Electronics Lab Course Experiment #0: Introduction and Preparational Experiment

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Contents

1 Aims of the experiment

The aim of this experiment is to understand the tools used in the electronics lab course, which shall be archieved by determination of the ramp-up time of the oszilloscope.

2 Preperational exercises

2.1 0.2.1.A

$$
\begin{aligned}
U(t) &= U_0 \cdot \sin(\omega t) \\
U_{PP} &= 2 \cdot U_0 \\
U_P &= U_0 \\
U_{RMS} &= \frac{U_0}{\sqrt{2}}
\end{aligned}
$$

2.2 0.2.1.B

For a symmetrical rectangular voltage[1]

$$
\begin{aligned}
U_{RMS} &= \frac{U_0}{\sqrt{2}} \\
&= 7.07\,\text{V}
\end{aligned}
$$

2.3 0.2.2.C

2.3.1 0.2.2.C.1

$$
\begin{aligned}
\text{To proof:}\quad R_i &= \frac{U_2 - U_1}{I_1 - I_2} \\
U_n &= U_0 \frac{R_n}{R_n + R_i} \\
I_n &= \frac{U_n}{R_n} \\
\Leftrightarrow I_n &= U_0 \frac{1}{R_n + R_i} \\
U_2 - U_1 &= U_0 \left(\frac{R_2}{R_2 + R_i} - \frac{R_1}{R_1 + R_i} \right) \\
I_1 - I_2 &= U_0 \left(\frac{1}{R_1 + R_i} - \frac{1}{R_2 - R_i} \right) \\
\Rightarrow \frac{U_2 - U_1}{I_1 - I_2} &= \frac{\left(\frac{R_2}{R_2 + R_i} - \frac{R_1}{R_1 + R_i} \right)}{\left(\frac{1}{R_1 + R_i} - \frac{1}{R_2 + R_i} \right)} \\
&= \frac{R_2 \left(R_1 + R_i \right) - R_1 \left(R_2 + R_i \right)}{R_2 + R_i - R_1 - R_i} \\
&= \frac{R_i \left(R_2 - R_1 \right)}{R_2 - R_1} \\
&= R_i
\end{aligned}
$$

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[1] In this case with $U_P = 10\,\text{V}$

2.3.2 0.2.2.C.2

$$
\begin{aligned}
U_0 &= 10\,\text{V} \\
U_n(50\,\Omega) &= 5\,\text{V} \\
U_n &= U_0 \frac{R_n}{R_n + R_i} \\
\Rightarrow R_i &= 50\,\Omega
\end{aligned}
$$

2.4 0.3.3.E

$$
\begin{aligned}
\text{To proof:}\quad B\Delta t &= 0.35 \\
B &= \frac{1}{2\pi\tau} \\
\Delta t &= t(0.9U_0) - t(0.1U_0) \\
\text{Decharging-function of a capacitor:}\quad U(t) &= U_0 \exp\left(-\frac{t}{\tau}\right) \\
\frac{0.1}{0.9} &= \exp\left(-\frac{\Delta t}{\tau}\right) \\
\Leftrightarrow \Delta t &= -\ln\left(\frac{1}{9}\right)\tau \\
&= 2.197\tau \\
\Rightarrow B\Delta t &= \frac{2.197}{2\pi} \\
&\approx 0.35
\end{aligned}
$$

4

3 Procedure

3.1 0.4.1.a

Different signals at different frequencies and amplitudes shall be observed at the oscilloscope.

3.2 0.4.1.b

Δt of a rectangular voltage shall be determined by measuring the delay from $0.1U_0$ to $0.9U_0$ with the oscilloscope.[2]

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[2]We must also pay attention to the bandwidth of the oscilloscope which is - so says the manual - $60\,\mathrm{MHz}$

4 Measurement

5 Evaluation

6 Conclusion