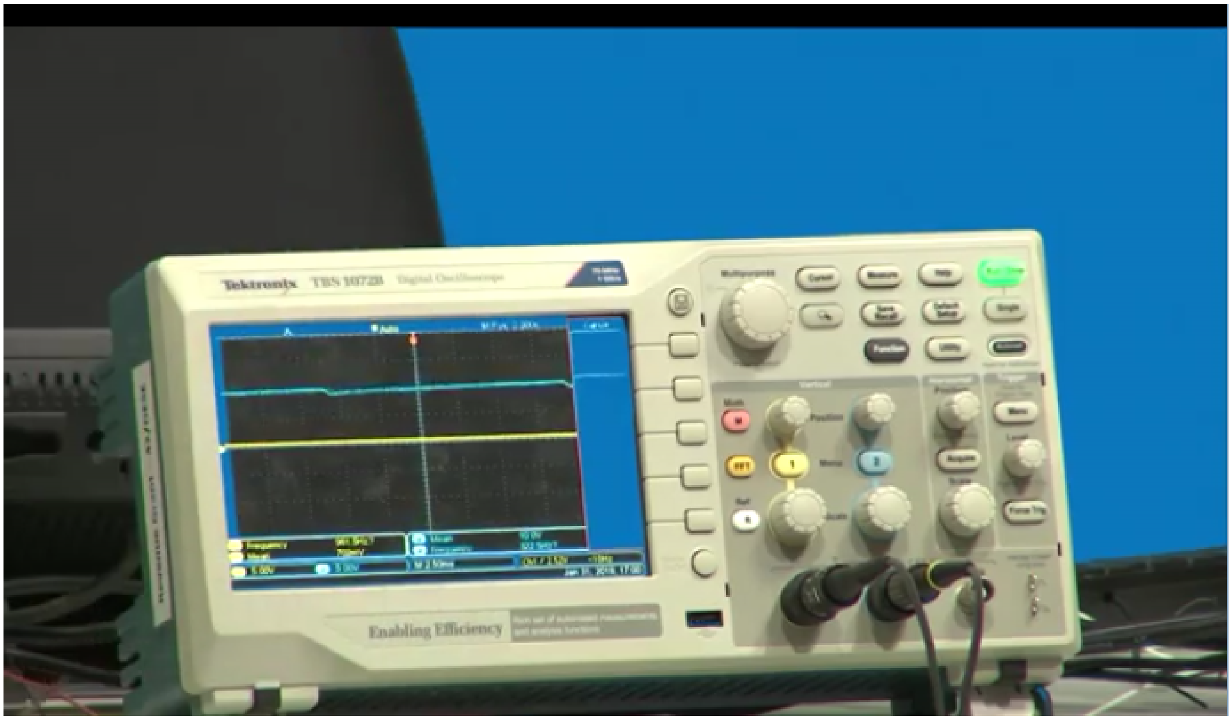

approximately 10 volts, okay, approximately 10 volts, so we also got when we apply 1 volt, sorry, right now the input is at 0.8, okay, I'm changing it to 1 volt, yeah, at 1 volt, we have also seen when we provide a 1 volt input signal we got somewhere around 10.215, right, so even here we can see somewhere around 8.86, that is because of small tolerances that we have, okay, and then I'll slowly vary to 1.2 volts, so now we are getting somewhere around 6.86, so let me note it down,

