E3
Measurements with an Oscilloscope

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10:00 A.M - 1:00 P.M

III. The Time-Base

0.2 s/div = 2 seconds for the spot to move across 10 divisions
$\frac{2.2 seconds}{10 divisions}$ = 0.22 seconds per division

Seconds (s)	Seconds per division (s/d)
2.2	0.2
1.2	0.1
0.5	0.05
0.2	0.02
0.1	0.01
0.05	0.005
0.02	0.002
0.01	0.001
0.005	0.0005
0.002	0.0002
0.001	0.0001

Shortest calibrated time is 0.1 milisecond (ms),
Shortest un-calibrated time is 0.2 microsecond (μs).

IV. Voltage and Frequency Measurements

(a) DC Voltage Measurements

0.5 V x 3 divisions = 1.5V

At 0.2 Volt / Div the signal goes off the screen
at 0.5 Volt / Div the signal is at the top of the screen
at 1 Volt / Div the signal jumps down 1 line
At 2 Volt / Div the signal jumps down another line
At 5 Volt / Div the signal jumps down one more line
No apparent difference in ”sensitivity”

The time based setting changes the speed of the signal being displayed
This is important when trying to observe small differences over time in the signal

When measuring the cell voltage using a Multimeter we get a reading of: 1.5V

(b) AC Voltage measurement

Frequency: if decreased, wave slows down period increases
if increased, wave speeds up and period decreases.

Voltage: If increased, amplitude increase if decreased, amplitude decrease

(c) Periodic time and frequency measurement with scope

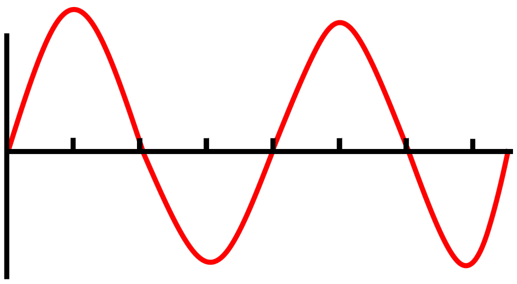

Figure 0.1: Sketch of sinewave

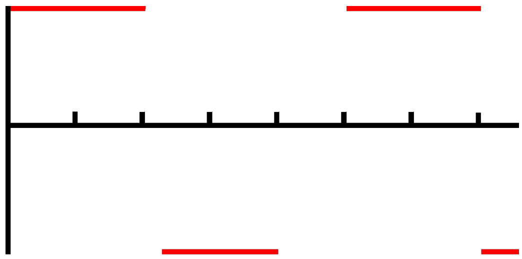

Figure 0.2: Sketch of squarewave

f = 15 kHz => FG.

frequency $= \frac{1}{Period}$
Period = 6.5 div x (10x10^{-6}) = 6.5×10^{-5}
f = $\frac{1}{6.5\times10^{-5}}$ = 15.38 kHz = Osc

f = 64 kHz => FG

frequency $= \frac{1}{Period}$
Period = 1.5 div x (10x10^{-6}) = 1.5×10^{-5}
f = $\frac{1}{1.5\times10^{-5}}$ = 66.7 kHz = Osc

f = 190 kHz => FG

frequency $= \frac{1}{Period}$
Period = 2.5 div x (2x10^{-6}) = 5×10^{-6}
f = $\frac{1}{5\times10^{-6}}$ = 200 kHz = Osc

(d) Peak and rms voltages

The measurement of voltage recorded using the multimeter is already given in V_{rms}, while the reading given by the Oscilloscope is not, as such we get values of 7.5V from the Multimeter and 10V from the Oscilloscope.

Multimeter: V_{rms} = 7.5 V
Oscilloscope: $\frac{10V}{\sqrt{2}} = 7.1V$

V. Investigation of the charge and discharge of a capacitor

R = 10$k\Omega$
C = 10nF
RC = 1×10^{-4} s, 0.1 ms
V_0 = 10V = V_c

$$V_c(t) = V_0[(1 - exp(-RC/RC))] = V_0[1 - \frac{1}{e}] = 0.63(V_0)$$

$$V_c(t) = (10V)(1 - e^{\frac{-0.1ms}{0.1ms}}) = 6.32V$$

$$V_c(t) = (10V)(1 - \frac{1}{e}) = 6.32V$$

$$V_c(t) = 0.63(10V) = 6.3V$$

$$V_c(t) = 6.3V$$

$$V_c(t) = V_0 e^{\frac{-RC}{RC}} = \frac{V_0}{e} = 0.37V_0$$

$$(10V)(e^{\frac{-0.1ms}{0.1ms}}) = 3.67V$$

$$\frac{10V}{e} = 3.67V$$

$$0.37(10V) = 3.7V$$

$$V_c(t) = 3.7V$$

Conclusion:

The frequency values compared to our values calculated using the period had percentage differences of 2.53%, 4.22% and 5.26% respectively.

When measuring the voltage with a multimeter against the voltage gained using the oscilloscope there was a percentage difference of 5.3%