Lab. 1. Introduction

Part I.

1. Digital oscilloscope

The oscilloscope will be used to measure time-domain signals, waveforms and signal parameters.

2.1 Using the oscilloscope

Turn on the oscilloscope.

Take a look at "Getting Started" and "Using Quick-Help" functions.

Most important menus:

Vertical inputs / Controls
Horizontal controls
Run controls
Trigger controls
Autoscale

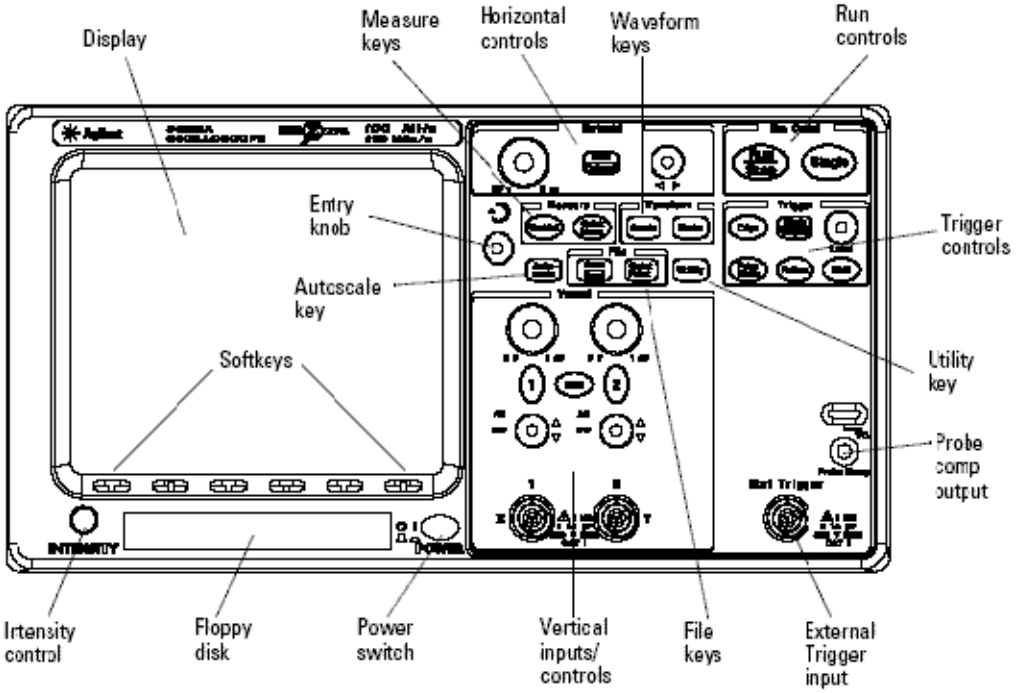

Figure 1. A digital oscilloscope

2.2 The Probe

Connect the Probe to the oscilloscope and to the calibration reference output (**`probe comp output`**). Set the parameters by using the **`Autoscale`** button! Check the compensation of the Probe!

3. Waveform generator

3.1 Setting a sine output

Turn on the waveform generator and set the following parameters:

Sine wave, 3 Vpp amplitude, 0 V offset, 8 kHz frequency

Load: High-Z (Menu: Utility/Output Setup: Load/HighZ)

Turn on the output (Output On)

4. Measure the sine wave with the oscilloscope

Connect the waveform generator to the oscilloscope with a BNC – BNC cable!

4.1 Setting the trigger:

Take a look at the following functions:

- Effects of **`Trigger control`**,
- Properties of **`Normal, Auto and Auto level`** modes (**`Mode/Coupling / Mode`** menu),
- Effects of changing trigger source, trigger level and trigger edge (Edge menu).

4.2 Measure the amplitude and period of the sine wave using the classic method!

Classic measurement: use the grid and compute the parameters taking into account the grid scale factor (time/div and Volt/div).

4.3 Measure the amplitude and period of the sine wave using the cursors!

Which measurement is more accurate?