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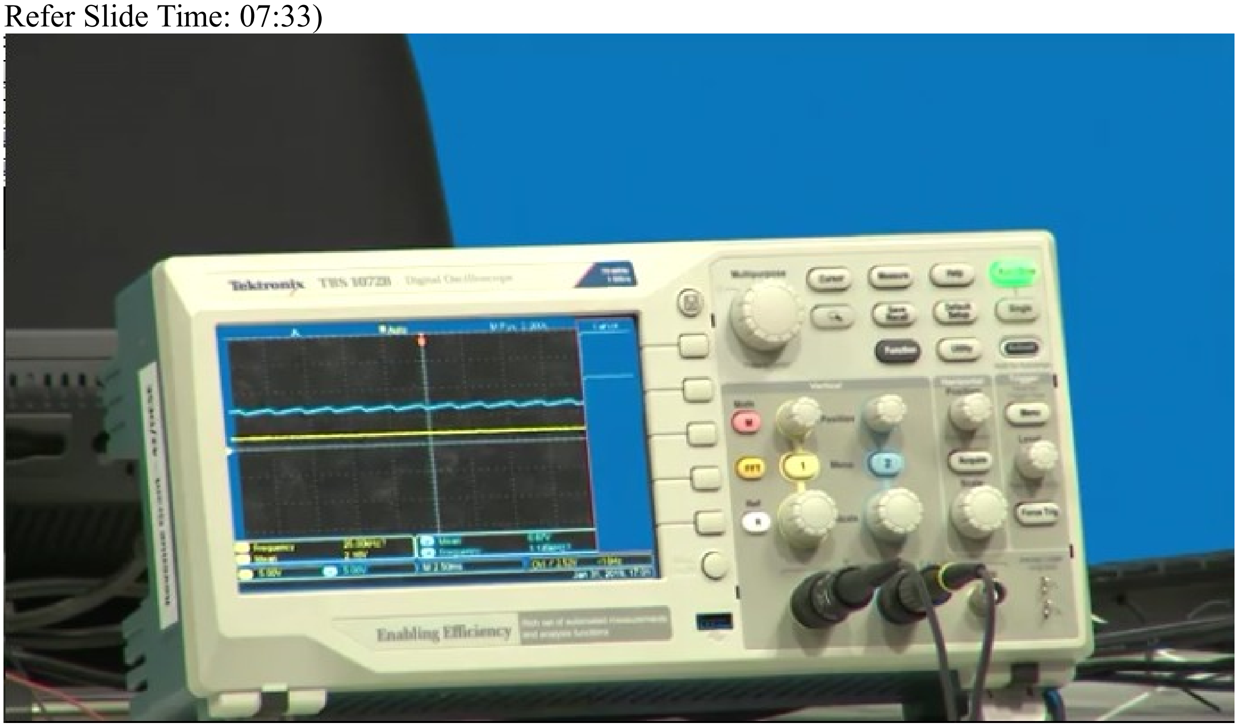

8.8 for 1 volt, 2 volts I'm getting around 6.8, then I will change it to 2.5, so 2.5 we got 5.5, then we will go to 3, we can see it's decreasing, so for 3 volts we got 4.63, I'm going to 3.5, for 3.5 we got 3.52,

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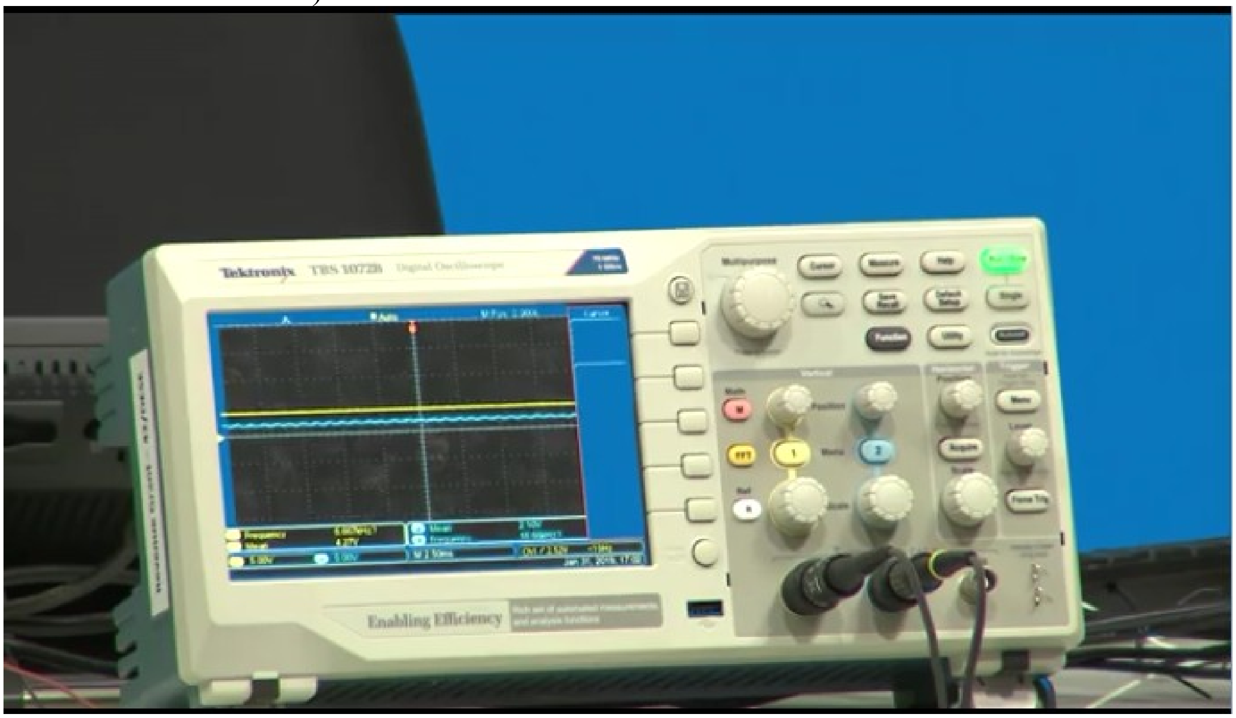

