

Electronics Lab Course

Experiment #0: Introduction and Preparational Experiment

Christopher Jörn

April 12, 2015

Contents

1	Aims of the experiment	2
2	Theoretical background	3
2.1	Amplitudes of AC voltage	3
2.2	Measuring instruments	3
3	Preperational exercises	4
3.1	0.2.1.A	4
3.2	0.2.1.B	4
3.3	0.2.2.C	4
3.3.1	0.2.2.C.1	4
3.3.2	0.2.2.C.2	5
3.4	0.3.3.E	5
4	Experiment set-up	6
5	Procedure	7
6	Measurement	8
7	Evaluation	9
8	Conclusion	10

1 Aims of the experiment

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

2 Theoretical background

2.1 Amplitudes of AC voltage

To describe AC voltage amplitudes, the following voltages can be used:

$$\begin{aligned} \text{peak-to-peak-voltage: } U_{PP} &= \max\{U(t)\} - \min\{U(t)\} \\ \text{peak-voltage (symmetric and most times also asymmetric voltage): } U_P &= \max\{|U(t)|\} \\ \text{root-mean-square-amplitude-voltage: } U_{RMS} &= \sqrt{\langle U^2(t) \rangle} \end{aligned}$$

2.2 Measuring instruments

Every measuring instrument is made up of two parts:

- Measuring unit
- Displaying unit

2.2.1 Measuring unit

The measuring unit measures the measurand and controls the displaying unit. It is made up itself of another 3 subunits:

- Measuring amplifier
-

3 Preperational exercises

3.1 0.2.1.A

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

3.2 0.2.1.B

For a symmetrical rectangular voltage¹

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

3.3 0.2.2.C

3.3.1 0.2.2.C.1

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

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

3.3.2 0.2.2.C.2

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

3.4 0.3.3.E

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

4 Experiment set-up

5 Procedure

6 Measurement

7 Evaluation

8 Conclusion