4.4 Measure the amplitude and period of the sine wave using the built-in measurement functions of the oscilloscope (`Quick Measurement`)!

NOTE: **`Quick Measurement`** uses the displayed part of the waveform to measure the signal properties.

4.5 Document the measurements with screenshot from the oscilloscope.

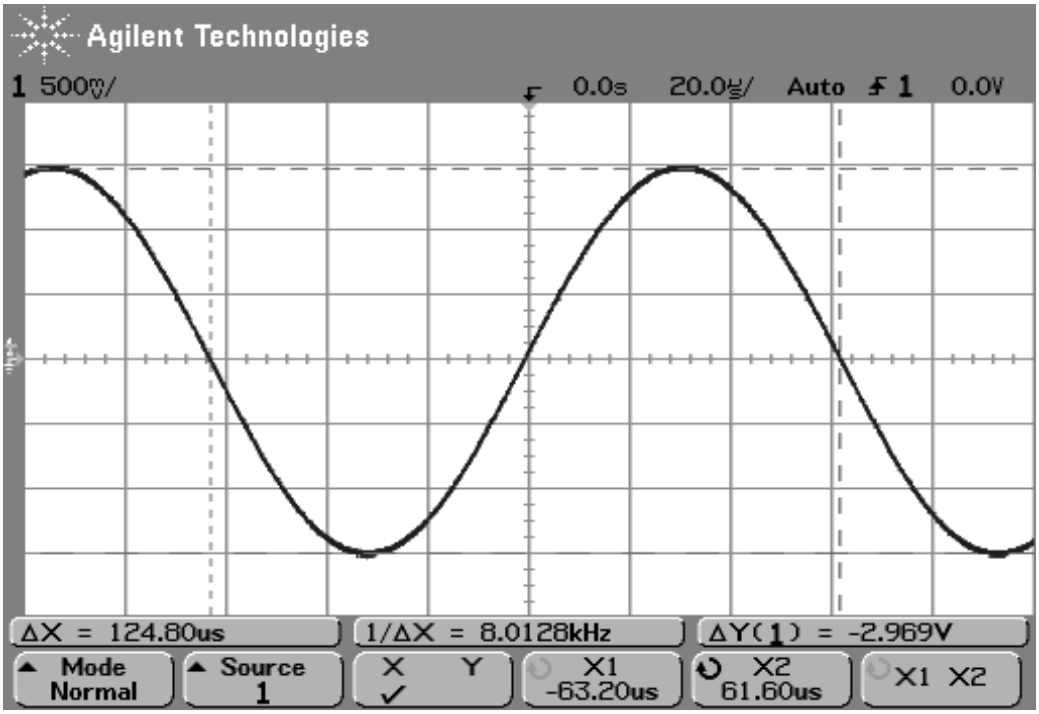

Figure 2.Measuring with cursors

5. Measuring square wave

5.1 Generate a TTL/CMOS-3,3V square wave with the waveform generator which is compatible with logic circuits!

E.g.: L level = 0 V, H level = 3,2 V, frequency: in the order of kHz.

5.2 Check the waveform using the oscilloscope!

Measure the rise time of the signal!

5.3 Effect of AC coupling

Set AC coupling on the oscilloscope. Measure the low and high level with this setting.

NOTE: Digital circuits must be measured in DC coupling mode.

Set the waveform generator frequency to 20 Hz, and check the result on the oscilloscope. What is the cause?

Part II.

1. AVR development with simulator

1.1 Create an 8 bit up-counter and display it on the LEDs.

1.2 Display the status of the 4 switches (SW3…SW0) on the 8 LEDs. Not used LEDs should be set to 0.

1.3 On the development board the 4 switches are not connected to an AVR port according to their names. Enhance the program written in 1.2 so that each SW is displayed on the corresponding LED. That is, SW1 is displayed on LED1, SW2 is displayed on LED2 and so on.