4 I'm getting 2.15 volt, I'm changing to 4.15, 4.5 I got 1.2 volt,

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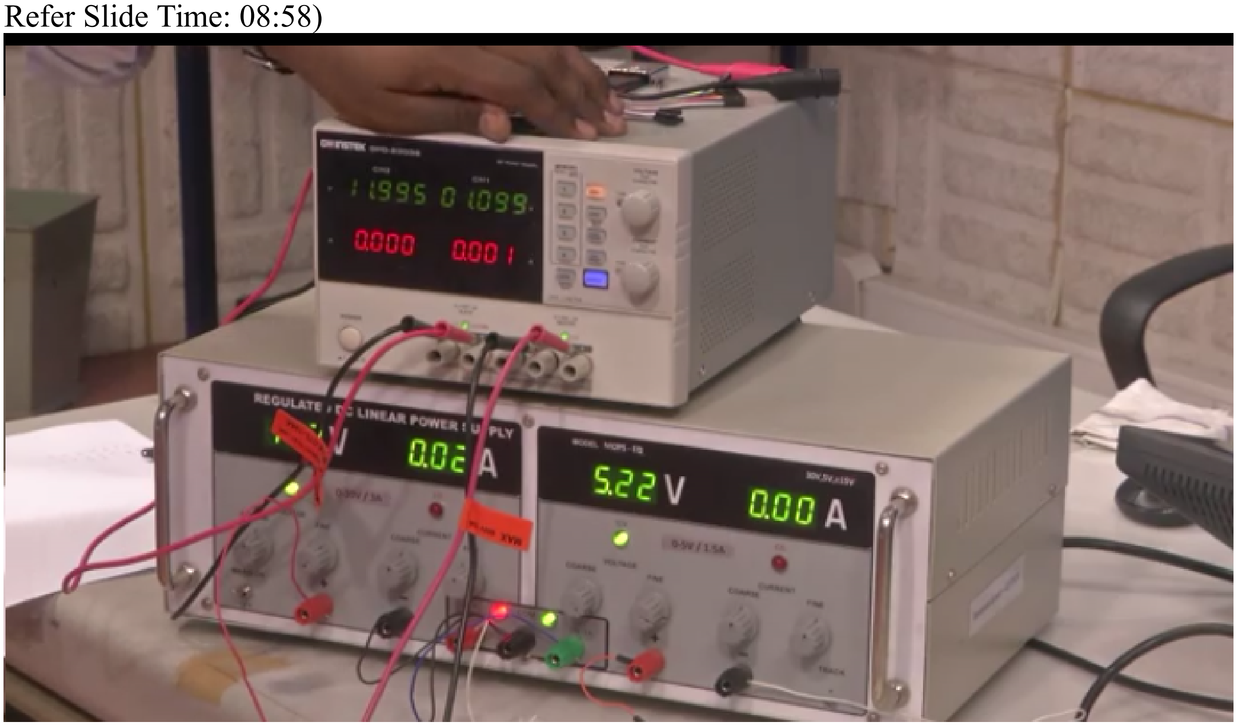

so here we can see when the input voltage is 1 volt we got integrator output of 8.7, right, so I will just change it to 2 volts.

