## **MP309**

Experiment 7

RC Differentiator and Integrator

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Part 1 :- RC Integrator



Figure 1: Oscilloscope



Figure 2: Oscilloscope Probe

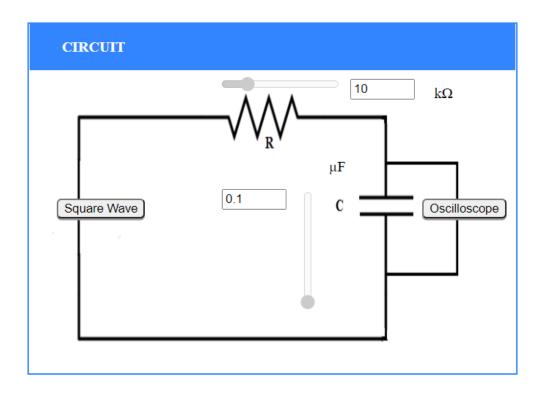


Figure 3: RC Integrator Circuit

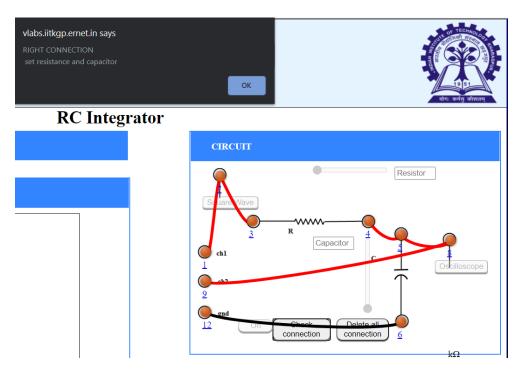


Figure 4: RC Integrator Circuit Connections

### **Initial Parameters**:-

- Resistance(R) = 10 k $\Omega$
- Capacitance(C) = 0.1  $\mu F$



Figure 5: The Integrator is a circuit that converts or 'integrates' a square wave input signal into triangular waveform output.

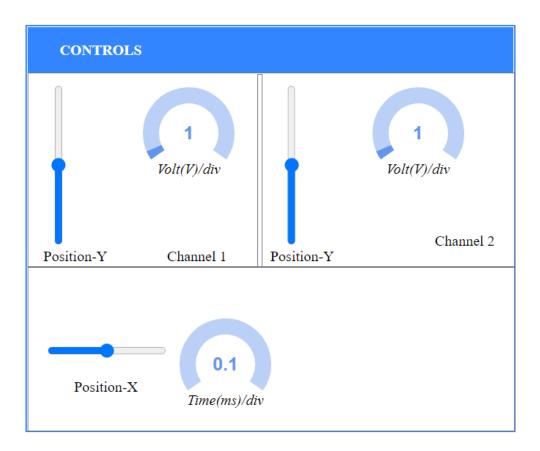


Figure 6: Controls

## Oscilloscope

- \* Channel 1(Input):
- \* Channel 2(Output):

Figure 7: Oscilloscope Channel representation



Figure 8: Square Wave at Frequency = 1000

```
\label{eq:Frequency} \begin{split} & \text{Frequency} = (\ 1\ /\ \text{Time Period}\ ) \\ & \text{Time Period} = (\ 1\ /\ \text{frequency}\ ) \\ & \text{i.e. Time Period} = (\ 1\ /\ 1000\ ) = 1 \\ & \text{May be a period} = (\ 1\ /\ 1000\ ) = 1 \\ & \text{May be a period} = 1 \\ & \text{Volt/div}) = 1 \\ & \text{V} \end{split} \text{Time(ms)/div} = 0.1 \text{ ms}
```



Figure 9: Square Wave at Frequency = 2000

```
Frequency = ( 1 / Time Period )  \label{eq:TimePeriod}  Time Period = ( 1 / frequency )  \label{eq:TimePeriod}  i.e. Time Period = ( 1 / 2000 ) = 0.5msec  \label{eq:Time(ms)/div}  Amplitude (Volt/div) = 1 V  \label{eq:Time(ms)/div}  Time(ms)/div = 0.1 ms
```



Figure 10: Square Wave at Frequency = 3000

```
Frequency = ( 1 / Time Period )  \label{eq:TimePeriod}  Time Period = ( 1 / frequency )  \label{eq:TimePeriod}  i.e. Time Period = ( 1 / 3000 ) = 0.333msec  \label{eq:Time(ms)/div}  Amplitude (Volt/div) = 1 V  \label{eq:Time(ms)/div}  Time(ms)/div = 0.1 ms
```



Figure 11: Square Wave at Frequency = 4000

```
Frequency = ( 1 / Time Period )  
Time Period = ( 1 / frequency )  
i.e. Time Period = ( 1 / 4000 ) = 0.25msec  
Amplitude (Volt/div) = 1 V  
Time(ms)/div = 0.1 ms
```



