Electrical Measurement And Electronic Instruments
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Lecture –58
Digital frequency meter

Hello and welcome. Today, we are going to study a new topic which is a Digital frequency meters.

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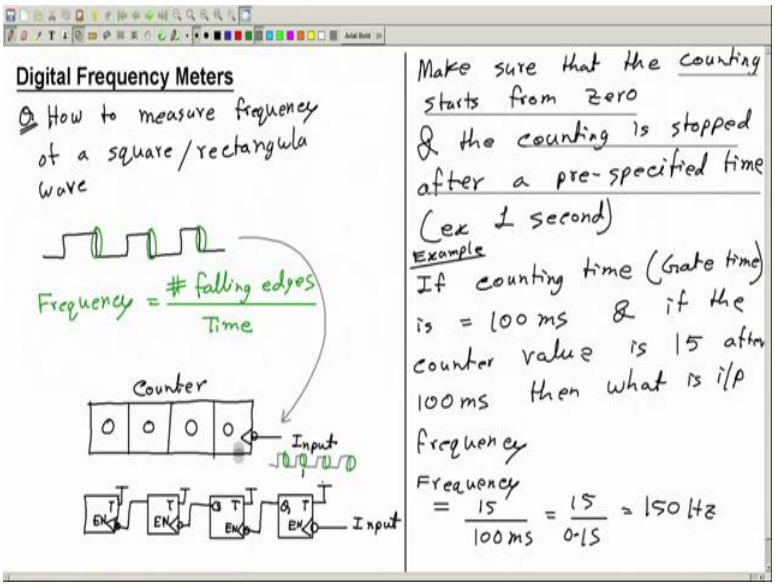

So, far we have seen in this part, we have broadly reviewed starting from flip flops up to counters on one side that is from the digital electronic side. And, on the other side from the analogue electronics we have reviewed about the op-amp. So, I thought why do we not start putting these things into use and make some nice measuring instruments, which is the goal of this course. So, today we are going to use counters, basically counters from digital electronics. And, make digital frequency meters out of it ok.

So, first thing that we will look at is how to measure frequency of our square wave, square or rectangular wave ok. So, the signal is like this ok, it can be square; that means, the positives the width of this part, positive half and the width of the negative half may be equal or may not be equal; that means, rectangular wave. So, this is the input signal and the question is we have how to measure the frequency of this signal, what is frequency?

Frequency is nothing, but the number of cycles complete cycles per unit time right. So, that is equivalent to say number of these positive edges or these negative edges, that occur per unit time. See for an example if we if we count the number of this negative edges per second, that will give us the frequency right. So, frequency is nothing, but the number of falling edges divided by time per unit time. So, basically what we have to do is a measure the or count the number of this edges within a given amount of time ok, how do we do that? So, let us take a counter. So, let this be a counter with a number of flip flops in it.

So, each small cell here will represent one flip flop so; that means, this is a 4-bit counter. So, you can if you recall very quickly. So, a counter is a set of T flip flops repel counter and you know that the output of 1 flip flop goes to the clock of the next flip flop. So, this is Q, this is the enable of the next flip flop and this is a H triggered flip flop, this is more precisely a negative edge triggered flip flop. Similarly, from here the output goes there and from here the output goes there. So, this we have studied in length ok.

And, here the first one will get the signal from outside, because all other flip flops are getting their clocks from the previous output or the output of the previous T flip flop, but here there is no previous one this is the first one. So, therefore, it will get the input from a clock generator or some source of a square wave or something ok. So, this set of 4 T flip flop. So, these are T flip flops all these Ts are you know, I had lived at logic level 1, these are enables this is what we have studied before. And, this is the this is what this is the input. And, now I am drawing this counter symbolically like this.

So, this 4, since 4 boxes are 4 bits or 4 flip flops inside ok. Then, so, let me draw the input here this input is this input and what else? Now, what, how to use this counter to measure this frequency? Ok. Answer is simple simply give or apply this input signal here ok, you just apply this input signal here. So, how do you have we have this square wave here, square or rectangular wave here and; that means, these negative edges are coming at the input and this let me take this as a negative edge triggered counter.