Now if you observe the integrator output in the oscilloscope, here we can see it is somewhere around 6.75,

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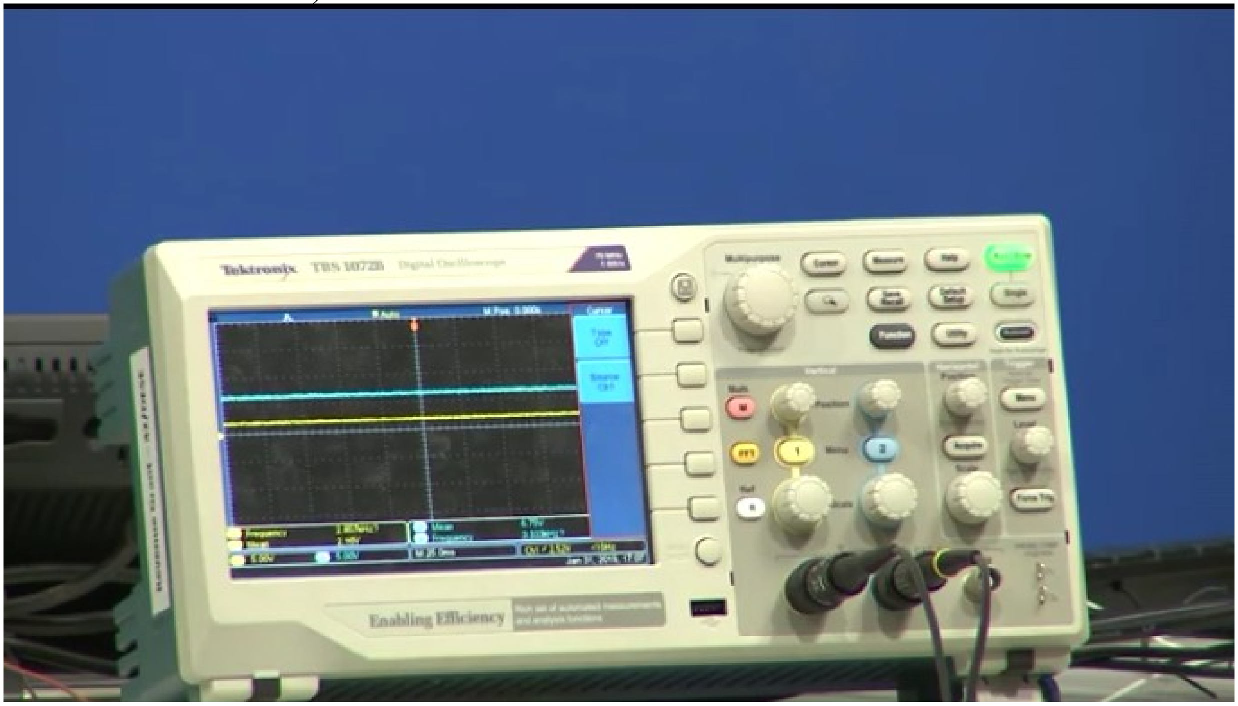

6.75 then I will change it to 2.5, so we are getting somewhere around 5.61, then I will go to 3, 4.48, 3.5, 2.37, I'll go to 4 volts, 2.21, 4.5, 1.08, then I'll finally I'll go to 5, we can see it is of 20 millivolts, so one thing we can understand that whatever the trend that we have seen in the simulation as well as our design based upon our understanding we can follow, we can see the same trend which is, with a negative slope and it is linearly decreasing it, but we do not know until and unless we plot whether it is linear or not, what we do is that we'll plot it whether it is a linear or not, but there are a small deviation with respect to our simulation, probably the region would be 1 as I've already told the you know, the saturation voltages will be smaller in case of a practical, whereas a simulation is showing somewhere around + or -15, and other reasons due to because of our tolerances due to the resistance, resistances and all, but we will also see the monostable multivibrator will connect it to the 5 volts, I'm just connecting to the 5 volts and the monostable multivibrator we can have a look, so if you slowly decrease,