Figure 12: Square Wave at Frequency = 5000

```
\label{eq:Frequency} \begin{split} & \text{Frequency} = (\ 1\ /\ \text{Time Period}\ ) \\ & \text{Time Period} = (\ 1\ /\ \text{frequency}\ ) \\ & \text{i.e. Time Period} = (\ 1\ /\ 5000\ ) = 0.2 \\ & \text{May be a possible of the expectation} \\ & \text{Amplitude (Volt/div)} = 1\ V \\ & \text{Time(ms)/div} = 0.1\ \text{ms} \end{split}
```

# Part 2 :- RC Differentiator

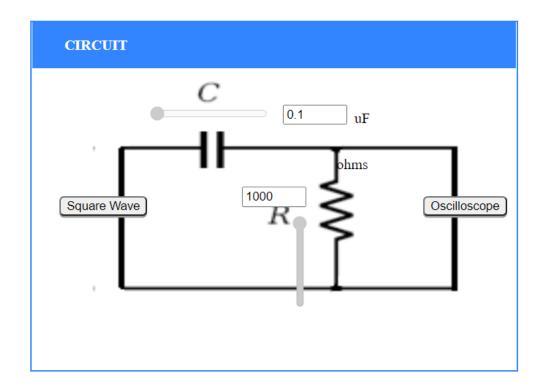


Figure 1: RC Differentiator Circuit

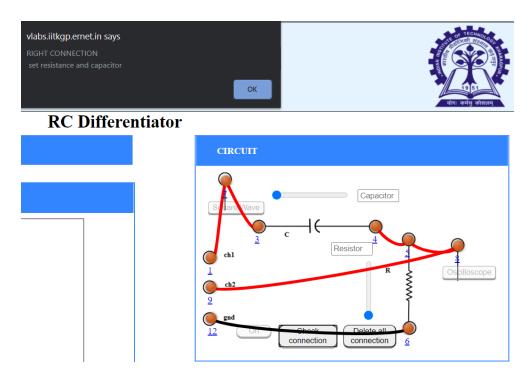


Figure 2: RC Differentiator Circuit Connections

#### **Initial Parameters**:-

- Resistance(R) =  $1 \text{ k}\Omega$
- Capacitance(C) = 0.1  $\mu$ F



Figure 3: The Differentiator circuit converts or 'differentiates' a square wave input signal into high frequency spikes at its output.

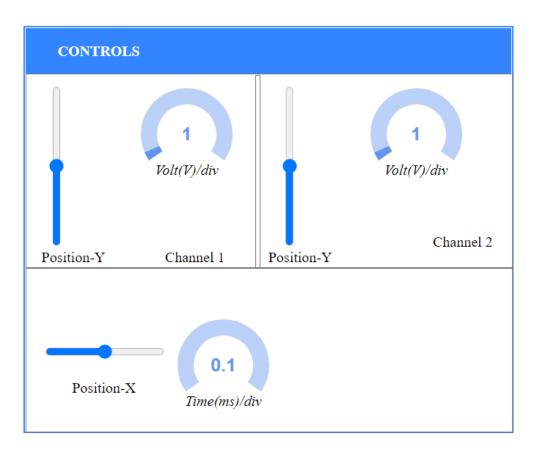


Figure 4: Controls

## Oscilloscope

- \* Channel 1(Input):
- \* Channel 2(Output):

Figure 5: Oscilloscope Channel representation



Figure 6: Square Wave at Frequency = 1000

```
\begin{aligned} & \text{Frequency} = (\text{ 1 / Time Period }) \\ & \text{Time Period} = (\text{ 1 / frequency }) \\ & \text{Time Period} = (\text{ 1 / 1000 }) = 1 \\ & \text{msec} \\ & \text{Amplitude (Volt/div)} = 1 \\ & \text{V} \\ & \text{Time(ms)/div} = 0.1 \\ & \text{ms} \end{aligned}
```



Figure 7: Square Wave at Frequency = 2000

Frequency = ( 1 / Time Period )

 $\label{eq:time_period} \mbox{Time Period} = (\ 1\ /\ \mbox{frequency}\ )$ 

Time Period = ( 1 / 2000 ) = 0.5msec

 $Amplitude \; (Volt/div) = 1 \; V$ 

Time(ms)/div = 0.1 ms



Figure 8: Square Wave at Frequency = 3000

```
Frequency = ( 1 / Time Period ) 
 Time Period = ( 1 / frequency ) 
 Time Period = ( 1 / 3000 ) = 0.333msec 
 Amplitude (Volt/div) = 1 V 
 Time(ms)/div = 0.1 ms
```



Figure 9: Square Wave at Frequency = 4000

```
Time Period = ( 1 / frequency ) 
 Time Period = ( 1 / 4000 ) = 0.25msec 
 Amplitude (Volt/div) = 1 V
```

Frequency = ( 1 / Time Period )

Time(ms)/div = 0.1 ms



Figure 10: Square Wave at Frequency = 5000

```
\begin{aligned} & \text{Frequency} = (\text{ 1 / Time Period }) \\ & \text{Time Period} = (\text{ 1 / frequency }) \\ & \text{Time Period} = (\text{ 1 / 5000 }) = 0.2 \\ & \text{msec} \\ & \text{Amplitude (Volt/div)} = 1 \text{ V} \\ & \text{Time(ms)/div} = 0.1 \text{ ms} \end{aligned}
```