So, this is a counter ok, particularly this is a 4-bit counter, you can take a greater number of bits if required. So, then what will happen as these negative edges come here 1 by 1 ok, then this count here will increase continuously. So, starting from the value of 0 0 0 0 then when this next negative edge comes it will become 0 0 0 1. After, that when this one comes

at this point this will become 1 0, then at this instant here it will become 1 1 and so on. This we counting will progress right.

Now, I have to make sure that so, I have to make sure that the counting starts from 0 and the counting is stopped after a f specified time maybe 1 second. Example 1 second, then what will happen? So, the counting starts from the value 0 and the counting continues for 1 second; that means, after 1 second whatever will be the value of this counter ok, whatever is there in I mean whatever is the value after 1 second that will directly give me the frequency of this input signal right.

Similarly, if I if this counting time pre specified piece 8 predetermined counting time is say 100 milliseconds instead of 1 second, if it is 100 milliseconds. So, let us take an example so, if counting time which is often called as gate time ok. If the counting time or gate time is equal to say 100 millisecond and if the counter value is say 15 after these 100 millisecond starting from the value of 0, then what is the frequency? It is very simple it is nothing, but so, frequency is nothing, but the count of these negative edges divided by the time is 100 millisecond.

Frequency = $\frac{15}{0.15}$ = 150 hz

that is 150 hertz as simple as that and the logic is very simple. So, if I have just a counter, I can give this square wave at the input making sure that the counting starts with the value of 0 and I stop the counting after pre specified time, then this way I can find the frequency very simple. Now, these are the two important things that you have to make sure that counting should start from 0. And, that it is stopped counting is stopped after some time these are the two important things. Now, how do we do that? To do that we will need a reset input of this counter.

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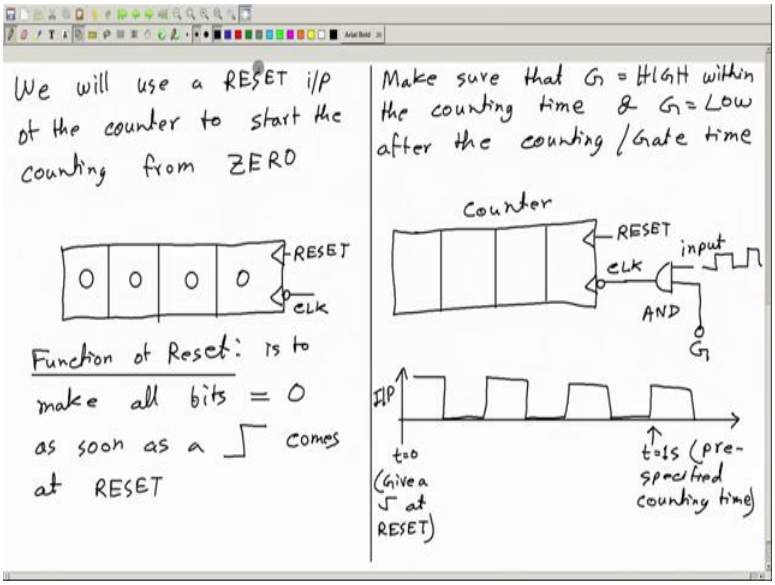

So, we will use a reset input of the counter to start the counting from 0 ok. So, the counter we will have at least two inputs; one is what we have already seen this one let us call this the clock ok. And, it should have another input other than the clock. So, if this is clock we need another input reset and this can be this can also be a edge triggered input.

So, that the function of this reset is as soon as you give an edge all the beats; that means, all the flip flops will reset to 0 immediately ok. So, function of reset is to make all beats equal to 0 as soon as positive edge or rising edge ok, as soon as the rising edge comes at reset ok. Now, how is this implemented internally; that means, how is this reset input connected to this T flip flops, that is a different question or how are these D flip flops made.