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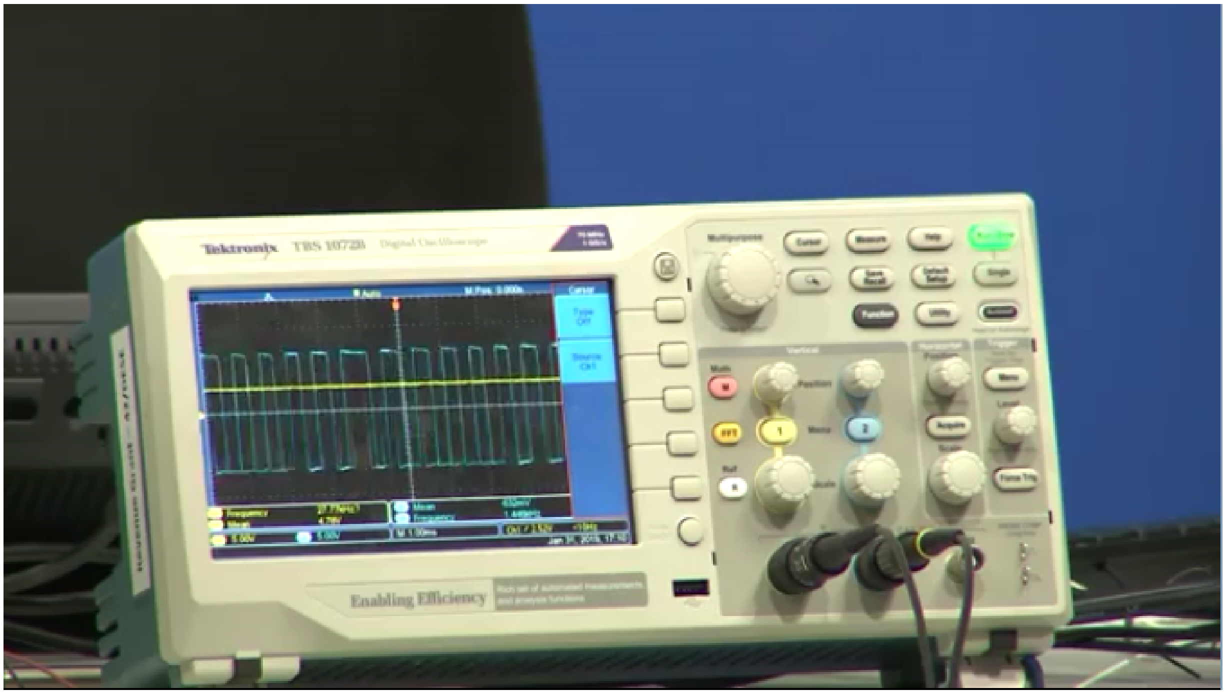

if I slowly decrease one thing it is clear that the on-time pulses, one thing it is clear that if you see here this is a fixed duration whereas this is of stable state, this is unstable state where it depends upon the discharging time and based upon what we have said,

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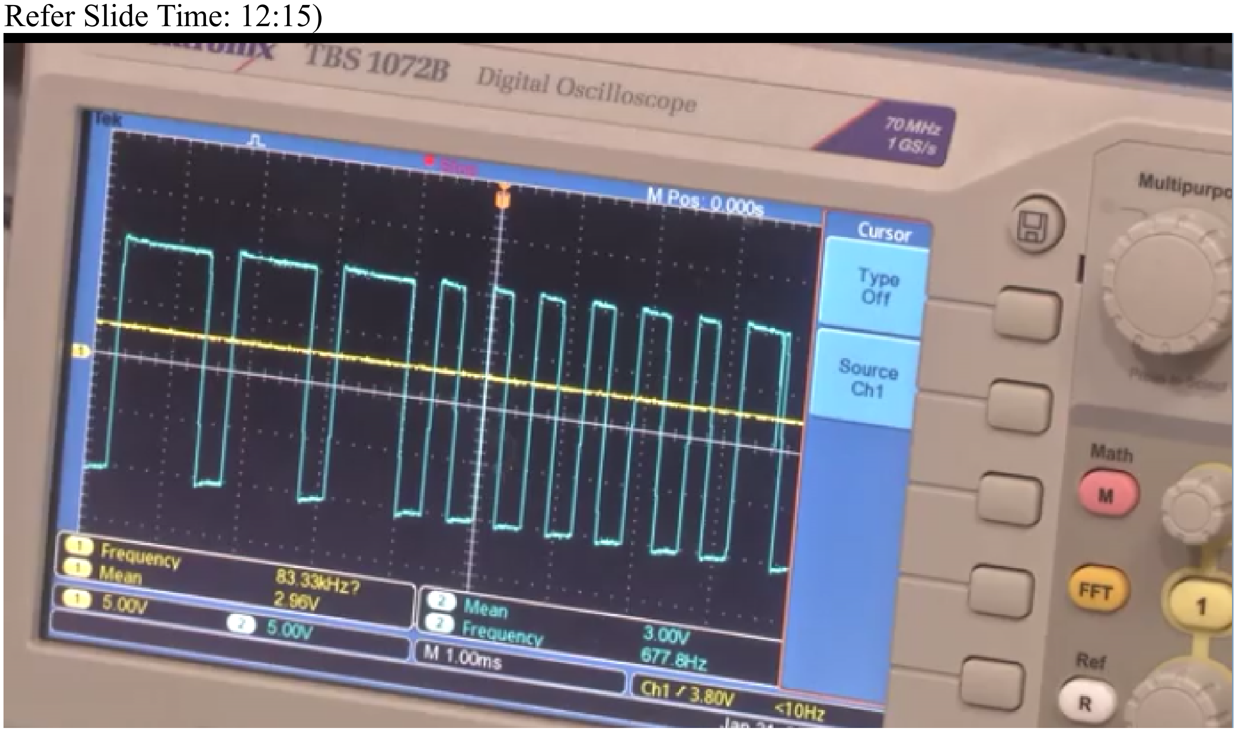

when we create a cursor and we have a look on this, we have designed for 280 microseconds, let’s see whether we are getting 280 microseconds or not with, so we are getting somewhere around if you observe here 320 microseconds.

So depends upon the RPM we can see the variation of the pulses, and it entirely depends upon the RPM at what voltage the motor is running it, also it depends upon the position of our encoder, so again let me measure it any particular voltage, so right now the voltage is at 1 volt, so we got 340,

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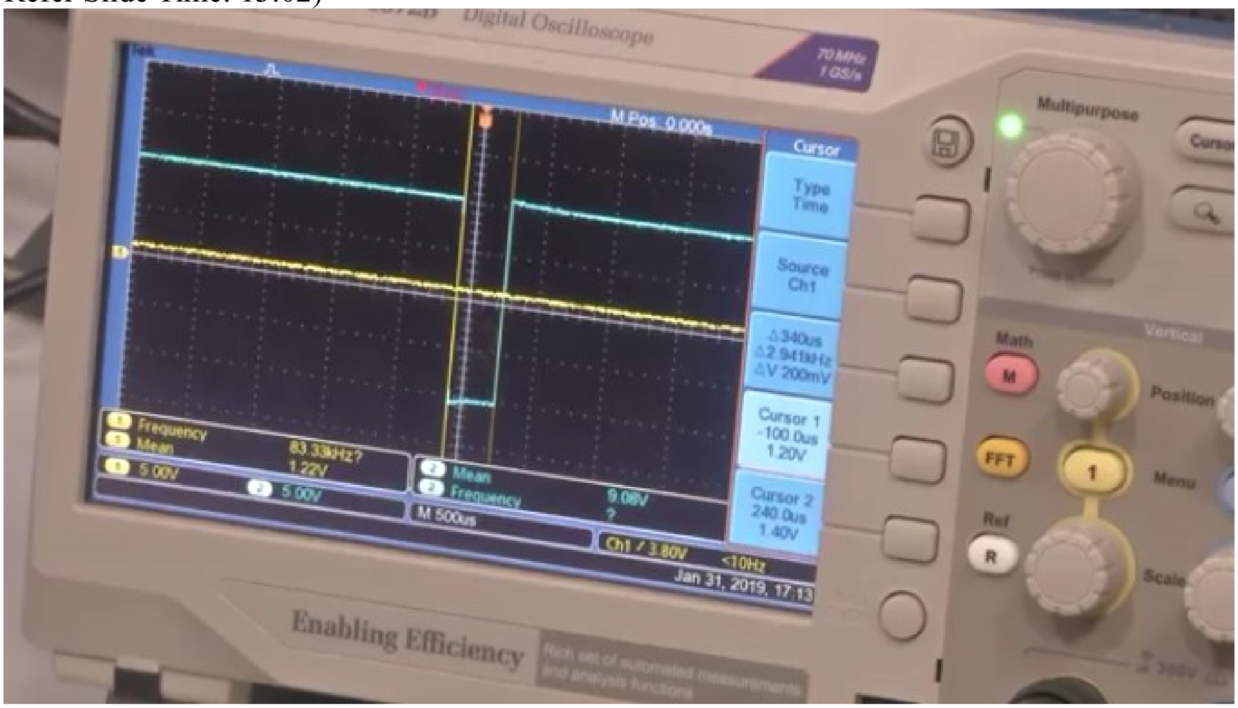