So, that these reset input can be realized that is a different question ok, that is also an interesting question , but we are not going into that much detail. If, you are interested please try it yourself and you can share your idea in the forum with us. We are now looking at it from an external or superficial perspective, functional perspective, we are just saying that this counter will have I input which will call the reset and as soon as you give this rising edge all the bits will become 0 immediately.

So, this is the function of reset and this is the symbol. So, this symbol triangle you know indicates a edge triggered input. I could also put a bubble here if I need a negative edge trigger input I can use that ok. So, how to use this reset, make sure that before you start

counting so; that means, at the moment equal to 0 time equal to 0 before applying this input here give arising edge here somehow.

So, that all the beads are set to 0 and then let the inputs come here ok. So, this is one thing that we need. Now, the other thing that we have to make sure that the counting is stopped after 1 second or some time how do you realize that? So, for that we can do this. So, let this day be the counter ok. So, we have two inputs, this is the clock and this is reset. Now, what I can do instead of applying the input directly here, I will first connect an end gate a two-input end gate.

And, here I will give the input which is this square wave right. And, here the other one; I will use to switch on and off the counting ok. So, call this some G call this input G. So, what we have to do is this make sure that G is equal to high or logic call one within the counting time and G is equal to low or logical 0 after the counting or gate time ok. So, this is the counter.

So, let me just state everything one second. So, what we have to do say, if this is my time this is time axis. And, the input signal is like this, it is a square wave like this. And, so, what I have to do. So, this is t = 0. So, at t equal to 0 give a rising edge at reset; that means, reset all the values to 0 all the flip bits to 0 ok. And, then starting from here to say this is 1 second.

So, this is t = 1 second or the pre specified counting time, this can be 100 millisecond 10 millisecond, 2 second, 10 second, whatever you choose as the counting time. So, then what we have to do. So, we have to make sure that G is 1 from here to here and then here it should be 0 ok.

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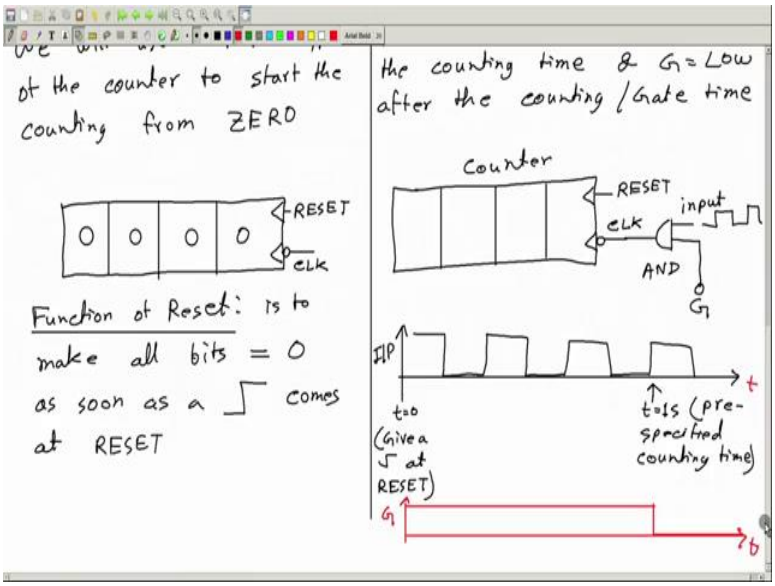

So, let me draw G this is t = 0. So, starting from here up to this point G should be 1. This is G gate signal and then here it should be 0, if you do not make it 0 here then what will happen. The counter will continue to count and the count will keep increasing right , but we want to measure only the number of edges in 1 second.

So, after 1 second or the pre specified time you have to stop it. So, this is the fundamental idea of a frequency meter ok. So, if you have understood up to this that is really great. And, in the next video we will talk up the next class we will talk about more and more details and see how much you can we can go on.

Thank you.