340 microseconds, so one thing it is clear that it is almost following the trend, but only thing the values are little bit here and there that is because of our + or –VCC.

We can see as the monostable output signal entirely depends upon the VCC as well as a diode that we have connected, R and C everything, so no matter what the trend whatever we have observed in the simulation as well as analysis its remains the same, but now we will observe whether the values, we plot the values and we will see we are getting the same trend or not, so let me open excel, so these are the voltage values that we have given as an input to the signal, into the motor, driver circuit and this is the output voltage we got from the integrators, so let me plot this two,

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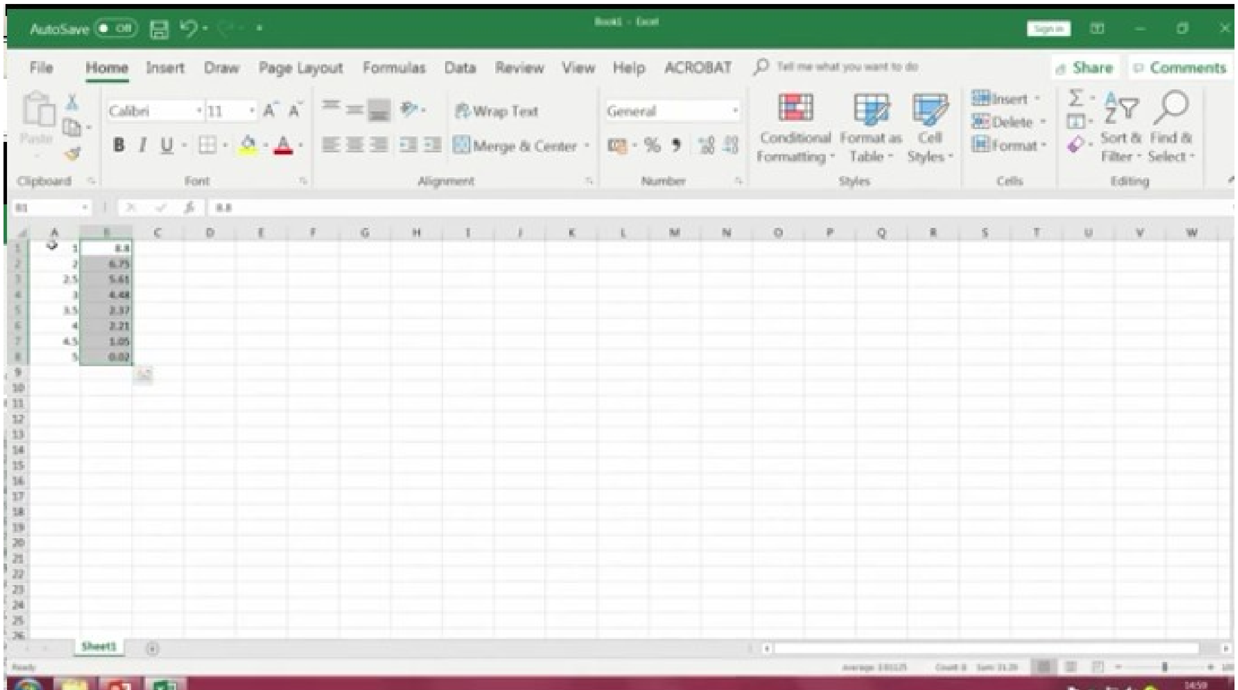

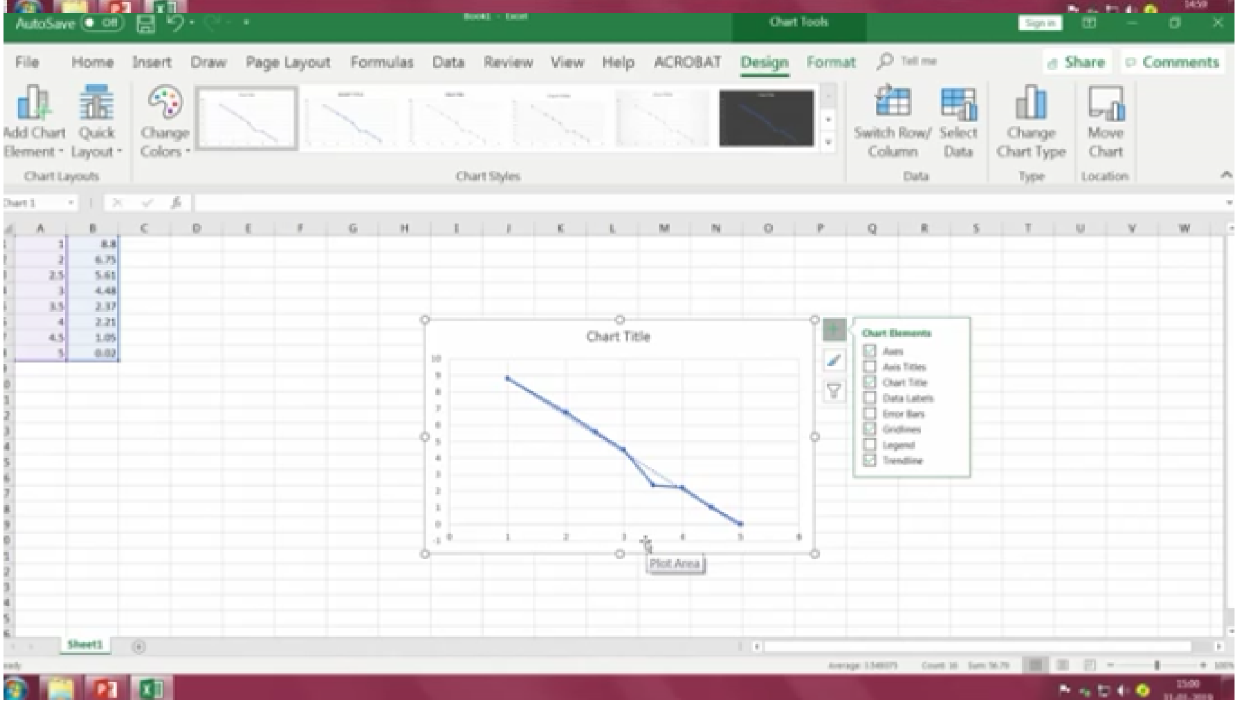

so one thing it is clear that it is linearly dependent, let me put it is linear, when you see the tread lines somewhere around 2.5 it got deviated, 3.5, it is deviated from the value maybe while writing we have noted it down wrong, 3.5, yeah, probably its supposed to be 3.5, I've noted it down as 2.37, so but it is completely linear and when I look into the signal the equation, right, we are getting somewhere around -2.21 + 11.123, even we have realized for -2.53 +12.84, so one on the same, the relation is almost same, the slope is approximately the same but there are little changes after the decimal points as well as the intercept value too, no matter what but if you see the design, the design that we have to follow even for this case I similar, but only what changes is the game settings, the feedback value, the feedback value of this R6 as well as R5 value that we are going to set should be different, but in this case what we can do is that since we have used, we have chosen R6 and R5 as potentiometers we can vary till we get that particular value.

Now with this we understood that the importance of having a monostable multivibrator and integrator circuit as a signal conditioning part in order to convert your DC to our linear output voltage, and we have also seen how exactly the signal conditioning circuit as well as the values of gains that we required to keep in order to match with respect to the input, with respect to the input set point.